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Catches, size, and age structure of the 2011–12 hoki fishery, and a summary of input data used for the 2013 stock assessment

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EXECUTIVE SUMMARY

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This report summarises the catch by area and presents the length and age structure of hoki caught commercially during the 2011–12 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 2013.

The total reported hoki catch in 2011–12 was 130 105 t, about 105 t above the TACC of 130 000 t, and 11 300 t higher than the catch in 2010–11. Catches in 2011–12 increased in all areas except for the east coast North Island. With the increase in the western catch allocation to 70 000 t in 2011–12, the catch from the west coast South Island (WCSI) increased to 54 540 t, and was the largest New Zealand hoki fishery for the second year in succession. In the non-spawning areas, the Chatham Rise was the second largest fishery, with 39 200 t taken, and the Sub-Antarctic catch increased to 15 800 t in 2011–12. The catch from the spawning fishery in Cook Strait increased slightly to 15 900 t, the second lowest catch taken from this fishery since 1989–90. About 71 600 t of the total catch was taken from western areas in 2011–12 and 58 500 t was taken from eastern areas.

Length frequencies and catch-at-age results from the commercial fishery show that most of the catch in 2011–12 was fish from 55 to 90 cm (mainly 2005–09 year-classes, aged 3–7 years The percentage of small fish in the catch in 2011–12 decreased due to relatively few 2 year olds (2010 year-class) being caught. Large hoki were taken from the WCSI, Sub-Antarctic and Cook Strait in 2011–12.

The relative biomass index for all hoki from the 2013 Chatham Rise trawl survey increased by 42% relative to the 2012 survey, with an increase of 29% in estimated biomass of recruited hoki (aged 3 and older). The 2011 year-class (age 1+) was the strongest in the Chatham Rise time series, but the abundance estimate from the 2010 year class (age 2+) was low. The estimated biomass from the 2012 Sub-Antarctic trawl survey was 17% higher than that in 2011. The first survey of the WCSI since 2000 was carried out in winter 2012. The WCSI survey followed a new design, with an acoustic survey over the entire hoki spawning area and a random trawl survey north of Hokitika Canyon. Hoki abundance was estimated from the 2012 acoustic survey using the same methodology that was used for the eight previous surveys in the acoustic time-series (1988–2000). The 2012 acoustic index was similar to that in 2000 and was included in the hoki assessment. The trawl estimate of hoki biomass in 2012 was much higher than the biomass estimated from daytime random trawls in the equivalent strata in the 2000 WCSI survey, but trawl estimates of hoki were not included in assessment as the reliability of these indices has yet to be evaluated.

1. INTRODUCTION

This report provides data relevant to the 2013 hoki stock assessment. Catch statistics and data from commercial sampling during the 2011–12 fishing year are presented and results from other research programmes since March 2012 are summarised. These include results of the trawl surveys of the Chatham Rise in January 2013, and Sub-Antarctic in November–December 2012, and a combined trawl and acoustic survey of the WCSI in July–August 2012. Details of model structure, results, and yield estimates from the hoki stock assessment carried out in 2013 will be published separately.

This report provides the final reporting requirement for Objective 2 of DEE2010/02HOKB ("Provide descriptive analysis of the hoki fishery in 2011–12 fishing year"), and Objectives 1, 2 and 7 of MID2010/01C (1, "To determine the age and size structure of the commercial catches of hoki in the main non-spawning fisheries from samples collected at sea by the Observer Programme in the 2011–12 year"; 2, "To determine the catch-at-age of commercial catches of hoki from the WCSI and Cook Strait spawning fisheries from data collected by the Observer Programme and from other sources in the 2011–12 year"; and 7, "To determine the age and size structure of hoki from the trawl surveys").

1.1 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) have 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). These differences demonstrate that there are two sub-populations of hoki. Whether they reflect genetic differences between the two sub-populations, or are the result of environmental differences between the Chatham Rise and Southern Plateau, is not known. The chemistry of otoliths from the WCSI and Cook Strait stocks is similar (Kalish et al. 1996), and no genetic differences were detected between spawning stocks (Smith et al. 1981, 1996).

From 2006 to 2007, the hoki stock assessment model had two variants which were associated with different stock structure hypotheses (Francis 2007, 2008). The original hypothesis (used before 2006 and from 2008 to 2012) assumes 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 themselves spawn in another area (i.e., a fish chooses to be 'eastern' or 'western' when it matures). Under both hypotheses, once a fish has spawned it shows site fidelity – it cannot 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 2011. These problems are now resolved and model runs which do not assume natal fidelity were included as sensitivity runs in the 2012 (McKenzie 2013) and 2013 assessments.

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. Francis et al. (2011) described a pilot study, aimed at determining whether analyses of stable isotopes and trace elements in otoliths could be useful in testing stock structure hypotheses 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).

1.2 Description of the hoki fishery

Historically, 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 in 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 in 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 have been 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.

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, and Puysegur). 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 (now defined as less than 55 cm total length) comprise more than 20% of the hoki catch by number.

1.3 Catch history

The total annual catches of hoki within the EEZ from 1969 to 2011–12 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 in 1987–88 of about 255 000 t (Table 2). Reported annual catches ranged between 175 000 and 215 000 t from 1988–89 to 1995–96, increasing to 246 000 t in 1996–97, and peaking 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 in 2007–08 and catches declined accordingly (Table 2). In 2009–10 and 2010–11 the TACC increased to 110 000 t and 120 000 t respectively, and catches increased. The TACC was further increased to 130 000 t from 1 October 2011.

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 has been due to a combination of TAC changes and redistribution of fishing effort. The catch from the WCSI declined steadily from 1988–89 to 1995–96, increased again to between 90 000 and 107 000 t from 1996–97 until 2001–02, then dropped sharply to a low of 20 500 t in 2008–09. The WCSI catch increased again to 36°400 t in 2009–10, to 48 300 t in 2010–11, and to 54 500 t in 2011–12. This was about 42% of the total hoki catch in 2011–12, making the WCSI the largest fishery in New Zealand for the two most recent years (Table 3). In Cook Strait, catches peaked at 67 000 t in 1995–96, but have declined to 14 900 t in 2010–11 and 15 900 t in 2011–12, the lowest levels since 1989–90. Non-spawning catches on the Chatham Rise peaked at about 75 000 t in 1997–98 and 1998–99, then decreased to a low of 30 700 t in 2004–05, before increasing again to 39 000 t from 2008–09 to 2011–12. The Chatham Rise was the largest hoki fishery from 2006–07 to 2009–10 and contributed about 30% of the total catch in 2011–12. Catches from the Sub-Antarctic peaked at over 30 000 t in 1999–00 to 2001–02, declined to a low of 6200 t in 2004–05 before increasing slowly to 15 000 t by 2011–12. Catches from Puysegur increased from 1200 t in 2010–11 to 1300 t in 2011–12; ECSI increased from 1600 t to 2500 t; and ECNI decreased from 1600 t to 900 t (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 following the 2003 hoki assessment in 2002–03, 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. The target catch from the western fishing grounds was further increased to 60°000 t in 2010–11 (within the overall TACC of 120 000 t) and 70 000 t in 2011–12 (within the overall TACC of 130 000 t). Western catches in 2010–11 and 2011–12 were 2000 t and 1600 t respectively above industry agreed targets. In the current fishing year (2012–13), the target catch from the western fishing grounds is the same as in 2011–12 at 70 000 t within the overall TACC of 130 000 t.

1.4 Recent hoki research

The importance of the hoki fishery and the complexity of the life cycle have resulted in a high level of research activity for over two decades. This was summarised in a recent book chapter (Livingston et al. in press). Research results presented in the past year are summarised here.

McKenzie (2013) reported the stock assessment carried out in 2012, 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 Hoki Working Group agreed on a single base run, with four sensitivities to the base run. In the base model run 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. In one of the sensitivity runs this problem was dealt with by the alternative solution of having domed selectivities for the spawning fishery. Two other sensitivity runs were carried out in which instead of giving additional weight to the Sub-Antarctic trawl series, two catchabilities were fitted to this series instead of just one. In the final sensitivity model run natal fidelity was not assumed, in contrast to the other model runs. Both the eastern and western hoki stocks were estimated to be increasing after reaching their lowest levels in about 2005. The western stock was estimated to be 41–60%B_0 and the eastern stock 47–52%B_0. The western stock experienced an extended period of poor recruitment from 1995 to 2001, but recruitment has been near or above average in the last five years, except for in 2010 where it was below average (McKenzie 2013).

Recent work by Kloser et al. (2011) on the acoustic target strength (TS) of hoki (blue grenadier) in Australia raises concern that New Zealand acoustic estimates based on the TS-length relationship of Macaulay (2006) may overestimate hoki biomass. Kloser et al. (2011) collected optically verified *in situ* measurements of hoki and found that the TS was considerably higher than that predicted by Macaulay (2006). O'Driscoll (2012) reported abundance estimates for Cook Strait based on TS predicted from Kloser et al. (2011) which were only 25–30% of those currently used in stock assessment. However, O'Driscoll (2012) notes that the choice of the TS-length relationship has relatively little impact on relative acoustic abundance indices. The implication for stock assessment of adopting the new TS-fish length relationship of Kloser et al. (2011) would be a change in the estimate of the acoustic catchability (q). This would also force us to reconsider our interpretation of, and priors on, q because in some years (e.g., 1996, 1998) the catch from Cook Strait exceeded the acoustic abundance estimate using the Kloser et al. (2011) TS (O'Driscoll 2012). This would only be possible if the turnover of fish on the spawning grounds is much quicker than currently estimated (Harley 2002). Target strength experiments on hoki using the acoustic-optical system (AOS) carried out in July-August 2012 on the WCSI survey (O'Driscoll et al. in press) should help to reconcile the very large difference in TS estimates for hoki.

New fisheries-independent estimates of hoki abundance since the 2012 hoki assessment were trawl surveys of the Sub-Antarctic in November–December 2012, and of the Chatham Rise in January 2013, and a combined trawl and acoustic survey carried out on the WCSI in July–August 2012. Results from these surveys are summarised in Section 3.1. An extensive review of Sub-Antarctic trawl surveys from 1991–2009, including biomass trends, and spatial and depth distributions for 134 species (including hoki) was published in 2013 (Bagley et al. 2013).

2. HOKI FISHERY, 2011–12

2.1 Catch and effort information

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

In the 2011–12 fishing year the TACC for HOK1 was 130 000 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 70 000 t of the TACC should be taken from western stock areas.

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 130 105 t was about 11 300 t higher than the catch in 2010–11 and about 100 t higher 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-long-lining-catch-effort-return (TLCER), and trawl-catch-effort-and-processing-return (TCEPR) data was 126 164 t. As the data extraction was done in mid-December 2012, a small amount of data may still not have been entered into the database. As estimated catches did not match the total monthly harvest return (MHR) catch, estimated catches were scaled up to the MHR total catch of 130 105 t.

Relative to 2010–11, catches in 2011–12 increased in all areas except for the ECNI (Figure 2a, Table 3). This was expected, given the increase in the target catch from western areas from 60 000 t in 2010–11 to 70 000 t in 2011–12. The WCSI was the largest fishery for the second time in six years, with the catch increasing by 6000 t to 54 540 t in 2011–12. Catches inside the 25 n. mile line made up 15% of the total WCSI catch in 2011–12, a similar percentage to 2010–11, but down from a peak of 41% of the catch in 2003–04 (Table A1a). The Chatham Rise was the second largest hoki fishery for the second year, with 39 200 t taken from this area in 2011–12. The catch from Cook Strait of 15 900 t was up by about 900 t from that in 2010–11, and the second lowest catch since 1989–90. The catch from the Sub-Antarctic of 15 800 t in 2011–12 was about 3000 t higher than in 2010–11 (see Table 3). Catches from Puysegur and ECSI increased by 200 t to 1300 t, and by 900 t to 2500 t respectively, and the ECNI catch decreased by 700 t to 900 t in 2011–12. Overall, about 71 600 t of the total catch in 2011–12 was taken from western areas (Figure 2a), 1600 t above the level of the industry-agreed catch split.

Most hoki catch was recorded on the TCEPR form (123 000 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 was taken by bottom trawling on the Chatham Rise and Sub-Antarctic (Figure 2b).

Up until 2003–04 almost all of the hoki catch was from target hoki tows. Hoki targeting decreased, especially 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 also increased, and in 2011–12, 95.6% of the overall catch was taken from hoki target tows (97% of the hoki catch on the WCSI, 86.5% on the Sub-Antarctic, and 97% on the Chatham Rise). Since then there has been a decrease in the percentage of hoki catches from tows targeting hake on the WCSI and Chatham Rise, ling on the Sub-Antarctic and Chatham Rise, and silver warehou on the WCSI and Sub-Antarctic. Cook Strait has remained almost exclusively a hoki target fishery.

A high proportion of the hoki catch in 2011–12 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), with most of the catch taken by mid-August. In Cook Strait, peak catches were from mid-July to mid-September, and about 3000 t was caught outside the spawning season (Figure 5). Fishing during the spawning season on the ECSI occurred mainly in July and September and at Puysegur mainly in June (Figure 5). Outside the spawning season, most of the catch was taken from October 2011 to June 2012 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 (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 and Figure 6, and standardised CPUE analyses for the WCSI, Cook Strait, Chatham Rise, and Sub-Antarctic were also

carried out. 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, but does not provide tow-by-tow effort data), or the TCER forms (which have been in use for only four years). It also did not include data from the LCER, LTCER, TLCER or NCELR forms. 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 are not currently included in the hoki stock assessment (McKenzie 2013). Changes in fleet structure (e.g., increased use of twin trawls), fishing practices (particularly target fishing), 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.

A lognormal linear model was used for all standardised analyses model following Dunn (2002). A forward stepwise Generalised Linear Model (Chambers & Hastie 1991) implemented in R code (R Development Core Team 2012) 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, with model fits to continuous variables being made as third-order polynomials, though a fourth-order polynomial was also offered to the models for duration. Categorical variables offered to the model included *vessel key*, *target species*, *primary method, month, vessel experience* (number of years vessel in the fishery*), twin vessel* (true/false variable for a vessel that has used a twin trawl), *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). 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 used. The dependent variable was the log-transformed estimated catch per tow with positive catches retained and zeros excluded.

A vessel variable was incorporated into the CPUE standardisation to allow for differences in fishing power between vessels. For consistency 80% of the catch was chosen for each analysis with vessels not involved in the fishery for a certain number of years (varied by analysis) excluded because they provided little information for the standardisations, which could result in model over-fitting (Francis 2001). Data were investigated for level of catch and effort for different years of vessel participation in the fishery, and thus CPUE analyses were undertaken for "core" vessels that reported approximately 80% of positive hoki catches in the defined fishery and were involved in the fishery for a certain number of years and tows in a year.

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 c.v.s represent the ratio of the standard error to the index. The 95% confidence intervals are 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).

For the WCSI, lognormal CPUE models were run for core vessels with either all target species or target hoki only tows; for Cook Strait, lognormal CPUE models were run for core vessel midwater tows that targeted hoki; for the Chatham Rise and ECSI, and Sub-Antarctic, lognormal CPUE models were run for core vessel bottom tows with either all target species or target hoki tows. A January CPUE model was also run for the Chatham Rise dataset, and a November–December Snares Shelf CPUE model for the Sub-Antarctic dataset, to correspond to the timing of the trawl surveys in these two areas. Selected explanatory variables for each run are listed in Table 4.

Unstandardised catch rates for the WCSI are presented for both midwater and bottom trawls (Table A2). Midwater trawl catches accounted for 60% of the total spawning season catch on the WCSI in 2011–12. The unstandardised catch rate from all non-zero midwater tows in 2011–12 decreased slightly and was the second highest in the series, with a median catch of 7.9 t per hour, and a median tow duration of 2.1 hours. Catch rates and median tow duration were the same for target hoki tows. Catch rates in bottom trawls on the WCSI were lower than in midwater trawls, with a median catch rate of 1.9 t per hour for all non-zero hoki catches and 4.1 t per hour for target hoki tows. Median tow duration of bottom trawls decreased to 5.2 hours for all target species, and 3.8 hours for target hoki only tows, in 2011–12. From 1999–2000 to 2003–04, standardised catch rates from all non-zero tows showed a similar decline to non-standardised catch rates. However, standardised indices have increased at a much higher rate than unstandardised indices since 2003–04 (Figure 6a). Core datasets for all target species or target hoki showed similar trends although the index in 2008–09 was higher for target hoki only tows and the 2010–11 index was lower (Figure 6b).

Midwater trawl catches accounted for more than 99.9% of the spawning season catch of 9658 t reported on TCEPR forms from Cook Strait in 2011–12. A further 3192 t of catch was reported on TCER forms (see Figure 2b). Non-standardised catch rates continued to be high in Cook Strait, with a decrease in median catch rate to 15.1 t per hour in non-zero mid-water tows in 2011–12, and an increase in median tow duration to 0.9 hours (equivalent to a median catch of 11.5 t per tow). Overall the non-standardised catch rates showed a slight increase from 1989–90 to 2011–12, whereas standardised catch rates showed a flat trend (Figure 6). Catch rates in Cook Strait appear to reflect a fishing strategy where vessels limit the size of catches to maintain fish quality.

Over 99% of the Chatham Rise catch in 2011–12 was taken in bottom trawls, with most of the catch reported on TCEPR forms (see Figure 2b). There has been a general increase in tow duration on the Chatham Rise since the 1990s, with a median tow duration of 4.8 hour in 2011–12. The median non-standardised catch rate in bottom trawls on the Chatham Rise in 2011–12 of 1.3 t per hour was the highest catch rate in the series. 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 decreased slightly to 1.5 t per hour in 2009–10 and 2010–11, and 1.6 t per hour in 2011–12. Standardised catch rates generally decreased from 1991–92 to 2003–04, increased to 2008–09, decreased in 2009–10, and then increased again to 2011–12 (Figure 6a). Similar trends were observed for core vessels targeting hoki and core vessels in January (Figure 6b).

Bottom trawl catches reported on TCEPR forms accounted for 89% of the catch taken from the Sub-Antarctic in 2011–12 (see Figure 2b). Median tow duration in 2011–12 remained the same as 2010–11 at 5.0 hours and non-standardised catch rates in bottom trawls were slightly higher at 0.5 t per hour in 2011–12. Catch rates for hoki target bottom trawls were much higher than those for all target trawls (1.6 t per hour in 2011–12) and were the same as those on the Chatham Rise in 2011–12. Standardised catch rates generally decreased from 1996–97 to 2003–04 and increased to 2009–10, with a slight decrease in 2010–11, and an increase in 2011–12 (Figure 6a). Core vessels targeting hoki showed similar trends (Figure 6b), although core vessels on the Snares Shelf in November–December showed a steeper decline to 2005–06.

Spawning season catches from the ECSI were mainly reported on TCEPR (see Figure 2b). Midwater tow catch rates in 2011–12 were 6.2 t per hour, and bottom tow catch rates were 2.9 t per hour. Spawning season catches from Puysegur were also mainly reported on TCEPR (see Figure 2b), with midwater catch rates in 2011–12 at 1.5 t per hour and bottom tow catch at 0.3 t per hour.

Standardised CPUE indices for WCSI, Chatham Rise, and Sub-Antarctic all showed overall similar trends: decreasing from 1991–92 to 2003–04 and increasing to 2011–12 (Figure 6).

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 2011–12 represent about 42% of vessels, 8.8% of tows, and 13.4% of the total catch (Table 5). The bycatch rate (defined as the percentage of the hoki catch) was estimated for hake, ling, silver warehou, and spiny dogfish (Table 6), and also included white warehou, javelinfish and rattails on the Chatham Rise, ECSI, and Sub-Antarctic, and southern blue whiting in the Sub-Antarctic. Other bycatch species are also taken, particularly in the non-spawning fisheries, but bycatch rates for these species are usually less than 1%. Note that 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 in Table 6 should be treated with caution. As there have been changes in the proportion of hoki target catches (see Figure 3, section 2.1.2), 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 2000–01 to 2006–07 is provided by Ballara et al. (2010).

Bycatch rates in the spawning areas in 2011–12 were generally low (less than 2%) for all species. The observed bycatch in the WCSI fishery in 2011–12 showed decreases in bycatch rates for hake (1.6%), ling (1.8%), and silver warehou (0.5%), but showed an increase for spiny dogfish (1.3%). As in the past, there was very little bycatch in Cook Strait, with spiny dogfish having the largest observed bycatch rate (1.7%).

In the non-spawning areas, bycatch rates in 2011–12 were also low for most species. On the Chatham Rise, ling (2.3%), hake (0.5%), silver warehou (3.0%), javelinfish (4.2%), and rattails (4.4%) showed small decreases in bycatch rates from 2010–11, whereas spiny dogfish (1.4%) showed an increase. Of the main Sub-Antarctic bycatch species, bycatch rates increased for hake (13.4%), and ling (1.5%), but decreased for silver warehou (0.1%), spiny dogfish (1.5%), southern blue whiting (0.4%), white warehou (1.0%), and rattails (1.5%), and remained the same for javelinfish (2.0%).

2.2 Size and age composition of commercial catches

Data to estimate length frequencies in 2011–12 were available from the Ministry for Primary Industries' Observer Programme (OP). No shed sampling of landed fish was carried out by NIWA in 2011–12. The industry observer programme formerly run by the Hoki Fishery Management Company (HMC) has been 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 2011–12 are shown in Figure 7 with the observed position of all tows sampled for hoki length frequency distributions by the OP shown in the TCEPR plot. Hoki were measured by OP observers in 1192 tows, of which 429 came from the WCSI, 88 from Cook Strait, 373 from the Chatham Rise, 257 from the Sub-Antarctic, 13 from the ECSI, 29 from Puysegur, 3 from ECNI, and 1 from the WCNI. Tables 7 and 8 describe observer trip timing in greater detail for the main areas sampled.

Length frequencies were estimated for each of the major fisheries as the weighted (by the 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. Data from outside the line were split into weekly time periods throughout the season, although adjacent weeks were combined if there were fewer than 10 OP length samples available. As there were 19 length frequencies from inside the line at the beginning of June, and no samples from outside the line, the June inside the line samples were scaled up to the total June catch (Table 8). Length frequencies from Cook Strait are normally stratified by month, island of landing, and vessel size. However, in 2012, with no market samples taken, Cook Strait stratification was

by month periods as there was no data for large vessels for July–September (Table 8). A regression tree method (described below) was used to stratify the two non-spawning fishing areas.

Catch-at-age from spawning fisheries was estimated using age-length keys derived from otolith ageing. Otoliths were available from the OP and from WCSI 2012 trawl survey samples on *Tangaroa* (O'Driscoll et al. in press). All available OP otoliths (767) from Cook Strait and a sub-sample of 793 otoliths from the WCSI (706 trawl survey, and 87 OP samples) were selected, prepared, and read using the validated technique of Horn & Sullivan (1996) as modified by Cordue et al. (2000). 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 the tails of the length distribution were represented. The chosen sample sizes approximated those necessary to produce mean weighted c.v.s of less than 20% across all age classes, in each of the spawning areas.

Age-length keys were constructed for each spawning fishery and applied to the total length frequency to produce an age frequency for the catch for 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 ring measurements using the consistency scoring method of Francis (2001) 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 c.v. of 0.20 in some years.

On the Chatham Rise in 2011–12, 1219 otoliths (including 463 males and 756 females) out of 2501 otoliths collected from 250 tows were selected as follows:
1. Reject all otoliths from tows catching less than 1 t of hoki.
2. For tows catching between 1 t and 3 t of hoki select at random 1 otoliths from each tow.
3. For tows catching between 3 t and 4 t of hoki select at random 2 otoliths from each tow.
4. For tows catching between 4 t and 7 t of hoki select at random 4 otoliths from each tow.
5. For tows catching more than 7 t of hoki select at random 6 otoliths from each tow.

On the Sub-Antarctic in 2011–12, 1246 otoliths (including 507 males and 739 females) out of 1966 otoliths collected from 151 tows were selected as follows:
1. Reject all otoliths from tows catching less than 1 t of hoki.
2. For tows catching between 1 t and 2 t of hoki select at random 4 otoliths from each tow.
3. For tows catching between 2 t and 6 t of hoki select at random 7 otoliths from each tow.
4. For tows catching between 6 t and 12 t of hoki select at random 9 otoliths from each tow.
5. For tows catching more than 12 t of hoki select at random 12 otoliths from each tow.

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 are 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

Most of the 2012 catch from the WCSI fishery was of fish from 55 to 100 cm (Figure 8) from the 2003–09 year-classes (ages 3–9) (Figure 9). The main length mode for female hoki was from 70–105 cm (Figure 8), and was made up of hoki aged 4 (2008 year-class) and older. Female hoki from the 2009 year class formed a smaller mode centred at 60 cm (Figures 8 and 9). The male modes for different year-classes were more distinct: the 2008 year-class was centred at 70 cm, and the 2009 year-class at 60 cm. The 2010 year-class, at 54 cm (females) and 49 cm (males), was poorly represented. A few small (30–35 cm) male and female hoki from the 2011 year-class were caught (Figures 8 and 9).

From 2000 to 2004, the sex ratio of the WCSI catch was highly skewed (Figure 10a), with many more females caught than males. In 2005–11, as the catch of younger fish increased, the sex ratio has reversed with more males than females caught, and in 2012, the catch contained about 50% males and females (Figure 10a). The percentage of hoki aged 7 and older in the WCSI catch declined steeply from 68% in 2003–04 to 16% in 2005–06, but has increased to 37% in 2011–12 (Figure 10b). However, there is still female dominance in the catch from the WCSI at older ages (Figure 10a). Conversely, the percentage of small fish (less than 65 cm, which is approximately equivalent to ages 3 years and younger) by number in the WCSI catch increased from 20% in 2006–07 to 31% in 2008–09, then decreased again to 13% in 2011–12 (Figure 10b). Many of these small fish are spawning: 23% of the female fish less than 55 cm (i.e., mostly 2 year-olds from the 2010 year-class) were in spawning condition, compared to 45% 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.

Comparisons of market samples in previous years show that there were differences in the length frequencies from shed samples of fish caught inside the 25 n. mile line and at-sea samples of fish outside this area in most years, with a higher proportion of larger fish (greater than 70 cm) from samples taken inside the line (Ballara & O'Driscoll 2012). In 2012, the observer data from inside the line in early June had very large fish (Figure 11), although these cannot be directly compared as all observer data from outside the line was collected from late June (see Table 8).

The overall mean length of hoki from the WCSI during the 2012 spawning season showed a decreasing trend to mid-August (Figure 12). The pattern of declining mean length over the spawning season used to be a common feature of the WCSI fishery, but was not observed between 1999 and 2006. The large difference between the mean lengths of males and females seen in catches from the 2004 and 2005 seasons was reduced in 2006–10 (Figure 12).

The mean length at age for hoki aged from 3–10 on the WCSI has increased since the start of the fishery, but may now be decreasing (Figure 13).

The OP data used to estimate catch-at-age was reasonably representative of the overall spatial, depth, and temporal distribution of the catch in 2011–12, although vessels less than 60 m were not well sampled (Figure 14).

Cook Strait

The length distribution of female hoki from Cook Strait in 2012 mainly ranged from 60 to 110 cm, while males were 55–95 cm (see Figure 15). There was a broad age distribution of females from ages 3 to 13, while most males were ages 3–10 (see Figure 16). The modal age was 5 (2007 year-class) for males and 7 (2005 year-class) for females (see Figure 16). Few fish from the 2010 year-class (age 2) were caught in Cook Strait, and only 2.9% of the catch was fish less than 60 cm in 2012, although 13.3% of the catch was fish less than 65 cm (see Figure 10b).

In 2012, the OP data used to estimate catch-at-age was reasonably representative of the overall spatial

and depth distribution of the catch, but temporal coverage was poor for large vessels (Figure 17, see Table 8). For vessels larger than 40 m there were samples taken in June but none from July to September 2012 (Figure 18). Therefore, length frequencies by month were applied to catches for that month without stratifying by vessel size (Table 8).

Length frequencies by month showed that the size distribution of the catch was broadly similar across the months, although smaller fish increased in proportion in August and September especially for the females (Figure 19), and in all months there were more males measured than females. The sex ratio of the Cook Strait catch was skewed towards females from 2001–05, then reversed as the percentage of males sampled from 2006–09 increased to 62%, and then decreased in 2010 and 2011 to 49% and 39%, but in 2012 rose sharply to 63% (see Figure 10a). The apparent change in sex ratio may be related to a sampling bias, as there is some evidence that larger vessels (which were poorly sampled in 2012) catch a higher proportion of female hoki in Cook Strait (e.g., O'Driscoll 2012). There was no clear trend in the mean length of male hoki over the season, although females showed a slight decreasing trend from August (Figure 20). As on the WCSI, the mean length at age has increased over time in the Cook Strait fishery (Figure 21), although there is now a slight decreasing trend especially at ages 6 and 7.

The Cook Strait catch-at-age for 2012 was not used in the 2013 hoki stock assessment model, except as a sensitivity, as it was not considered representative of the commercial catch in 2012 due to poor observer coverage and the rapidly changing sex ratio.

Puysegur

In 2011–12, 23 samples were collected from Puysegur during the spawning season, and these were mainly fish of 55–100 cm (Figure 22), from the 2006–09 year classes, with no 2 year old fish (2010 year class) present.

East coast South Island

Twelve samples were collected from the ECSI during the 2012 spawning season. Fish from this area (Figure 23) were larger than those observed in the non-spawning fishery on the Chatham Rise, and similar to the length distribution observed in Cook Strait.

2.2.2 Size and age composition in non-spawning fisheries

Chatham Rise

About 97% of the commercial catch, 89% of length frequencies, and 94% of the available otoliths came from the hoki target fishery in 2011–12 (Figure 24). The remainder of otoliths were from tows targeting barracouta, alfonsino, ling, hapuka, smooth oreo, silver warehou, and white warehou. The tree-based regression split the OP data from the Chatham Rise fishery into three strata based on depth and longitude (Table 10). The mean length of hoki on the Chatham Rise was shorter in shallower water, and to the west.

The length distribution of hoki from the Chatham Rise in 2011–12 was unimodal and similar for males and females (Figure 25). The catch was dominated by hoki of 45–90 cm from the 2006–08 year-classes (ages 3–5), with few fish from the 2010 year class (age 1+) and few larger, older fish caught (Figure 26). The modal age of the females was 4+ (2007 year-class), and for the males was 3+ and 4+ (2008 and 2007 year classes). More females than males were caught in 2011–12, with males comprising 41% of the catch (see Figure 10a). There was a lower proportion of large old fish (males and females) in the Chatham Rise than in other areas, with only 11% of the catch aged 7 years or older (see Figure 10b), and only 22% of these being male (see Figure 10a). About 27% of the catch by number was less than 65 cm in 2011–12, a large decrease from 2010–11 (53%), mainly due to the lack of age 1+ and 2+ fish in the catch (see Figure 10b).

The OP data used to estimate catch-at-age was reasonably representative of the overall spatial and temporal distribution of the catch in 2011–12 (Figure 27), although coverage was lower than ideal in some months, especially January, April and July, and on the northern Chatham Rise. The western side of the Chatham Rise (statistical areas 020, 021, 022, and 023) was well sampled, as was the southern Chatham Rise (statistical areas 407–409), but the coverage was poor on the northern Chatham Rise (statistical areas 401–404) (Figure 27).

Sub-Antarctic

About 87% of the commercial catch, 47% of length frequencies, and 71% of the available otoliths came from the hoki target fishery in 2011–12 (Figure 28). The remainder of otoliths were from tows targeting black oreo, hake, ling, southern blue whiting, squid, silver warehou, or white warehou. The tree-based regression split the OP data from the Sub-Antarctic fishery into four strata based on latitude, longitude, and time (Table 10). Smaller fish were found on the Snares Shelf, especially in shallower water, and the southern strata had larger fish early on in the season.

The catch in 2011–12 consisted mainly of 45–105 cm fish, with the males having a slightly narrower length range than females (Figure 29). Catch-at-age estimates showed that the Sub-Antarctic catch, like that from the other areas, consisted mainly of fish from the 2007–09 year-classes. The modal age of females and males was 3+ (2008 year-class). There was a higher proportion of old fish caught in the Sub-Antarctic than on the Chatham Rise (Figure 30) and the catch of fish less than 65 cm decreased markedly from 42% in 2009–10 to 28–30% in 2010–11 and 2011–12 (see Figure 10b). About 50% of the fish caught in the Sub-Antarctic in 2011–12 were males (see Figure 10a).

The OP sampling in the Sub-Antarctic was not very representative of the overall spatial or temporal distribution of the catch (Figure 31), with good sampling in October, and some sampling from November to May, and September (see Table 7). Coverage was good on the Snares Shelf and to the east of the Auckland Islands, but poor in other areas.

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

In addition to the problems associated with whether OP coverage is representative of the catch, there is an on-going problem with selection of otoliths. Observers collect otoliths from 10 fish out of the 50–150 sampled for length measurement (and otoliths from three fish in the spawning fisheries). As in previous years (e.g., Ballara et al. 2008), a rank sums test showed that the observers tended to select larger fish for extraction of otoliths from the Sub-Antarctic, but tended to select smaller fish on the Chatham Rise in 2011–12 (Figure 32). This introduces a bias into the age estimates which is difficult to correct. Improved training of observers is required to ensure that otoliths are taken randomly. Electronic aids now being used to help Observers take random samples for otoliths may solve this problem.

2.2.3 Comparison of size and age composition between main areas

Length distributions from the main fisheries in 2011–12 are compared in Figure 33. The catch in all areas was dominated by fish from 55 to 90 cm (mainly 2006–09 year-classes, aged 3–6 years), with very few from the 2010 year class, hence the percentage of small fish in the catch in each area was lower (see Figure 10b). Most fish on the Chatham Rise were less than 80 cm. Large female fish (over 90 cm) were proportionately more abundant in Cook Strait, ECSI, Sub-Antarctic, and WCSI.

3. HOKI RESEARCH

3.1 Resource surveys

3.1.1 Trawl surveys

Chatham Rise

The twenty-second annual trawl survey of the Chatham Rise was completed between 2 and 26 January 2013, with 93 tows used for biomass estimation. The total biomass of all hoki in 2013 increased by 42% to 124 100 t (Table 11). There was a 29% increase in the biomass estimate for recruited hoki (3 years and older) from 55 900 t in 2012 to 72 100 t in 2013. The biomass estimate for age 2+ (2010 year-class) of 1000 t was the lowest in the series, and the estimate for age 1+ (2011 year-class) of 50 900 t was the highest in the series (Table 11).

Hoki size and age frequencies from the 2013 Chatham Rise survey were dominated by 1+ (33–48 cm), and 3+ (55–85 cm) hoki, with few 2+ hoki, and few larger fish (Figures 34 and 35).

The 2013 Chatham Rise trawl survey included additional deepwater strata from 800–1300 m. Some large hoki (typically longer than 80 cm) were caught deeper than the core survey boundary at 800 m, but the deepwater strata only contributed a small proportion (1.4%) of the total hoki biomass.

Sub-Antarctic

The fifteenth survey in the *Tangaroa* summer trawl time series was carried out from 25 November to 23 December 2012, with 80 successful tows. Previous surveys in the summer series were in November–December 1991–93, and 2000–09, and 2011. An autumn series has also been carried out in the same area in March–June 1992, 1993, 1996, and 1998. The abundance estimate of hoki in core 300–800 m strata from the 2012 survey was 55 738 t (Table 12), 17% higher than the 2011 survey. The estimated biomass in 2012 was lower than that in 2009, slightly higher than that seen in 2007 and 2008, but only about two thirds of the biomass estimated in the early 1990s.

Hoki length frequencies in 2012 ranged from 30–110 cm (Figure 36). The main adult mode consisted of fish from the 2009–04 year-classes at ages 3–8, with some larger older fish (Figure 37). There were very few fish in the 49–55 cm range due to the lack of the 2+ hoki (2010 year class). The mode at 32–50 cm corresponds to hoki from the 2011 year-class (Figure 37) and these small fish were mainly caught at Puysegur and on the Stewart-Snares shelf.

The summer Sub-Antarctic trawl survey series shows large annual changes in numbers-at-age (particularly between 2006 and 2007) which cannot be explained by changes in abundance, and are suggestive of a change in catchability for the survey. In the 2011 and 2012 stock assessments, model sensitivities were run in which two catchabilities were fitted for the series, instead of just one, and these were found to improve the model fit substantially (McKenzie 2013). In 2013, three base models were run, two of which fitted two catchabilities to the Sub-Antarctic summer trawl series.

West Coast South Island

A combined trawl and acoustic survey of the west coast South Island (WCSI) was carried out using *Tangaroa* from 20 July to 19 August 2012. This was the ninth in a series of acoustic surveys of WCSI hoki spawning areas, but the first since 2000. The survey was also the second in a new time series of trawl estimates for middle depth species from the WCSI, with results that are comparable to the random trawl component from the 2000 WCSI survey.

A total of 63 successful random trawl survey tows were completed in the area north of Hokitika Canyon.

The 2012 trawl abundance estimate for hoki was 32 602 t (c.v. 24 %). This was much higher than the abundance estimated from daytime random tows in the equivalent strata in the 2000 WCSI survey, and trawl biomass estimates of hoki were not included in the 2013 assessment as the reliability of the indices had not been evaluated.

Several modes were present in the hoki scaled length frequency from the 2012 WCSI survey (Figure 38) including small (1-year old) hoki at 25–35 cm. Most male hoki were between 50 and 80 cm, and most females were 60–100 cm. The modal length of hoki caught in 2012 was smaller than the modal length from the equivalent survey area in 2000 and that there were fewer small (less than 40 cm) hoki caught in 2000 (Figure 38). The modal age of hoki in the 2012 survey was age 3 years (2009 year-class) with few males older than age 7 and few females older than age 10 (Figure 39). Hoki were not aged from the 2000 survey.

3.1.2 Acoustic surveys

West coast South Island

As described above, a combined trawl and acoustic survey of spawning hoki abundance on the WCSI was carried out using *Tangaroa* from 20 July to 19 August 2012 (O'Driscoll et al. in press). Three acoustic snapshots of the main WCSI hoki spawning areas were completed, with 27 targeted tows to identify acoustic marks and collect biological samples. Moored cameras were also used to study species composition on untrawlable ground. Acoustic estimates of hoki abundance were sensitive to the choice of hoki TS, sound absorption, stratum areas, and the method used to correct for species composition in mixed marks. 'Old' acoustic estimates were calculated using the same methods as previous surveys in the time series (O'Driscoll 2002). These estimates ranged from 348 000 t in the first snapshot to 478 000 t in the second snapshot, with an average across all three snapshots of 412 000 t (Table 13). This was 4% higher than the equivalent acoustic index from 2000 and slightly above the long-term average of the time-series (Table 14). The acoustic survey weighting (expressed as a proportional coefficient of variation, c.v.), which includes uncertainty associated with survey timing, sampling precision, mark identification, calibration, and target strength was 0.51.

4. CONCLUSIONS

The total reported hoki catch in 2010–11 was 130 105 t, about 105 t above the TACC of 130 000 t, and 11 000 t higher than the catch in 2010–11. Relative to 2010–11, catches in 2011–12 increased in all areas except for the ECNI. With the increase in the western catch allocation to 70 000 t, the catch on the WCSI increased by nearly 6 000 t to 54 540 t, and, for the second time in six years, was the largest hoki fishery. The Chatham Rise was the second largest fishery, with 39 200 t taken, and the Sub-Antarctic catch increased to 15 800 t in 2011–12. The catch from Cook Strait increased slightly to 15 900 t, and was the second lowest catch from this fishery since 1989–90.

Length frequencies and catch-at-age results from the commercial fishery show that most of the catch in 2011–12 was fish from 55 to 90 cm (mainly 2005–09 year-classes, aged 3–7 years). The percentage of small fish in the catch in 2011–12 decreased, mainly due to the lack of 2 year old hoki from the 2010 year-class. The largest hoki came from the WCSI, Sub-Antarctic and Cook Strait in 2011–12.

The relative biomass index for all hoki from the 2013 Chatham Rise trawl survey increased by 42%, with an increase of 29% in estimated biomass of recruited hoki (aged 3 and older). The 2011 year-class (age 1+) was the strongest in the Chatham Rise time series, but the abundance estimate from the 2010 year class (age 2+) was low. The estimated biomass from the 2012 Sub-Antarctic trawl survey was 17% higher than that in 2011. The abundance index from an acoustic survey of the WCSI spawning grounds in 2012 was similar to that from a comparable survey in 2000.

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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.

				New Zealand		
Year	U.S.S.R.	Japan	South Korea	Domestic	Chartered	Total
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 are based on estimated catches from vessel logbooks. Few data are available for the first 3 months of 1978 because these vessels did not begin completing these logbooks until 1 April 1978.

\+ Soviet hoki catches are taken from the estimated catch records and differ from official Ministry for Primary Industries statistics. Estimated catches are used because of the large amount of hoki converted to meal and not recorded as processed fish.

Table 2: Reported catch (t) from QMS[1], estimated catch (t) data, and TACC (t) for HOK 1 from 1986–1987 to 2011–12. Estimated catches include 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	Estimated catch	Reported catch (MHR)		TACC
		Exclude HOKET	Include HOKET	
1986–87	175 000		158 171	250 000
1987–88	255 000		216 206	250 000
1988–89	210 000		208 500	250 000
1989–90	210 000		208 851	251 884
1990–91	215 000		212 720	201 897
1991–92	215 000		212 167	201 897
1992–93	195 000		191 994	202 155
1993–94	190 000		192 385	202 155
1994–95	168 000		176 787	220 350
1995–96	194 000		209 639	240 000
1996–97	230 000		246 756	250 000
1997–98	261 000		269 239	250 000
1998–99	234 000		244 528	250 000
1999–00	237 000		242 423	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	126 164	130 106	130 106	130 000

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 has been 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 have been shown including and excluding HOKET catches (catches outside the EEZ).

Table 3: Estimated total catch (t) of hoki by area[1], 1988–89 to 2011–12. Estimated (TCEPR and CELR) catches were scaled to reported (QMR or MHR) catch totals. Data also includes LCER (from 2003–04), and NCELR estimated data (from 2006–07), and TCER and LTCER data (from 2007–08).

	Spawning fisheries				Non-spawning fisheries					
Fishing Year	WCSI	Puysegur	Cook Strait	ECSI	Sub-Antarctic	Chatham Rise	ECNI	WCNI	Other[2]	Total catch
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	102 234	6 798	36 298	2 411	30 076	49 847	2 035	147	-	229 846
2001–02	92 716	5 322	23 976	2 971	30 175	39 151	1 147	39	-	195 497
2002–03	73 860	5 948	36 713	7 382	20 199	39 092	929	532	4	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	54 540	1 308	15 861	2 531	15 745	39 231	858	31	-	130 105

1 Estimated catches by area from TCEPR, CELR, LCER, NCELR, and TCER adjusted pro rata to the total reported (QMR or MHR) catches (excluding HOKET 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 model for each area and the corresponding total R^2 value.

	All target species		Target hoki
Variable	R^2	Variable	R^2
WCSI spawning, core vessels			
Year	5.1	Year	5.5
Day of year	19.4	Day of year	16.5
Vessel	26.8	Vessel	24.7
Target species	32.7	Mid time	27.9
Mid time	35.3		
Cook Strait spawning, core MW vessels			
		Fishing year	2.4
		Day of fishing year	17.7
		Vessel	23.3
Chatham Rise and ECSI Non-spawning, core BT vessels			
Fishing year	5.3	Fishing year	8.9
Vessel	32.9	Vessel	13.9
Target species	36.1	Start time of tow	16.9
Start time of tow	38.1	Duration of tow	19.9
Duration of tow	40.1	Month	21.2
Sub-Antarctic non-spawning, core BT vessels			
Fishing year	8.7	Fishing year	3.7
Target species	42.1	Month	9.3
Month	45.0	Start time of tow	13.5
Start time of tow	47.5	Vessel	16.5
Vessel	49.3	Statistical area	19.0
Distance 2	50.6	Duration of tow	20.5
		Depth of net	21.6

Table 5: Observer coverage 2011–12 by area, BT (bottom trawl), BPT (bottom pair trawl), MW (midwater tow), MPT (midwater pair trawl) trawl methods only. WCSI, Cook Strait and ECSI are for June to September only.

(a) All target species tows

	Number of vessels			Number of tows			Catch (t)		
Area	All	Observed	Percent	All	Observed	Percent	All	Observed	Percent
Chatham Rise	50	14	28.0	5 826	373	6.4	39 226	3 596	9.2
Cook Strait	28	7	25.0	1 119	75	6.7	12 877	1 081	8.4
ECNI	50	2	4.0	2 451	3	0.1	852	6	0.7
ECSI	16	3	18.8	268	12	4.5	2 526	263	10.4
Macquarie	1	1	100.0	4	1	25.0	-	-	-
Puysegur	20	5	25.0	252	29	11.5	1 308	227	17.4
Sub–Antarctic	37	17	45.9	2 732	257	9.4	15 745	2 350	14.9
WCNI	18	1	5.6	115	1	0.9	31	-	1.6
WCSI	44	16	36.4	3 747	423	11.3	54 228	9 638	17.8
All areas combined	111	33	29.7	17 867	1 192	6.7	130 089	17 322	13.3

(b) Target hoki tows

	Number of vessels			Number of tows			Catch (t)		
Area	All	Observed	Percent	All	Observed	Percent	All	Observed	Percent
Chatham Rise	29	10	34.5	4 471	331	7.4	38 038	3 343	8.8
Cook Strait	22	7	31.8	1 034	75	7.3	12 863	1 081	8.4
ECNI	15	1	6.7	332	1	0.3	561	4	0.8
ECSI	12	3	25.0	219	12	5.5	2 468	263	10.7
Macquarie	5	1	20.0	97	21	21.6	1 000	196	19.6
Puysegur	21	7	33.3	1 262	119	9.4	13 612	2 066	15.2
Sub–Antarctic	5	1	20.0	12	1	8.3	22	-	2.2
WCNI	37	15	40.5	3 171	406	12.8	52 616	9 565	18.2
WCSI	64	27	42.2	11 253	985	8.8	124 400	16 680	13.4
All areas combined									

Table 6: Bycatch rates on vessels with Observer Programme observers in the hoki fishery for tows targeting hoki from 1990–91 to 2011–12. The WCSI, Cook Strait, and ECSI data cover 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 are no observer data). Bycatch rates not calculated where observed hoki catch is less than 100 t. Species include: HAK, Hake; HOK, Hoki; JAV, Javelinfish; LIN, Ling; RAT, Rattails; SBW, Southern blue whiting; SPD, Spiny dogfish; SWA, Silver warehou, and WWA, White warehou.

(a) WCSI

	Catch in t (% of hoki catch)				
Fishing year	HOK	HAK	LIN	SWA	SPD
1990–91	28 670	1 574 (5.5)	243 (0.8)	465 (1.6)	43 (0.1)
1991–92	18 674	152 (0.8)	141 (0.8)	156 (0.8)	98 (0.5)
1992–93	19 095	370 (1.9)	182 (1.0)	138 (0.7)	56 (0.3)
1993–94	32 568	217 (0.7)	167 (0.5)	614 (1.9)	215 (0.7)
1994–95	25 721	840 (3.3)	221 (0.9)	162 (0.6)	192 (0.7)
1995–96	17 706	1 409 (8.0)	279 (1.6)	472 (2.7)	315 (1.8)
1996–97	14 283	648 (4.5)	131 (0.9)	422 (3.0)	59 (0.4)
1997–98	18 655	1 077 (5.8)	327 (1.8)	445 (2.4)	245 (1.3)
1998–99	17 428	1 026 (5.9)	290 (1.7)	220 (1.3)	219 (1.3)
1999–00	18 762	1 081 (5.8)	291 (1.6)	384 (2.0)	110 (0.6)
2000–01	16 433	514 (3.1)	262 (1.6)	295 (1.8)	82 (0.5)
2001–02	16 668	1 460 (8.8)	513 (3.1)	124 (0.7)	119 (0.7)
2002–03	10 191	528 (5.2)	191 (1.9)	96 (0.9)	41 (0.4)
2003–04	8 431	817 (9.7)	507 (6.0)	269 (3.2)	51 (0.6)
2004–05	7 178	344 (4.8)	281 (3.9)	99 (1.4)	38 (0.5)
2005–06	9 525	404 (4.2)	232 (2.4)	97 (1.0)	62 (0.7)
2006–07	9 740	112 (1.1)	79 (0.8)	80 (0.8)	30 (0.3)
2007–08	7 774	47 (0.6)	73 (0.9)	53 (0.7)	48 (0.6)
2008–09	9 418	84 (0.9)	88 (0.9)	68 (0.7)	32 (0.3)
2009–10	11 619	85 (0.7)	162 (1.4)	65 (0.6)	79 (0.7)
2010–11	9 556	231 (2.4)	189 (2.0)	99 (1.0)	61 (0.6)
2011–12	18 435	301 (1.6)	334 (1.8)	90 (0.5)	244 (1.3)

(b) Cook Strait

	Catch in t (% of hoki catch)				
Fishing year	HOK	HAK	LIN	SWA	SPD
1992–93	107	- (-)	- (-)	- (-)	1 (0.9)
1993–94	495	- (-)	6 (1.2)	- (-)	1 (0.2)
1995–96	734	- (-)	2 (0.3)	- (-)	13 (1.8)
1997–98	3 435	- (-)	7 (0.2)	- (-)	55 (1.6)
1998–99	4 881	1 (-)	19 (0.4)	- (-)	97 (2.0)
1999–00	3 243	- (-)	10 (0.3)	- (-)	106 (3.3)
2000–01	4 361	- (-)	16 (0.4)	1 (-)	87 (2.0)
2001–02	2 032	- (-)	6 (0.3)	- (-)	45 (2.2)
2002–03	2 436	- (-)	6 (0.2)	- (-)	104 (4.3)
2003–04	2 486	- (-)	4 (0.2)	- (-)	39 (1.6)
2004–05	2 176	- (-)	4 (0.2)	2 (0.1)	38 (1.7)
2005–06	1 080	- (-)	2 (0.2)	- (-)	15 (1.4)
2006–07	2 124	- (-)	11 (0.5)	2 (0.1)	84 (4.0)
2007–08	3 437	- (-)	8 (0.2)	1 (-)	63 (1.8)
2008–09	2 290	- (-)	3 (0.1)	- (-)	27 (1.2)
2009–10	3 393	- (-)	5 (0.1)	- (-)	28 (0.8)
2010–11	1 637	- (-)	- (-)	2 (0.1)	13 (0.8)
2011–12	1 551	- (-)	4 (0.3)	7 (0.5)	27 (1.7)

Table 6: continued.

(c) Puysegur

Catch in t (% of hoki catch)

Fishing year	HOK	HAK	LIN	SWA	SPD
1990–91	986	3 (0.3)	25 (2.5)	1 (0.1)	1 (0.1)
1991–92	1 025	27 (2.6)	431 (42.0)	2 (0.2)	4 (0.4)
1992–93	231	2 (0.9)	60 (26.0)	- (-)	- (-)
1993–94	938	- (-)	8 (0.9)	7 (0.7)	6 (0.6)
1994–95	226	- (-)	8 (3.5)	- (-)	- (-)
1995–96	719	2 (0.3)	33 (4.6)	3 (0.4)	2 (0.3)
1996–97	454	- (-)	6 (1.3)	3 (0.7)	3 (0.7)
1998–99	226	4 (1.8)	25 (11.1)	6 (2.7)	9 (4.0)
1999–00	369	- (-)	25 (6.8)	17 (4.6)	7 (1.9)
2000–01	573	5 (0.9)	18 (3.1)	211 (36.8)	6 (1.0)
2001–02	561	- (-)	20 (3.6)	34 (6.1)	1 (0.2)
2002–03	527	2 (0.4)	28 (5.3)	16 (3.0)	2 (0.4)
2003–04	549	- (-)	32 (5.8)	14 (2.6)	2 (0.4)
2004–05	1 237	1 (0.1)	20 (1.6)	1 (0.1)	11 (0.9)
2005–06	372	2 (0.5)	104 (28.0)	- (-)	1 (0.3)
2006–07	10	- (-)	4 (40.0)	- (-)	- (-)
2009–10	31	- (-)	- (-)	1 (3.2)	- (-)
2010–11	1	- (-)	- (-)	- (-)	- (-)
2011–12	301	6 (2.0)	19 (6.3)	5 (1.7)	- (-)

(d) Sub-Antarctic

Catch in t (% of hoki catch)

Fishing year	HOK	HAK	LIN	SWA	SPD	JAV	RAT	SBW	WWA
1990–91	1 960	203 (10.4)	90 (4.6)	- (-)	3 (0.2)	16 (0.8)	14 (0.7)	1 (0.1)	3 (0.2)
1991–92	3 562	332 (9.3)	249 (7.0)	9 (0.3)	15 (0.4)	47 (1.3)	39 (1.1)	6 (0.2)	35 (1.0)
1992–93	3 468	676 (19.5)	252 (7.3)	5 (0.1)	10 (0.3)	30 (0.9)	21 (0.6)	- (-)	22 (0.6)
1993–94	1 929	226 (11.7)	171 (8.9)	11 (0.6)	15 (0.8)	11 (0.6)	10 (0.5)	- (-)	5 (0.3)
1994–95	882	24 (2.7)	64 (7.3)	- (-)	15 (1.7)	14 (1.6)	12 (1.4)	3 (0.3)	8 (0.9)
1995–96	1 080	32 (3.0)	146 (13.5)	8 (0.7)	6 (0.6)	9 (0.8)	15 (1.4)	- (-)	22 (2.0)
1996–97	717	10 (1.4)	25 (3.5)	1 (0.1)	- (-)	4 (0.6)	3 (0.4)	- (-)	- (-)
1997–98	1 893	127 (6.7)	190 (10.0)	3 (0.2)	20 (1.1)	66 (3.5)	59 (3.1)	1 (0.1)	28 (1.5)
1998–99	4 784	134 (2.8)	257 (5.4)	26 (0.5)	20 (0.4)	74 (1.5)	78 (1.6)	- (-)	18 (0.4)
1999–00	5 470	213 (3.9)	340 (6.2)	162 (3.0)	47 (0.9)	186 (3.4)	65 (1.2)	5 (0.1)	25 (0.5)
2000–01	4 286	99 (2.3)	439 (10.2)	237 (5.5)	58 (1.4)	78 (1.8)	50 (1.2)	9 (0.2)	26 (0.6)
2001–02	3 908	154 (3.9)	194 (5.0)	35 (0.9)	97 (2.5)	308 (7.9)	94 (2.4)	35 (0.9)	27 (0.7)
2002–03	2 032	83 (4.1)	373 (18.4)	22 (1.1)	81 (4.0)	99 (4.9)	47 (2.3)	21 (1.0)	20 (1.0)
2003–04	781	37 (4.7)	326 (41.7)	54 (6.9)	171 (21.9)	36 (4.6)	16 (2.0)	16 (2.0)	14 (1.8)
2004–05	391	24 (6.1)	189 (48.3)	5 (1.3)	6 (1.5)	71 (18.2)	15 (3.8)	1 (0.3)	10 (2.6)
2005–06	1 172	14 (1.2)	118 (10.1)	68 (5.8)	63 (5.4)	29 (2.5)	14 (1.2)	- (-)	70 (6.0)
2006–07	1 225	16 (1.3)	225 (18.4)	82 (6.7)	85 (6.9)	50 (4.1)	18 (1.5)	1 (0.1)	85 (6.9)
2007–08	3 105	101 (3.3)	1 004 (32.3)	13 (0.4)	30 (1.0)	176 (5.7)	28 (0.9)	61 (2.0)	76 (2.4)
2008–09	3 070	93 (3.0)	361 (11.8)	52 (1.7)	83 (2.7)	130 (4.2)	40 (1.3)	37 (1.2)	39 (1.3)
2009–10	3 260	73 (2.2)	309 (9.5)	26 (0.8)	73 (2.2)	166 (5.1)	93 (2.9)	7 (0.2)	37 (1.1)
2010–11	2 981	34 (1.1)	221 (7.4)	58 (1.9)	105 (3.5)	61 (2.0)	58 (1.9)	40 (1.3)	56 (1.9)
2011–12	3 172	46 (1.5)	424 (13.4)	2 (0.1)	46 (1.5)	64 (2.0)	48 (1.5)	12 (0.4)	31 (1.0)

Table 6: continued.

(e) Chatham Rise and ECSI (excluding ECSI from June–September).

Catch in t (% of hoki catch)

Fishing year	HOK	HAK	LIN	SWA	SPD	JAV	RAT	WWA
1990–91	3 328	132 (4.0)	157 (4.7)	210 (6.3)	24 (0.7)	142 (4.3)	102 (3.1)	2 (0.1)
1991–92	5 011	64 (1.3)	145 (2.9)	28 (0.6)	5 (0.1)	70 (1.4)	129 (2.6)	16 (0.3)
1992–93	1 321	59 (4.5)	12 (0.9)	9 (0.7)	3 (0.2)	38 (2.9)	11 (0.8)	2 (0.2)
1993–94	4 835	162 (3.4)	124 (2.6)	16 (0.3)	18 (0.4)	85 (1.8)	115 (2.4)	6 (0.1)
1994–95	2 156	36 (1.7)	75 (3.5)	22 (1.0)	14 (0.6)	65 (3.0)	66 (3.1)	2 (0.1)
1995–96	5 331	136 (2.6)	146 (2.7)	128 (2.4)	49 (0.9)	118 (2.2)	197 (3.7)	23 (0.4)
1996–97	1 762	112 (6.4)	75 (4.3)	116 (6.6)	10 (0.6)	87 (4.9)	130 (7.4)	4 (0.2)
1997–98	8 948	212 (2.4)	243 (2.7)	91 (1.0)	71 (0.8)	439 (4.9)	315 (3.5)	24 (0.3)
1998–99	7 713	99 (1.3)	273 (3.5)	81 (1.1)	129 (1.7)	343 (4.4)	327 (4.2)	26 (0.3)
1999–00	3 837	64 (1.7)	114 (3.0)	125 (3.3)	135 (3.5)	222 (5.8)	159 (4.1)	23 (0.6)
2000–01	5 476	143 (2.6)	262 (4.8)	217 (4.0)	97 (1.8)	385 (7.0)	339 (6.2)	55 (1.0)
2001–02	4 607	94 (2.0)	221 (4.8)	48 (1.0)	120 (2.6)	382 (8.3)	381 (8.3)	32 (0.7)
2002–03	2 356	68 (2.9)	211 (9.0)	138 (5.9)	47 (2.0)	431 (18.3)	336 (14.3)	39 (1.7)
2003–04	2 460	52 (2.1)	157 (6.4)	242 (9.8)	58 (2.4)	250 (10.2)	265 (10.8)	51 (2.1)
2004–05	4 820	52 (1.1)	180 (3.7)	134 (2.8)	106 (2.2)	531 (11.0)	339 (7.0)	94 (2.0)
2005–06	5 120	48 (0.9)	131 (2.6)	259 (5.1)	93 (1.8)	394 (7.7)	315 (6.2)	104 (2.0)
2006–07	5 535	80 (1.4)	155 (2.8)	195 (3.5)	39 (0.7)	500 (9.0)	165 (3.0)	75 (1.4)
2007–08	5 532	77 (1.4)	120 (2.2)	149 (2.7)	74 (1.3)	405 (7.3)	319 (5.8)	35 (0.6)
2008–09	4 376	49 (1.1)	94 (2.1)	71 (1.6)	45 (1.0)	351 (8.0)	286 (6.5)	14 (0.3)
2009–10	5 726	68 (1.2)	134 (2.3)	244 (4.3)	48 (0.8)	541 (9.4)	429 (7.5)	22 (0.4)
2010–11	5 973	52 (0.9)	142 (2.4)	221 (3.7)	46 (0.8)	382 (6.4)	314 (5.3)	26 (0.4)
2011–12	7 902	42 (0.5)	185 (2.3)	236 (3.0)	107 (1.4)	329 (4.2)	351 (4.4)	31 (0.4)

(f) ECSI, June–September.

Catch in t (% of hoki catch)

Fishing year	HOK	HAK	LIN	SWA	SPD	JAV	RAT	WWA
2000–01	5	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)
2001–02	97	- (-)	1 (1.0)	- (-)	- (-)	- (-)	1 (1.0)	- (-)
2002–03	914	22 (2.4)	8 (0.9)	20 (2.2)	5 (0.5)	6 (0.7)	18 (2.0)	2 (0.2)
2003–04	939	2 (0.2)	4 (0.4)	1 (0.1)	1 (0.1)	4 (0.4)	6 (0.6)	2 (0.2)
2004–05	280	- (-)	1 (0.4)	- (-)	- (-)	1 (0.4)	2 (0.7)	- (-)
2005–06	505	5 (1.0)	- (-)	35 (6.9)	1 (0.2)	1 (0.2)	3 (0.6)	- (-)
2007–08	72	2 (2.8)	1 (1.4)	2 (2.8)	- (-)	2 (2.8)	9 (12.5)	2 (2.8)
2008–09	311	- (-)	- (-)	- (-)	- (-)	- (-)	1 (0.3)	- (-)
2009–10	41	- (-)	1 (2.4)	- (-)	- (-)	1 (2.4)	18 (43.9)	2 (4.9)
2010–11	413	2 (0.5)	1 (0.2)	- (-)	- (-)	- (-)	4 (1.0)	2 (0.5)
2011–12	355	1 (0.3)	1 (0.3)	10 (2.8)	- (-)	2 (0.6)	15 (4.2)	3 (0.8)

Table 7: Number of 2011–12 hoki length frequencies and otoliths by observer trips, target species, and monthly timing. Length frequencies with errors, missing data or outide the sample period (e.g. non-spawning in a spawning area) have been removed.

(a) WCSI observer samples

			Number of	
Trip	Month	Target species	Length frequencies	Otoliths
1	Jun	BAR/HOK	9	-
2	Jun	HOK	10	-
3	Jul	HOK	24	-
4	Jun	HOK	1	-
5	Jun/Jul	HOK	17	39
6	Jun/Jul	HOK	35	-
7	Jun/Jul	HAK/HOK	20	17
8	Jul	HOK	16	31
9	Jul/Aug	HOK/LIN	41	-
10	Jul/Aug	HAK/HOK	20	-
11	Jul	HOK	36	-
12	Jul	HOK	17	-
13	Jul/Aug	HOK	33	-
14	Jul/Aug	HOK	14	-
15	Jul/Aug	HOK	31	-
16	Jul/Aug	HOK	25	-
17	Aug	HOK	25	-
18	Aug	HOK	8	-
19	Aug	HOK	10	-
20	Aug	HOK	18	-
21	Aug/Sep	HAK/HOK	8	-
22	Sep	BAR/HAK	2	-
23	Sep	HAK	3	-
TAN1210	-	-	-	706
Total	-	-	423	793

(b) Cook Strait observer samples

					Month		Total
Data set	Stratum		Jun	Jul	Aug	Sep	
Observer tows	Nelson/Picton	vessel <30 m	-	11	36	11	58
	Nelson/Picton	vessel 30–40m	2	-	-	-	2
	Nelson/Picton	vessel >40 m	15	-	-	-	15

Table 7: continued.

(c) Chatham Rise and ECSI observer data; Chatham Rise includes ECSI non-spawning data.

			Number of length frequencies		
Trip	Month	Target species	Chatham Rise	ECSI spawning	Number of otoliths
1	Oct	HOK	4	-	22
2	Oct	HOK/SWA/WWA	5	-	10
3	Oct/Nov	HOK	6	-	24
4	Nov	SSO	1	-	-
5	Nov/Dec	HOK	3	-	6
6	Oct/Nov/Dec	BYS/HOK	64	-	280
7	Nov	OEO/ORH/SSO	9	-	-
8	Dec	SSO	1	-	-
9	Nov/Dec	HOK	73	-	-
10	Dec/Jan	HOK	31	-	168
11	Feb	BAR	3	-	-
12	Feb/Mar	HOK/SWA/WWA	29	-	140
13	Feb/Mar	HOK	44	-	251
14	May	HOK	17	-	96
15	May	HOK	16	-	70
16	May	SWA	1	-	4
17	May/Jun	HOK/SWA	19	-	-
18	Jun	HOK	4	-	11
19	Jun	SWA	2	-	3
20	Aug	HOK	5	2	28
21	Aug/Sep	HOK	8	9	29
22	Sep	SWA	1	-	6
23	Sep	BAR/LIN/SWA	7	-	11
24	Sep	HOK	4	-	22
25	Sep	HOK	-	1	-
26	Sep	HOK	6	-	29
27	Sep	BAR/HOK/SWA	10	-	-
Total	-	-	373	12	1210

(d) Sub-Antarctic observer data

Trip	Month	Target species	Number of Length frequencies	Number of Otoliths
1	Oct	HOK	2	17
2	Oct	HOK	34	338
3	Oct	LIN/WWA	5	33
4	Oct/Nov	HOK	22	181
5	Oct	LIN	5	-
6	Nov/Dec	BOE	2	4
7	Nov/Dec	HAK/LIN/WWA	9	44
8	Dec/Jan	HAK/LIN	9	54
9	Jan/Feb	HOK	8	74
10	Jan/Feb	HAK/WWA	4	26
11	Feb	SQU	8	5
12	Mar	HOK	11	92
13	Feb	HOK	1	-
14	Mar/Apr	SQU	5	7
15	Feb	SQU	1	-
16	Mar	SQU	1	-
17	Apr	SQU	3	7
18	Mar/Apr	SQU	6	4
19	Apr	SQU	2	-
20	Mar	SQU	1	-
21	Apr	SQU	2	-
22	Apr/May	SQU/SWA	11	71
23	May	HOK	2	14
24	May	HOK	20	-
25	Jul	LIN/WWA	12	100
26	Sep	SBW	24	-
27	Sep	SBW	2	-
28	Sep	HOK/LIN	16	119
29	Sep	SBW	2	-
30	Sep	SBW	12	-
31	Sep	HOK	4	39
32	Sep	SBW	2	-
33	Sep	SBW	8	-
Total	-	-	256	1229

Table 8: Stratification for the 2012 WCSI and Cook Strait length frequencies.

(a) Number of WCSI hoki length frequency data and catch by week from inside and outside the 25 n. mile line.

Week	Date	Number of length frequencies		Catch (t)	
		Inside	Outside	Inside	Outside
22	1–2 Jun	2	-	109.2	-
23	3–9 Jun	10	1	430.7	51.5
24	10–16 Jun	7	-	557.4	252.1
25	17–23 Jun	-	-	525.9	538.5
26	24–30 Jun	-	10	549.8	1 084.5
27	1–7 Jul	-	44	1 124.4	4 461.0
28	8–14 Jul	-	41	938.4	5 210.1
29	15–21 Jul	-	62	858.2	7 071.3
30	22–28 Jul	-	66	927.6	6 305.3
31	29 Jul–4 Aug	-	64	681.7	6 779.0
32	5–11 Aug	-	55	245.9	6 531.2
33	12–18 Aug	-	22	552.4	2 908.3
34	19–25 Aug	-	24	313.4	2 846.0
35	26 Aug–1 Sep	-	7	258.4	1 085.2
36	2–8 Sep	-	1	107.5	614.9
37	9–15 Sep	-	2	58.3	167.3
38	16–22 Sep	-	5	0.2	58.6
39	23–29 Sep	-	-	-	4.9

(b) Stratification of WCSI hoki fishery length frequency data.

	Length frequencies		Catch	
Stratum	Description	Number	Description	Catch (t)
1	1–23 Jun; Inside line	19	1–23 Jun	2483.8
2	24–30 Jun; Outside line	11	24–30 Jun	1634.4
3	1–7 Jul; Outside line	44	1–7 Jul	5585.5
4	8–14 Jul; Outside line	41	8–14 Jul	6148.6
5	15–21 Jul; Outside line	62	15–21 Jul	7929.6
6	22–28 Jul; Outside line	66	22–28 Jul	7232.9
7	29 Jul–4 Aug; Outside line	64	29 Jul–4 Aug	7460.8
8	5–11 Aug; Outside line	55	5–11 Aug	6777.1
9	12–18 Aug; Outside line	22	12–18 Aug	3460.8
10	19–25 Aug; Outside line	24	19–25 Aug	3159.4
11	26 Aug–1 Sep; Outside line	7	26 Aug–1 Sep	1343.6
12	2–22 Sep; Outside line	8	2–30 Sep	1011.5

(c) Cook Strait

Stratum	Month	Catch (t)	Number of Observer samples
1	Jun	612	17
2	Jul	1857	11
3	Aug	612	11
4	Sep	612	17

Table 9: Percentage of female hoki by observer stages on the WCSI for female fish less than or equal to 55 cm (n = 395) and female fish greater than 55 cm (n = 20 635) for the 2012 spawning season.

	Females ≤ 55 cm	Females > 55 cm
Immature and resting	22.3	2.8
Ripening	52.2	46.8
Ripe	21.0	38.5
Running ripe	2.5	6.6
Spent	2.0	5.3

Table 10: Strata for the 2011–12 non spawning fisheries based on the tree regression of all data (Observer Programme only), with comparison of the TCEPR, Observer Programme (OP), and otolith data by stratum. The catch for OP is the total catch for the observed tows.

(a) Chatham Rise

	Splitting variable		Mean length	Hoki catch (t)		No. of tows sampled		No. of otoliths	No. of fish Measured
Stratum	Depth of net	Longitude	(cm)	TCEPR	OP	TCEPR	OP		
1	< 646.5 m	< 177.9°	68.5	22 642	1 849	3 130	165	619	16 672
2	< 646.5 m	≥ 177.9°	72.0	14 173	1 465	1 989	178	443	17 972
3	≥ 646.5 m	-	82.7	2 410	210	719	28	81	1 832

(b) Sub-Antarctic

			Splitting variables	Mean length	Hoki catch (t)		No. of tows sampled		No. of otoliths	No. of fish Measured
Stratum	Latitude	Longitude	Dates	(cm)	TCEPR	OP	TCEPR	OP		
1	north of 48.9° S	-	-	67.8	9 370	1 606	1 315	110	750	10 184
2	south of 48.9° S	west of 168.3°	Oct 2011 – 25 Jun 2012	74.9	3 793	359	982	63	155	4 135
3	south of 48.9° S	west of 168.3°	26 Jun – 25 Oct 2012	87.4	612	211	115	17	147	1 964
4	south of 48.9° S	east of 168.3°	-	89.6	1 969	132	328	65	101	1 745

Table 11: Relative biomass estimates of hoki on the Chatham Rise from *Tangaroa* trawl surveys, January 1992–2013. The c.v. is the coefficient of variation as % (in parentheses).

	+ hoki			2+ hoki			3++ hoki		Total hoki	
Survey	Year-class	'000 t	c.v.	Year-class	'000 t	c.v.	'000 t	c.v.	'000 t	c.v.
1992	1990	2.8	(28)	1989	1.2	(18)	116.1	(8)	120.2	(10)
1993	1991	32.9	(33)	1990	2.6	(25)	150.1	(9)	185.6	(10)
1994	1992	14.6	(20)	1991	44.7	(18)	86.2	(9)	145.6	(10)
1995	1993	6.6	(13)	1992	44.9	(11)	69.0	(9)	120.4	(8)
1996	1994	27.6	(24)	1993	15.0	(13)	106.6	(10)	152.8	(10)
1997	1995	3.2	(40)	1994	62.7	(12)	92.1	(8)	158.0	(8)
1998	1996	4.5	(33)	1995	6.9	(18)	75.6	(11)	86.7	(11)
1999	1997	25.6	(30)	1996	16.5	(19)	67.0	(10)	109.1	(12)
2000	1998	14.4	(32)	1997	28.2	(21)	29.1	(9)	71.7	(12)
2001	1999	0.4	(75)	1998	24.2	(18)	35.7	(9)	60.3	(10)
2002	2000	22.4	(26)	1999	1.2	(21)	50.7	(12)	74.4	(11)
2003	2001	0.5	(46)	2000	27.2	(15)	20.4	(9)	52.6	(9)
2004	2002	14.4	(33)	2001	5.4	(20)	32.8	(13)	52.7	(13)
2005	2003	17.5	(23)	2002	45.8	(16)	21.2	(11)	84.6	(12)
2006	2004	25.9	(22)	2003	33.6	(19)	39.7	(10)	99.2	(11)
2007	2005	9.1	(28)	2004	32.6	(13)	28.8	(9)	70.5	(8)
2008	2006	15.8	(32)	2005	23.8	(15)	37.2	(8)	76.9	(11)
2009	2007	25.2	(29)	2006	65.2	(17)	53.7	(8)	144.1	(11)
2010	2008	19.3	(31)	2007	28.6	(15)	49.6	(16)	97.5	(15)
2011	2009	26.9	(37)	2008	28.3	(14)	40.7	(8)	93.9	(14)
2012	2010	2.6	(30)	2009	29.1	(17)	55.9	(8)	87.5	(10)
2013	2011	50.9	(25)	2010	1.0	(44)	72.1	(13)	124.1	(15)

Table 12: Relative biomass estimates (t in thousands) of hoki in 300–800 m depths from Sub-Antarctic November–December *Tangaroa* trawl surveys. (c.v. coefficient of variation; 3++ all hoki aged 3 years and older.)

Survey	1+ hoki			2+ hoki			3 ++ hoki		Total hoki	
	1+ year class	t	c.v.	2+ year class	t	c.v.	t	c.v.	t	c.v.
Dec 91	1990	0.7	(87)	1989	0.2	(56)	79.4	(7)	80.3	(7)
May 92	1990	0.8	(39)	1989	1.4	(13)	65.6	(9)	67.8	(8)
Sep 92	1991	0.1	(94)	1990	0.0	(58)	34.1	(14)	34.3	(14)
Dec 92	1991	0.2	(66)	1990	0.2	(90)	86.9	(6)	87.4	(6)
May 93	1991	1.8	(76)	1990	0.2	(33)	51.4	(10)	53.5	(11)
Dec 93	1992	1.1	(98)	1991	3.7	(49)	94.9	(9)	99.7	(9)
Apr 96	1994	1.7	(58)	1993	3.2	(41)	85.4	(9)	90.4	(10)
Apr 98	1996	0.2	(62)	1995	0.6	(27)	67.1	(11)	67.8	(11)
Dec 00	1999	0.1	(99)	1998	0.0	(51)	55.6	(13)	55.7	(13)
Dec 01	2000	0.2	(49)	1999	0.1	(46)	37.8	(16)	38.2	(16)
Dec 02	2001	0.0	(53)	2000	2.5	(51)	37.4	(14)	39.9	(14)
Dec 03	2002	1.8	(28)	2001	0.1	(26)	12.4	(14)	14.3	(13)
Dec 04	2003	1.1	(58)	2002	3.3	(57)	13.2	(9.4)	17.6	(12)
Dec 05	2004	0.4	(50)	2003	1.6	(25)	18.5	(14)	20.4	(13)
Dec 06	2005	0.5	(48)	2004	0.7	(25)	13.1	(11)	14.3	(11)
Dec07	2006	1.0	(54)	2005	1.9	(42)	43.0	(17)	45.9	(16)
Dec08	2007	1.0	(48)	2006	1.6	(37)	44.4	(15)	47.0	(14)
Dec 09	2008	0.5	(54)	2007	11.1	(64)	53.4	(12)	65.0	(16)
Dec 11	2010	0.0	(100)	2009	2.3	(21)	43.8	(15)	46.1	(15)
Dec 12	2011	0.9	(44)	2010	0.2	(60)	54.6	(15)	55.7	(15)

Table 13: Hoki acoustic abundance estimates from the 2012 WCSI by snapshot and stratum using the 'old' analysis method (see O'Driscoll et al. in press for details).

	Biomass ('000 t)							
Snapshot	12	4	5A	5B	6	7	Total	c.v. (%)
1	23	114	81	11	86	32	348	17
2	69	104	159	23	98	25	478	28
3	143	32	52	30	135	18	410	28
Mean	78	83	97	22	106	25	412	15

Table 14: Acoustic abundance indices for WCSI. Indices were calculated using 'old' method updated from O'Driscoll (2002).

Year	Biomass ('000 t)	c.v.
1988	417	0.60
1989	249	0.38
1990	255	0.40
1991	341	0.73
1992	345	0.49
1993	549	0.38
1997	655	0.60
2000	397	0.60
2012	412	0.51

FIGURES

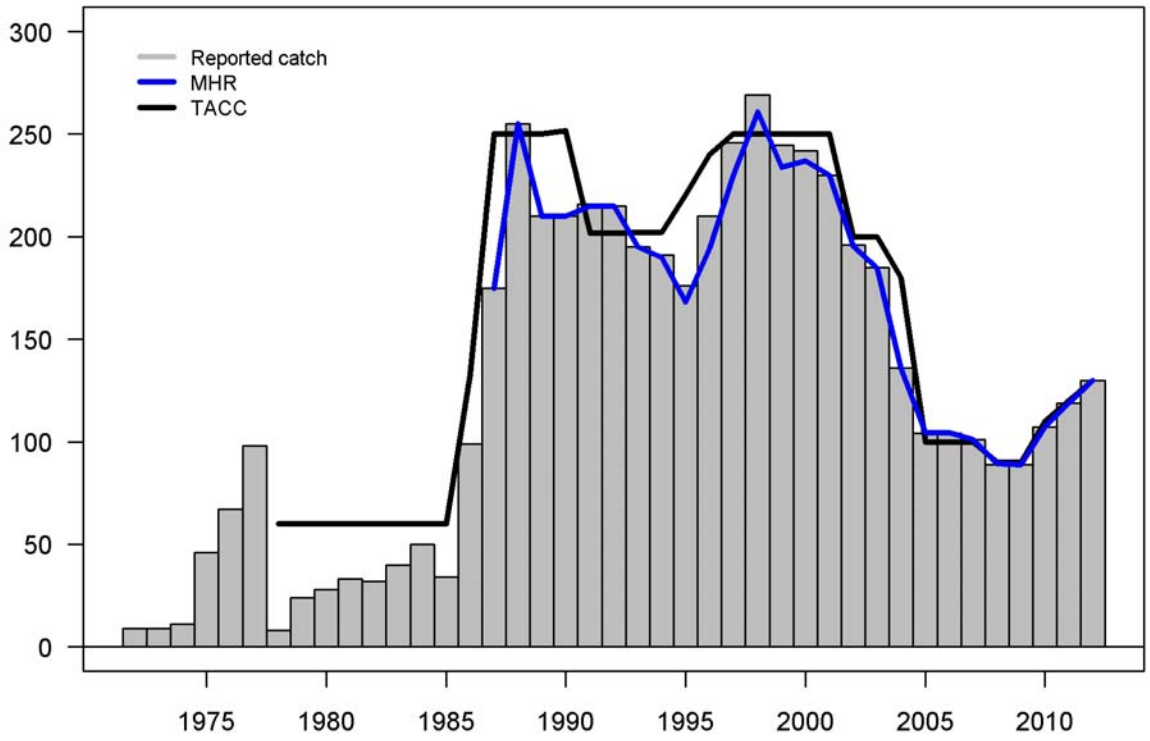


Figure 1: Total New Zealand hoki catch estimated from reported landings for calendar years 1972 to 1983 and fishing years 1983–84 (1984) to 2011–12.

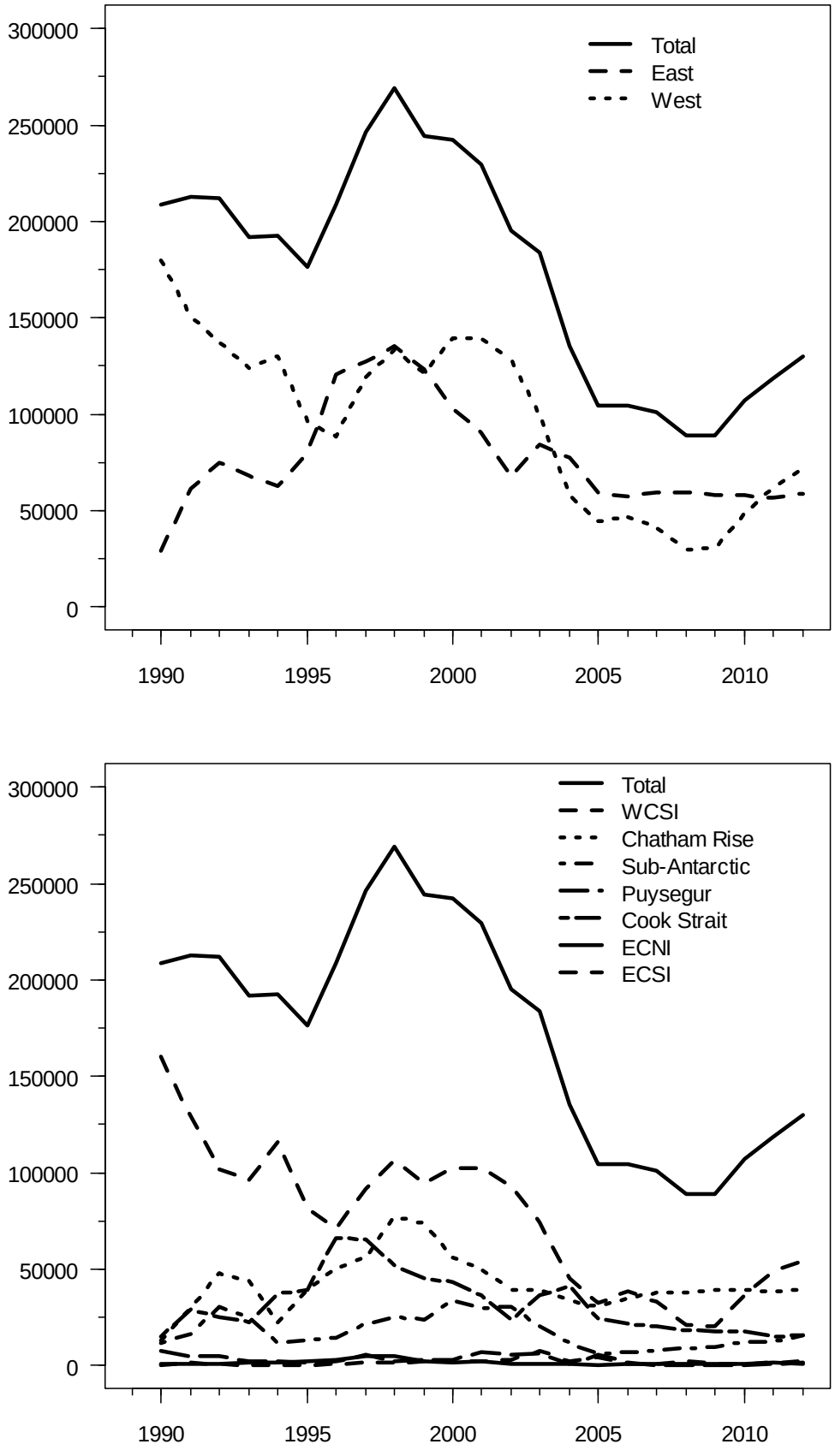


Figure 2a: Estimated total catch (t) of hoki by 'stock' area (upper panel) and fishing area (lower panel) from 1988–89 (1989) to 2011–12 (2012). "Eastern" areas include Chatham Rise, east coast South Island (ECSI), Cook Strait, and east coast North Island (ECNI). "Western" areas include west coast South Island (WCSI), Sub-Antarctic, and Puysegur.

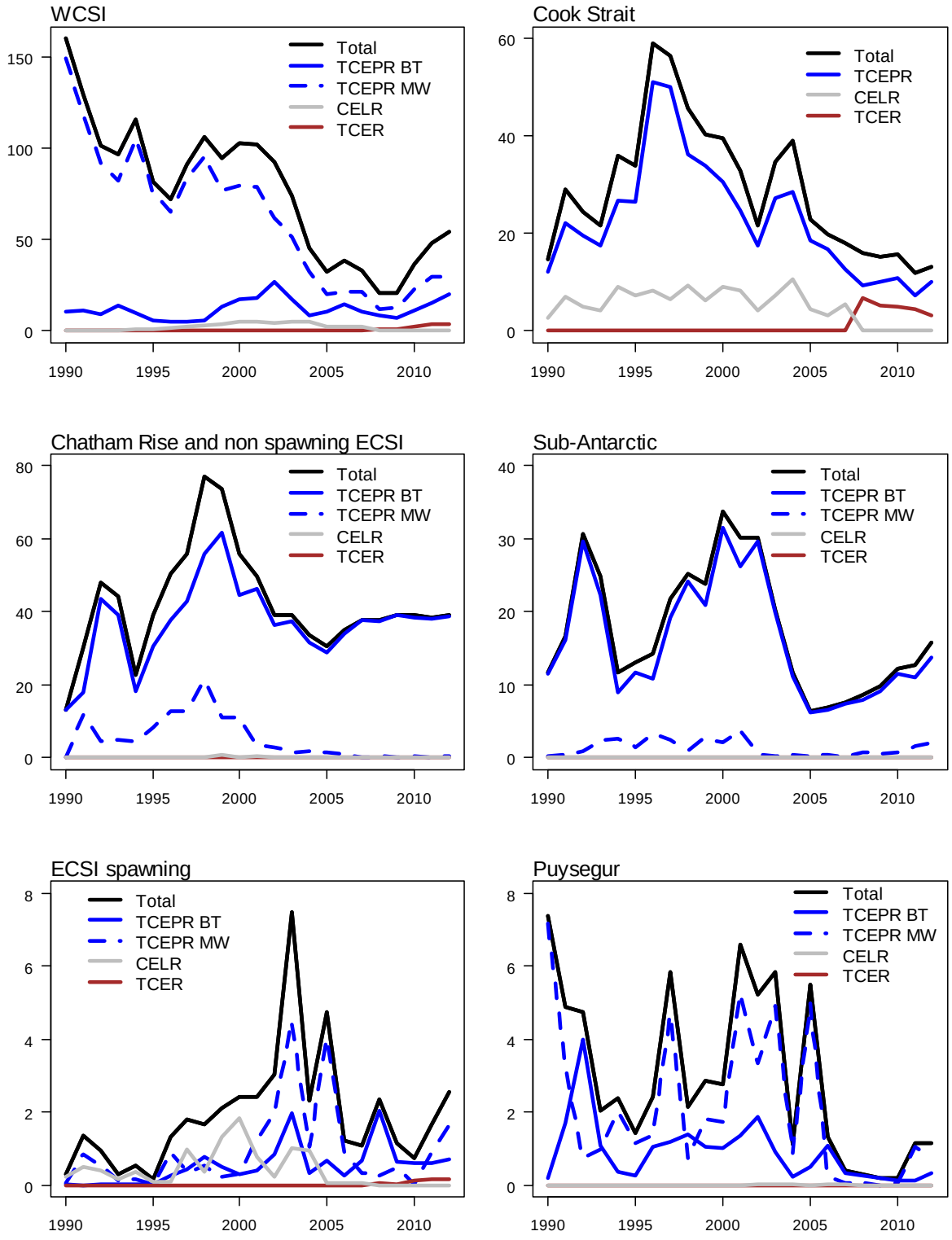
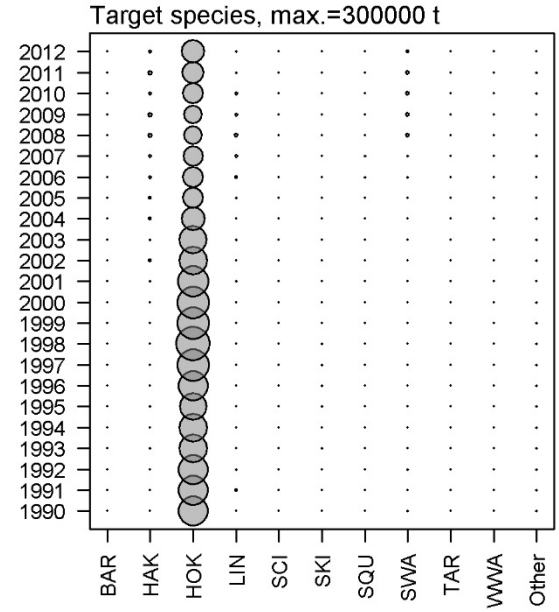


Figure 2b: Total catches and catches by form type by hoki area and fishing year. All areas (except Cook Strait) also show TCEPR data split by MW (midwater trawl) and BT (Bottom trawl). Sub-Antarctic and Puysegur have very little CELR or TCER data. There are no TCER or CELR catches for Sub-Antarctic.

(a)



(b)

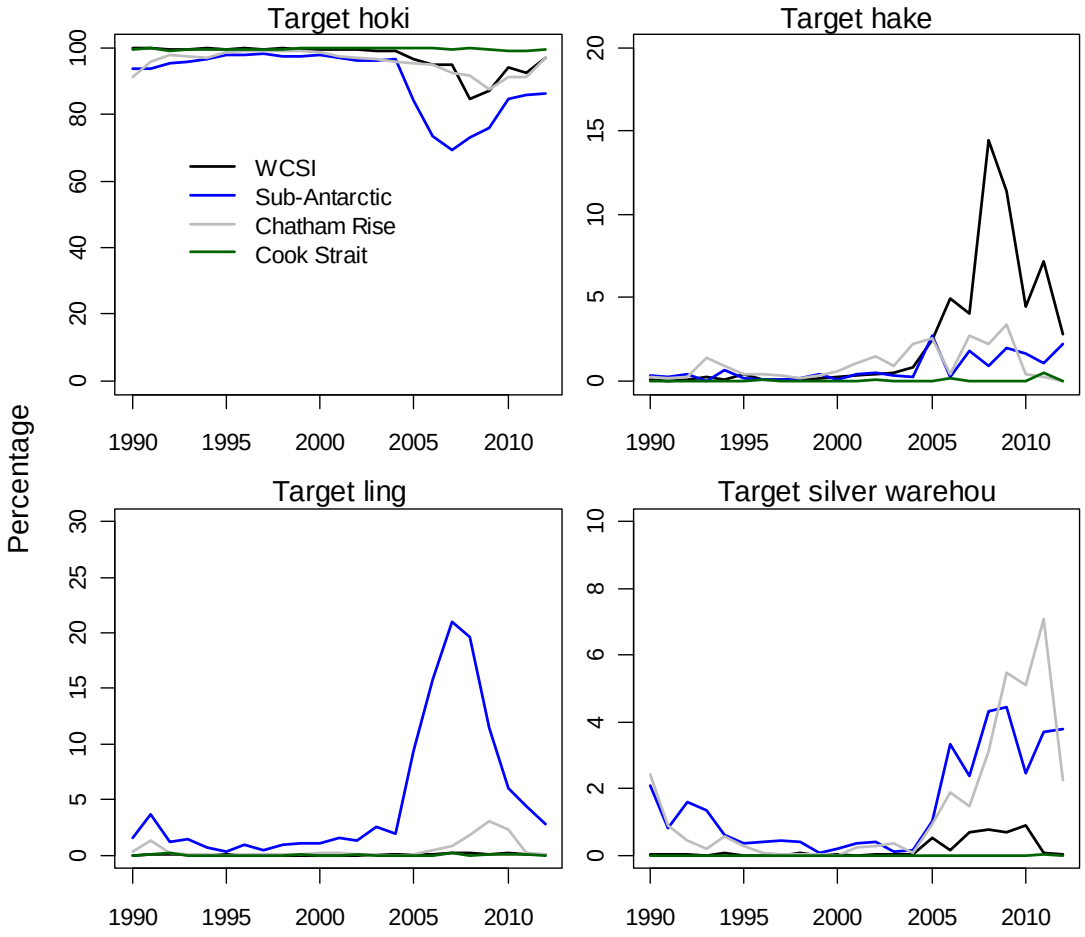
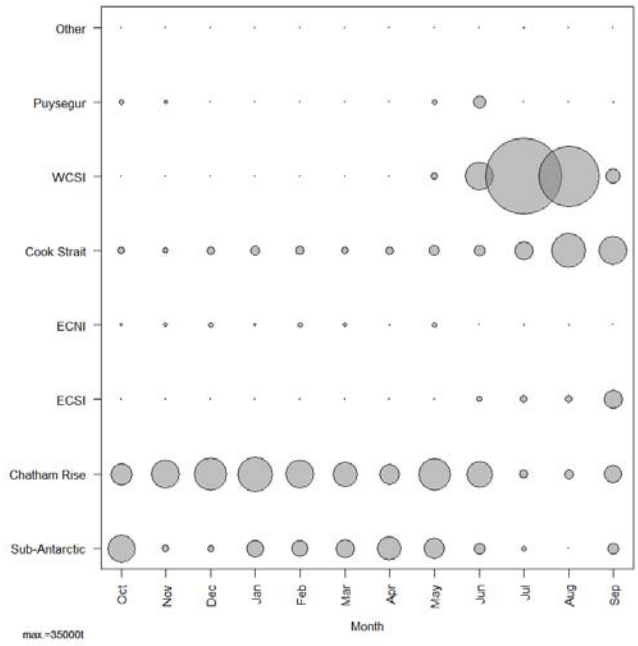


Figure 3: (a) Distribution of hoki catch by target species, and (b) percentage of hoki catch by hoki, hake, ling, and silver warehou target tows for the 1989–90 to 2011–12 fishing years.

(a)



(b)

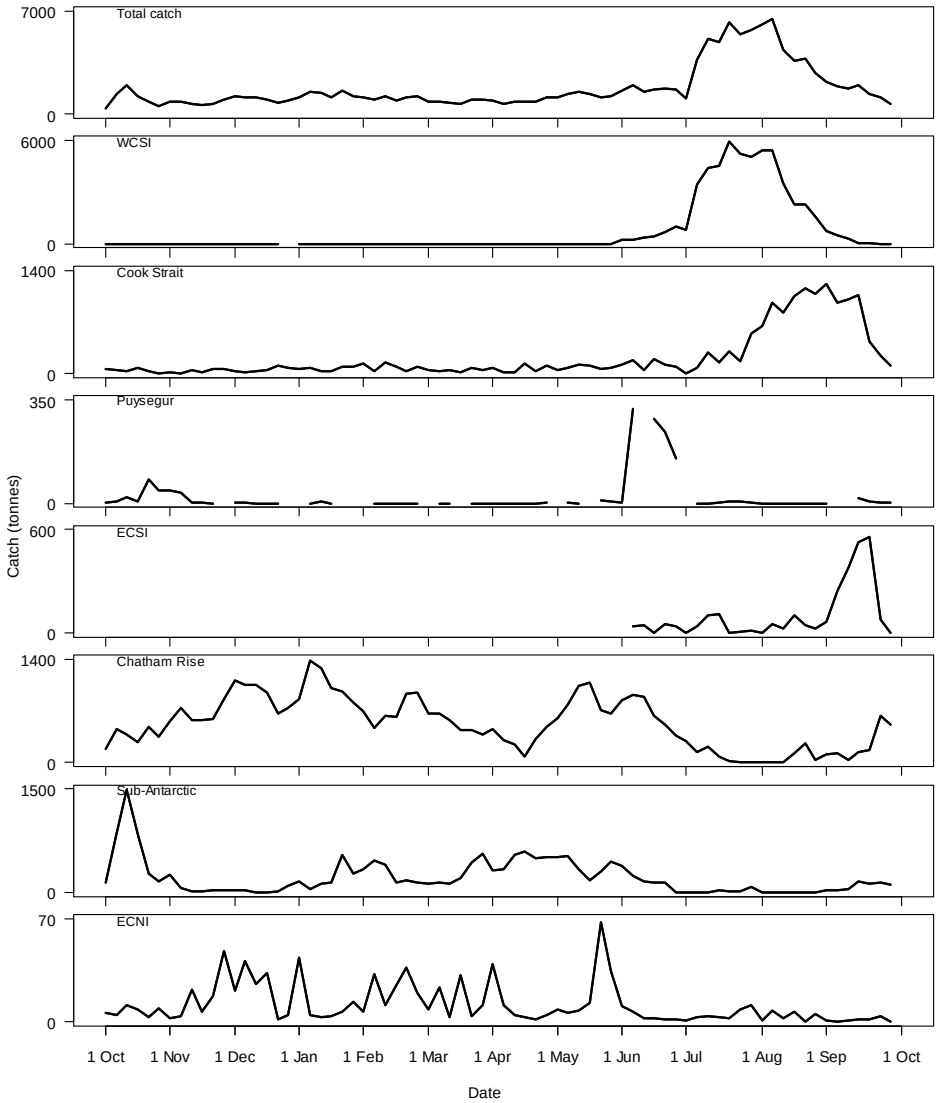


Figure 4: (a) Hoki catch by month and area (maximum circle size is 25 000 t) and (b) distribution of hoki catch (in 5 day bins) by area in the 2011–12 fishing year.

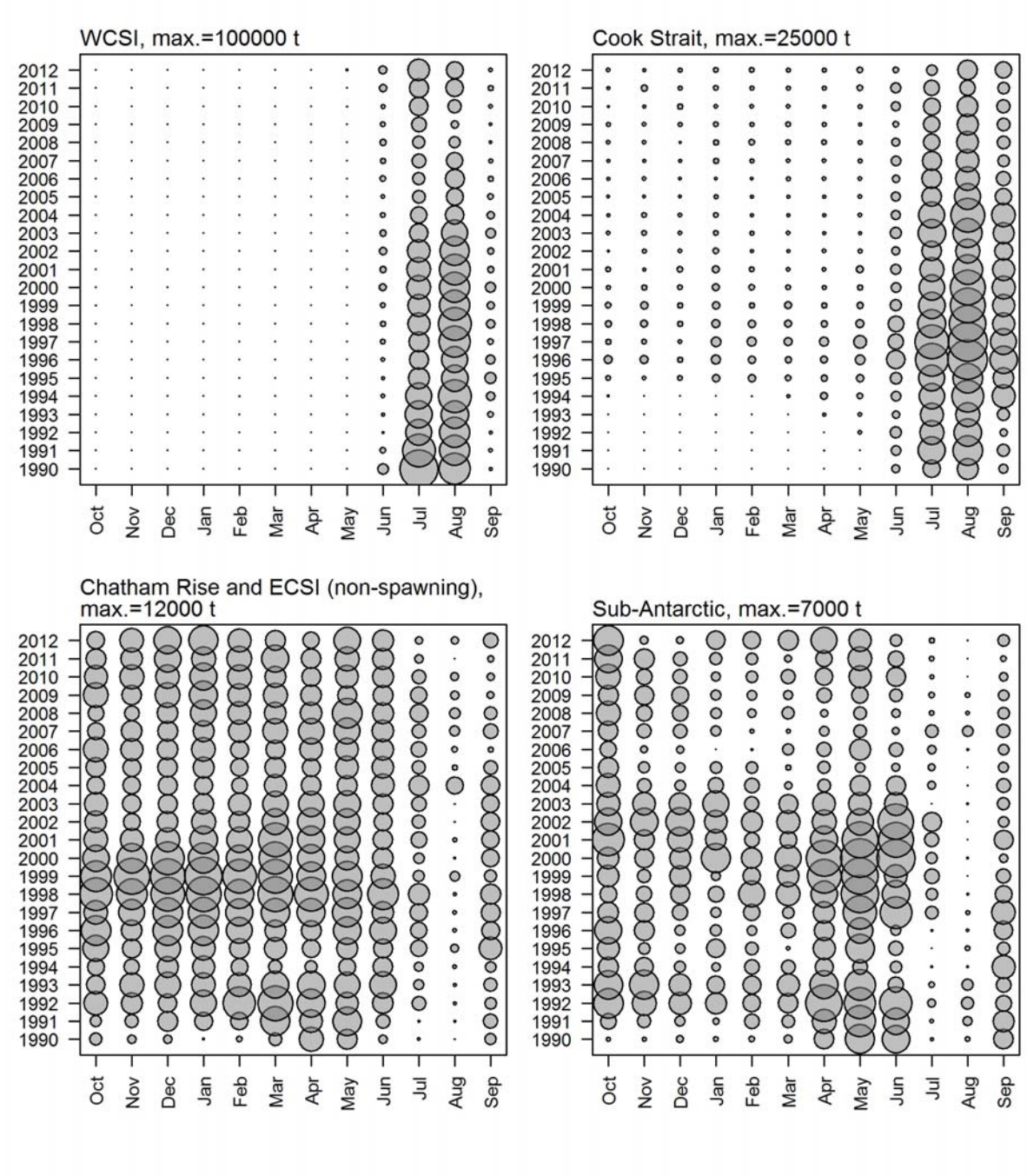


Figure 5: Distribution of hoki catch by month and area for the 1989–90 to 2011–12 fishing years.

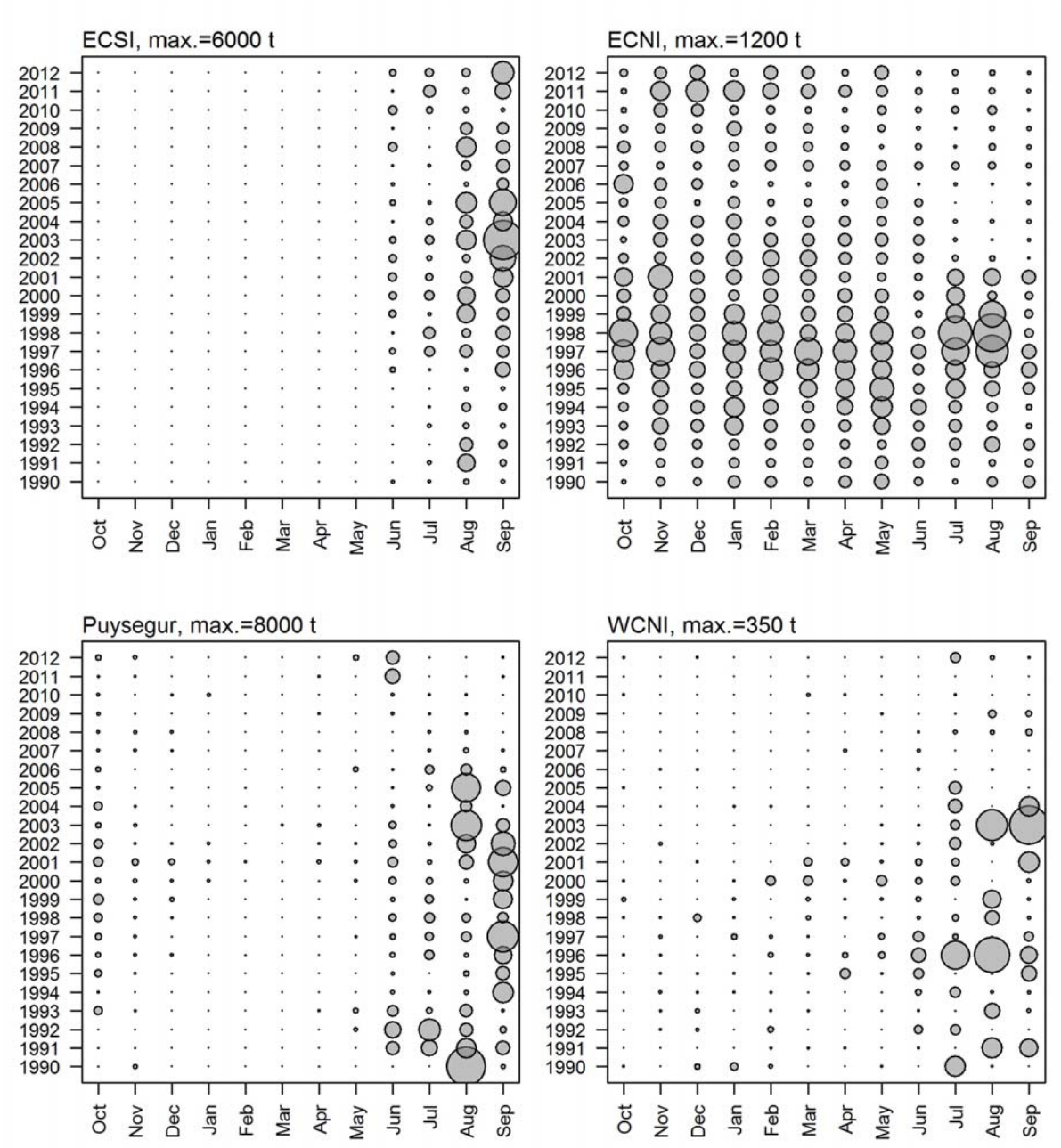
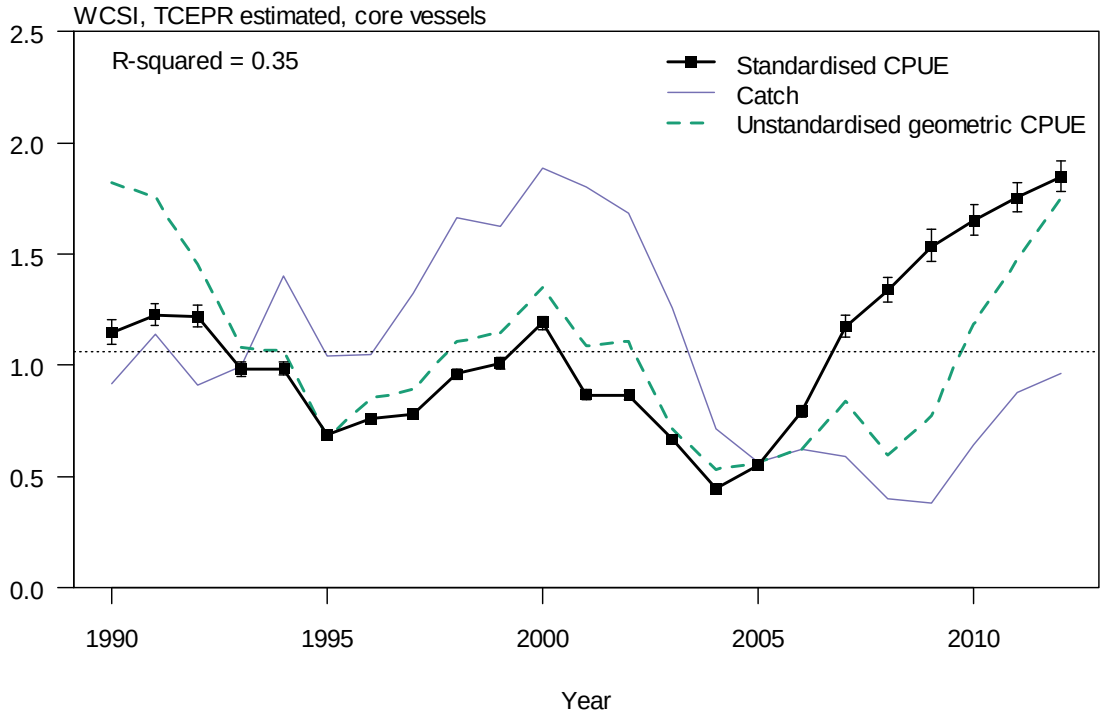

ECSI, max.=6000 t
ECNI, max.=1200 t
Puysegur, max.=8000 t
WCNI, max.=350 t
2012
2011
2010
2009
2008
2007
2006
2005
2004
2003
2002
2001
2000
1999
1998
1997
1996
1995
1994
1993
1992
1991
1990
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep

Figure 5 ctd.



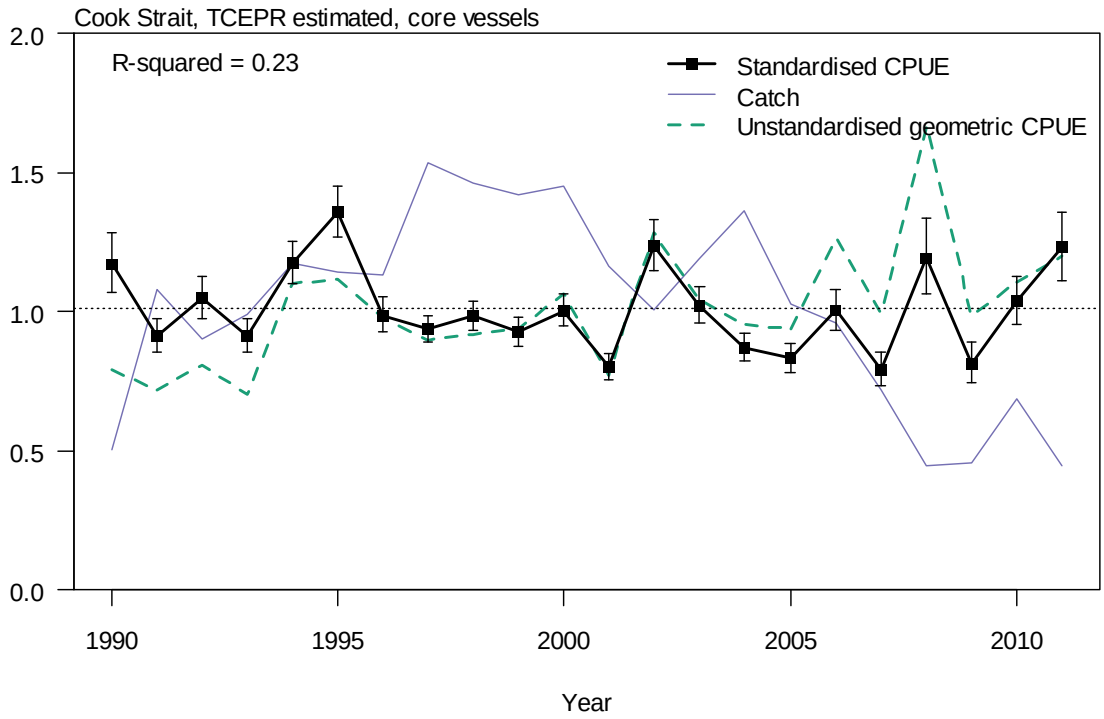
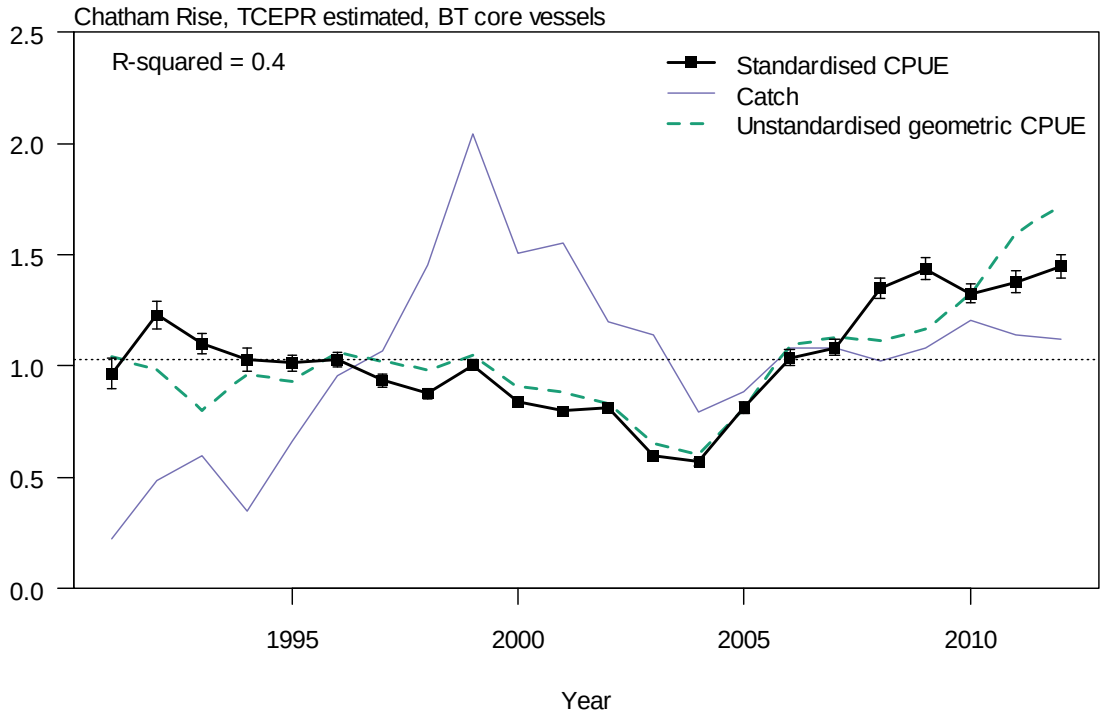


Figure 6a: Model catch, and unstandardised geometric and standardised CPUE indices by area for core data hoki tows for 1990–2012. Datasets for Chatham Rise and ECSI, and Sub-Antarctic included only bottom tows, and Cook Strait included only midwater tows.



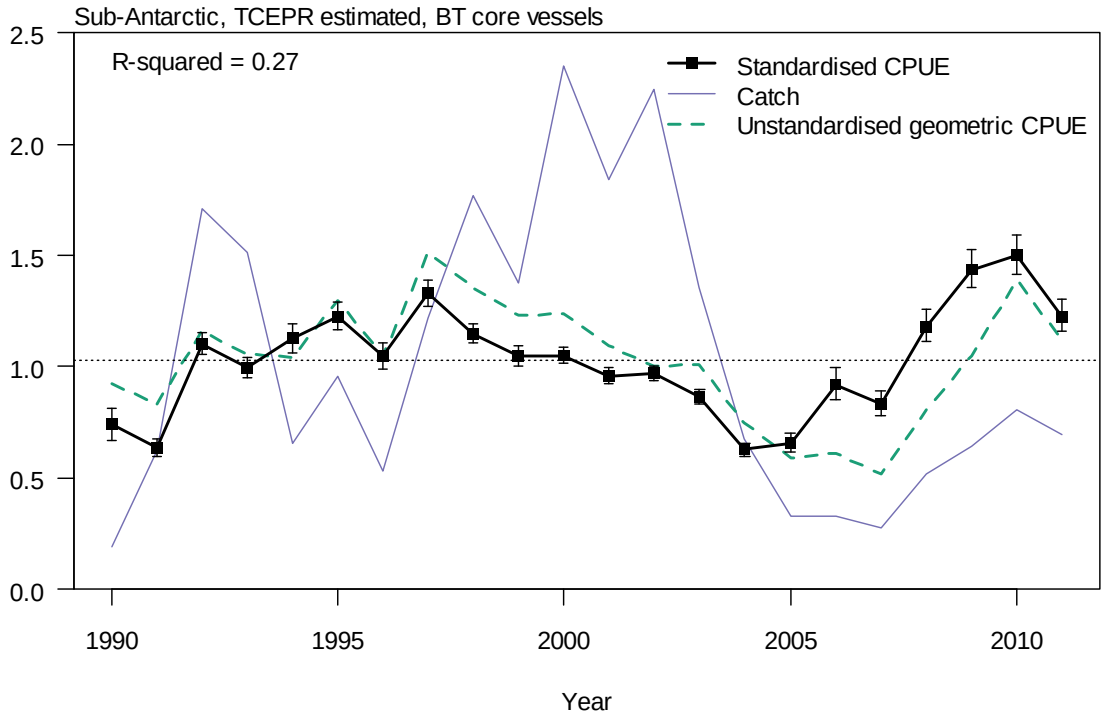


Figure 6a ctd.

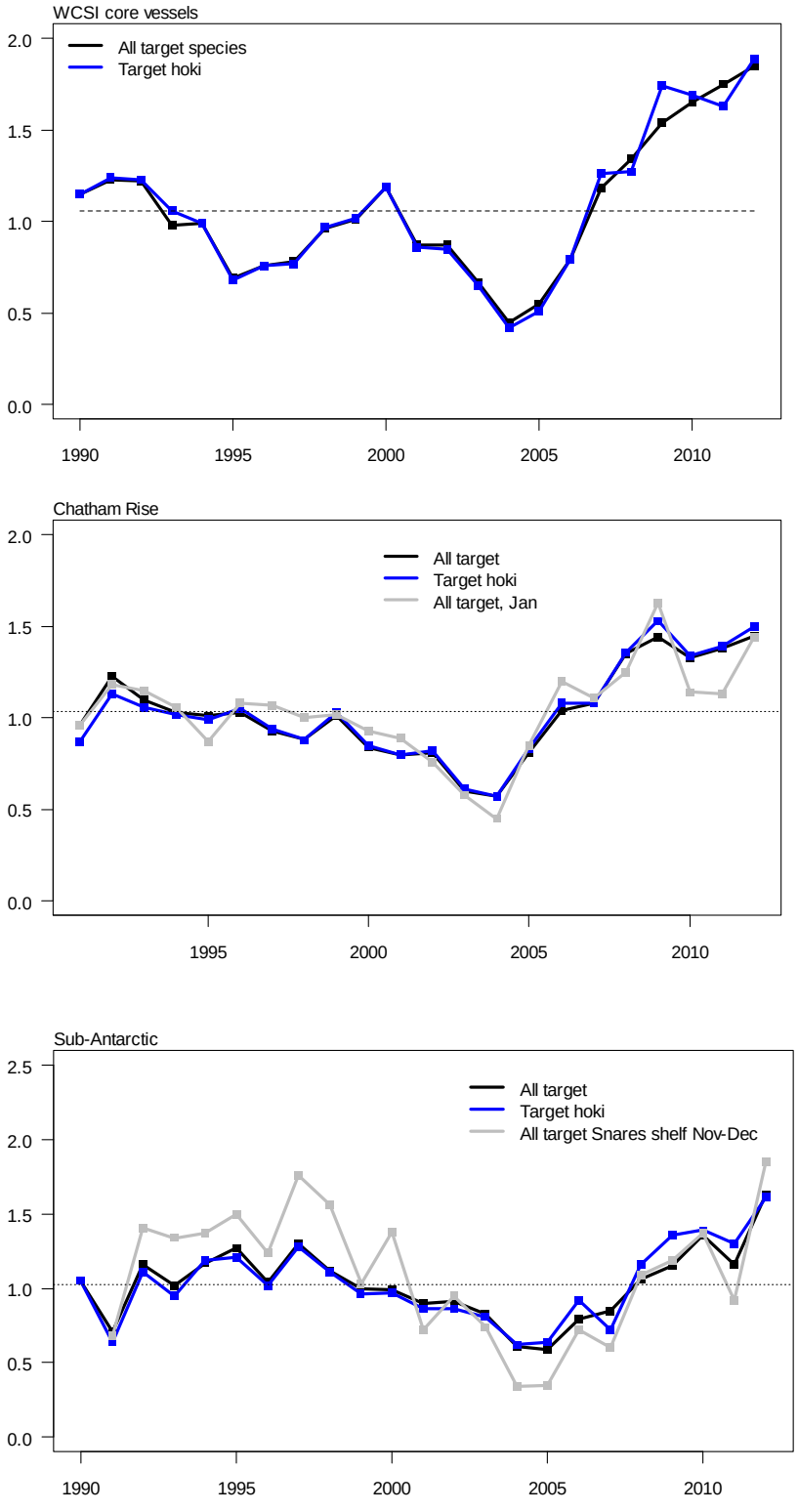


Figure 6b: Comparison of relative standardised CPUE indices from model runs for each area.

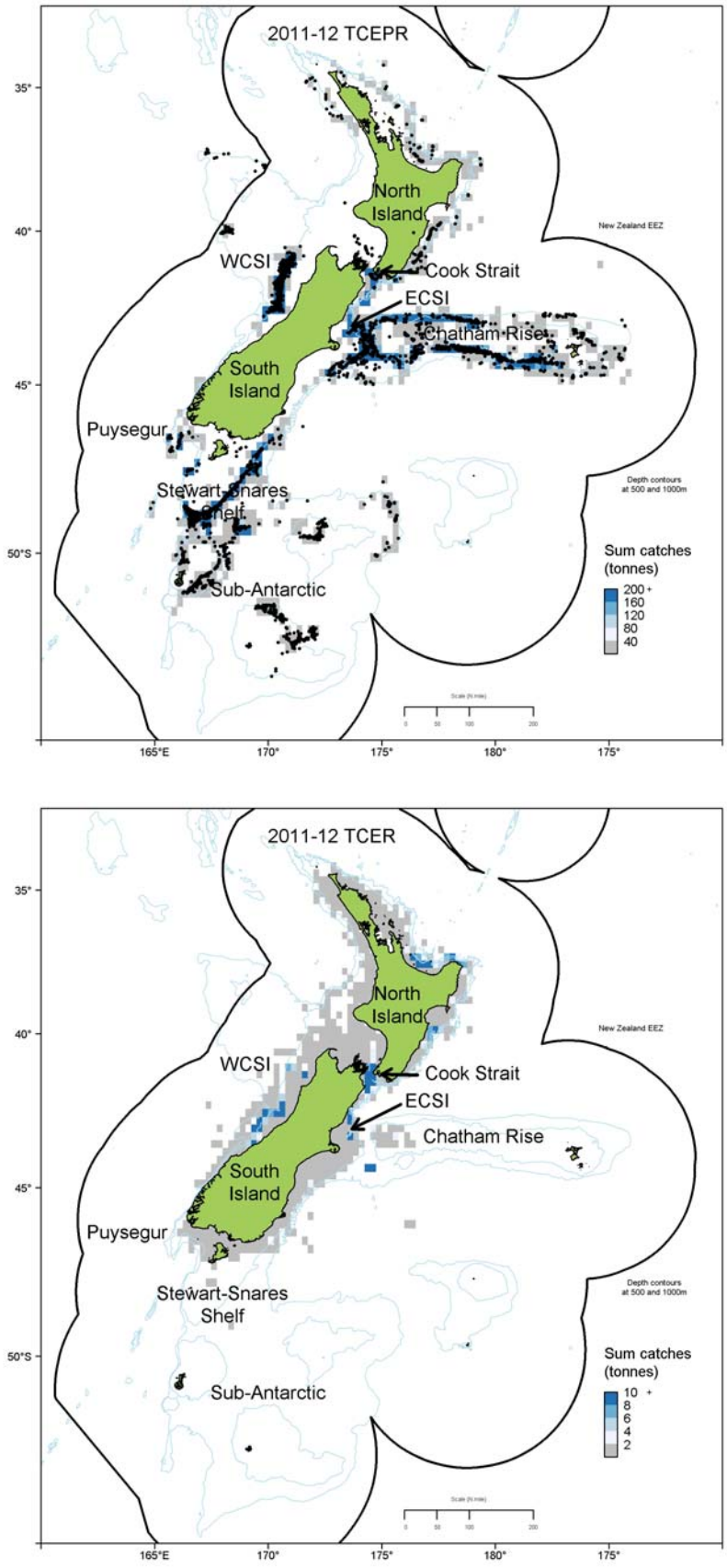


Figure 7: Density plots of all commercial TCEPR and TCER trawls where hoki was caught in the 2011–12 fishing year. TCEPR plot also shows observed positions as black dots.

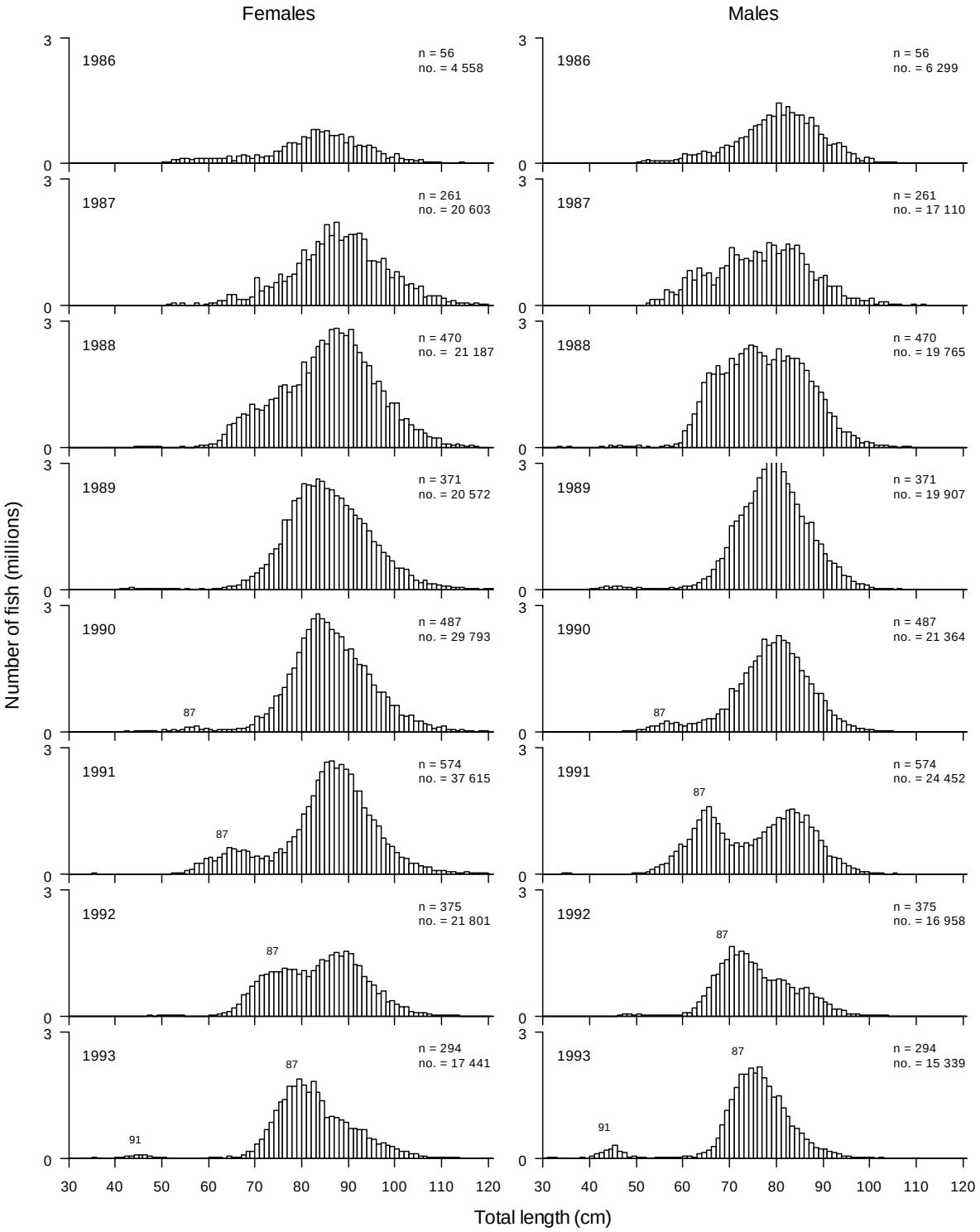


Figure 8: Length frequency of hoki in commercial catches from the west coast South Island spawning fishery from 1989 to 1993 sampled at sea by the Observer Programme. n, number of tows sampled; no., number of fish sampled. Numbers above the histograms mark estimated year-class modes, e.g., 91 = 1991 year-class.

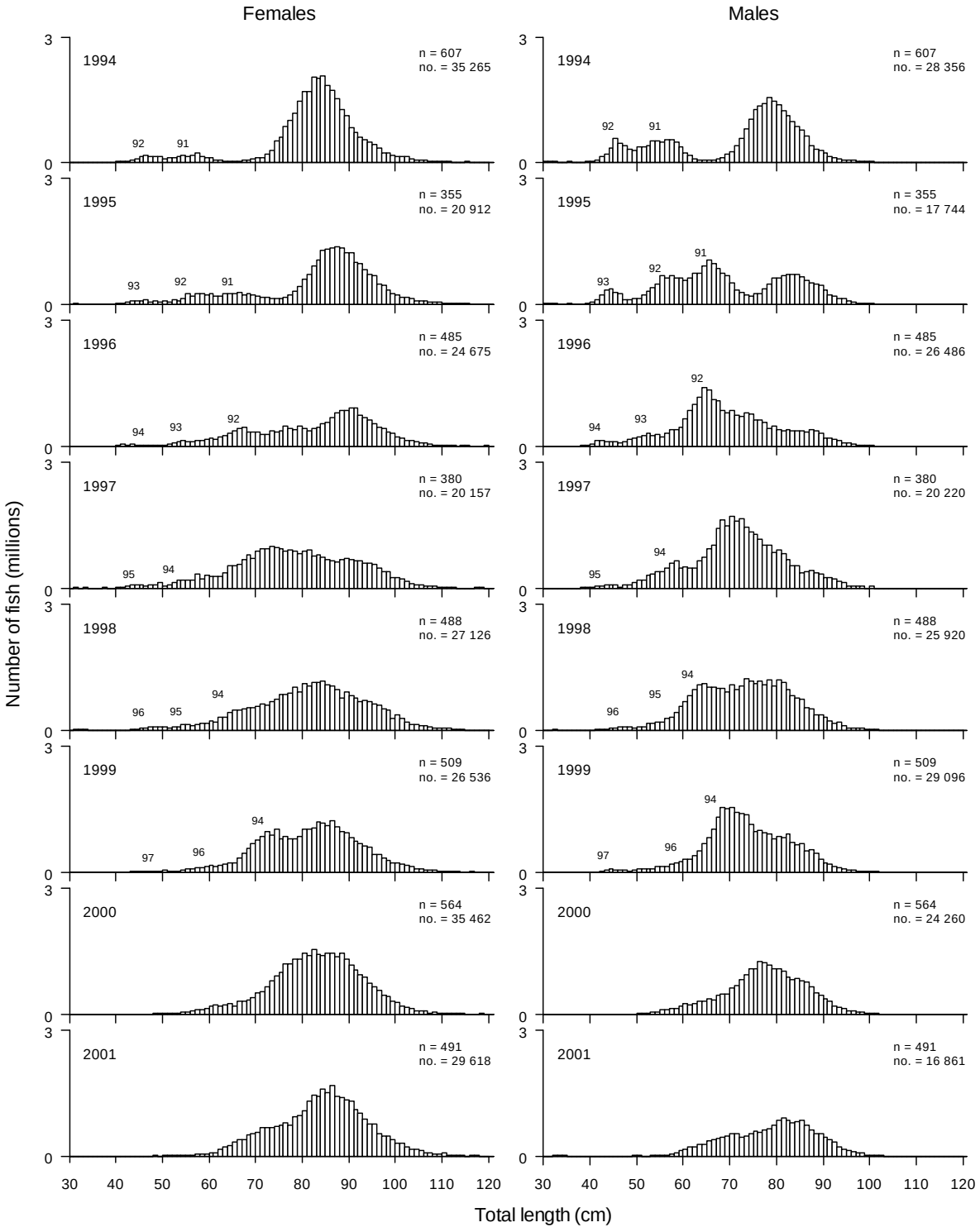


Figure 8 ctd. Length frequency of hoki in commercial catches from the west coast South Island spawning fishery from 1994 to 2001 sampled at sea by the Observer Programme. n, number of tows sampled; no., number of fish sampled. Numbers above the histograms mark estimated year-class modes, e.g., 91 = 1991 year-class.

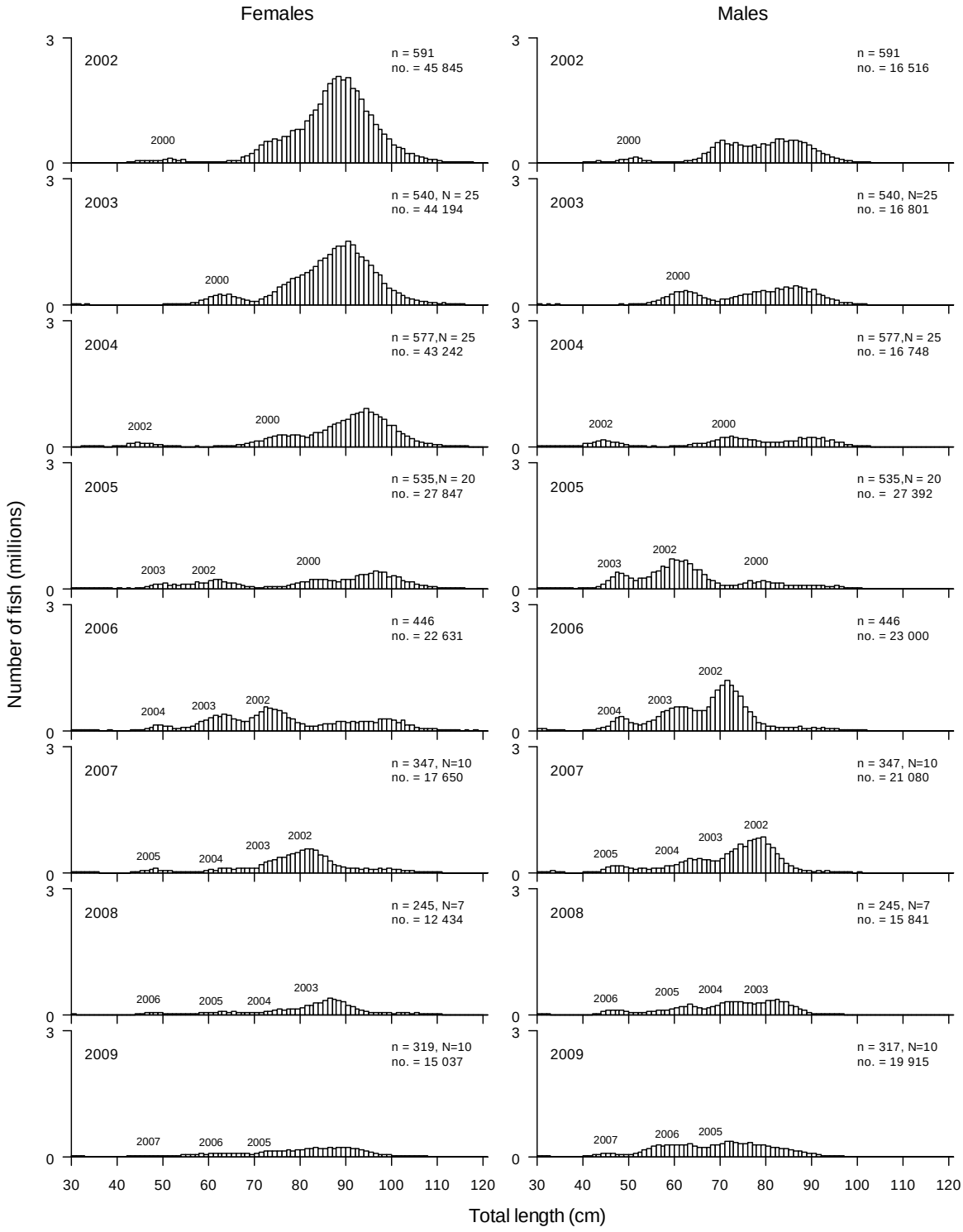


Figure 8 ctd. Length frequency of hoki in commercial catches from the west coast South Island spawning fishery from 2002 to 2009. In 2003–05 and 2007–09, Observer Programme data are combined with samples of landings from inside the 25 n. mile line sampled by NIWA. n, number of tows sampled; no., number of fish sampled; N, number of landings sampled. Numbers above the histograms mark estimated year-class modes, e.g., 2004 = 2004 year-class.

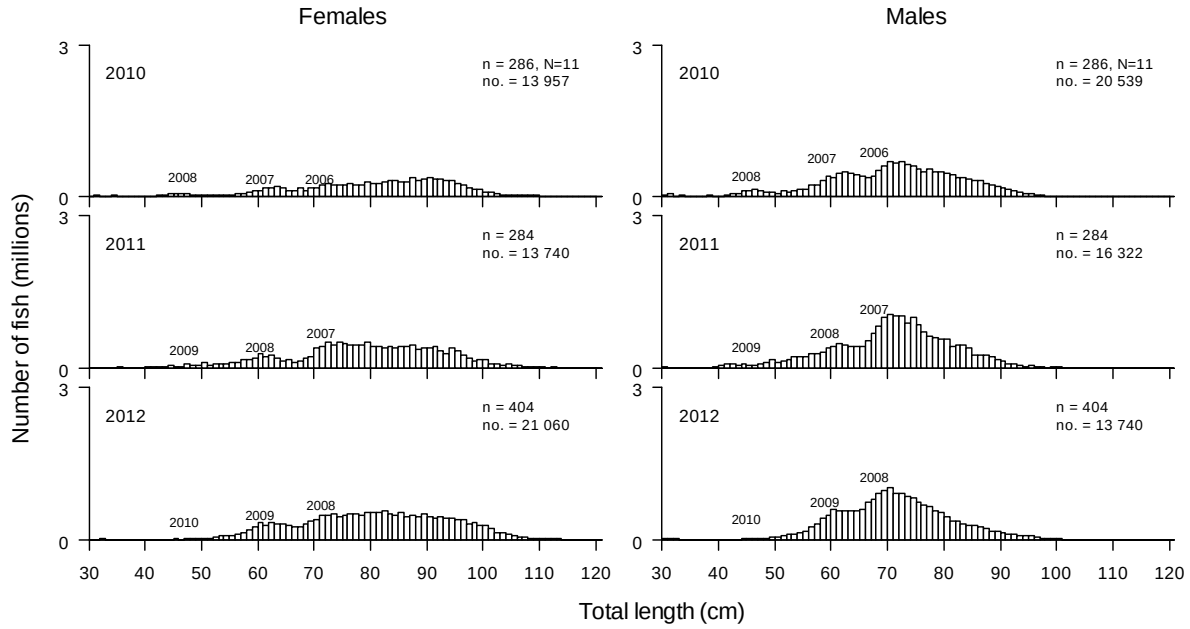


Figure 8 ctd. Length frequency of hoki in commercial catches from the west coast South Island spawning fishery from 2010 to 2012. In 2010, Observer Programme data are combined with samples of landings from inside the 25 n. mile line sampled by NIWA, and in 2011 and 2012 there is only Observer data outside the 25 n. mile line. n, number of tows sampled; no., number of fish sampled; N, number of landings sampled. Numbers above the histograms mark estimated year-class modes, e.g., 2007 = 2007 year-class.

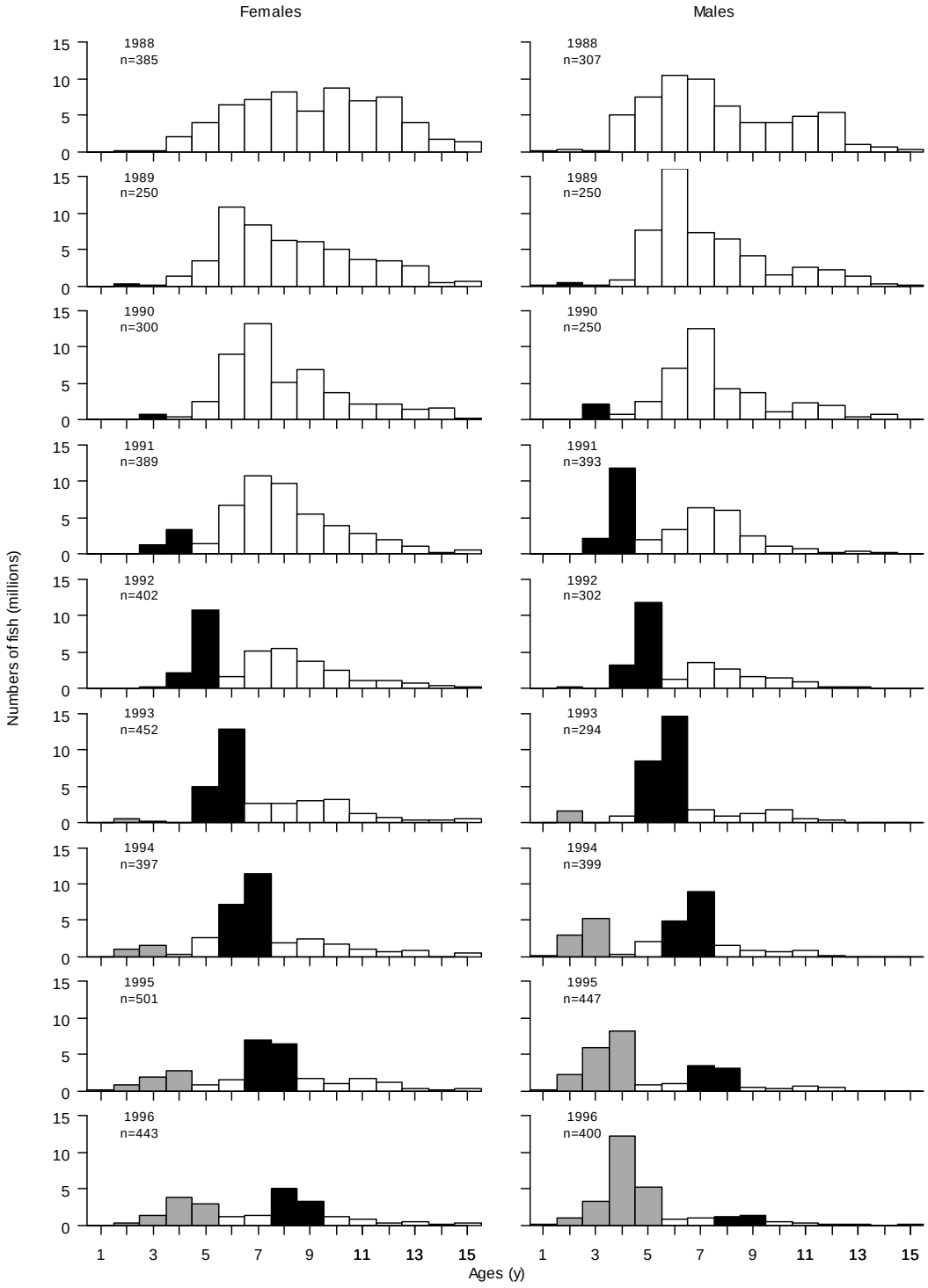


Figure 9: Catch at age of hoki in commercial catches from the west coast South Island spawning fishery from 1988 to 2012. n, number of fish aged. Black bars for the years 1990 to 2000 show 1987 and 1988 year-classes, grey bars show 1991–94 year-classes, and light grey bars in the 2004–2012 seasons represent the 2002 and 2003 year-classes.

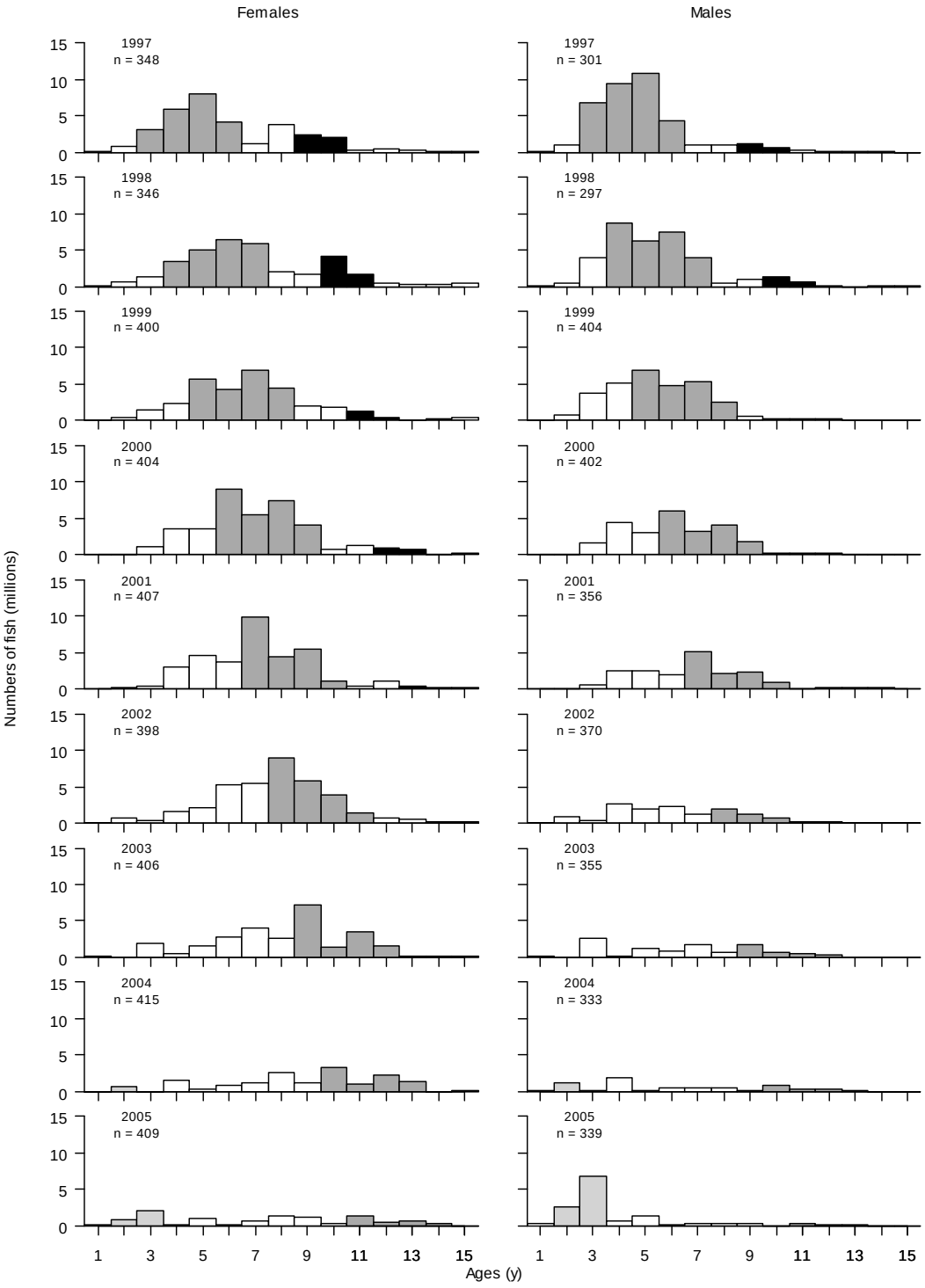

Females
Males
1997
n = 348
1997
n = 301
1998
n = 346
1998
n = 297
1999
n = 400
1999
n = 404
2000
n = 404
2000
n = 402
2001
n = 407
2001
n = 356
2002
n = 398
2002
n = 370
2003
n = 406
2003
n = 355
2004
n = 415
2004
n = 333
2005
n = 409
2005
n = 339
Numbers of fish (millions)
Ages (y)

Figure 9 ctd.

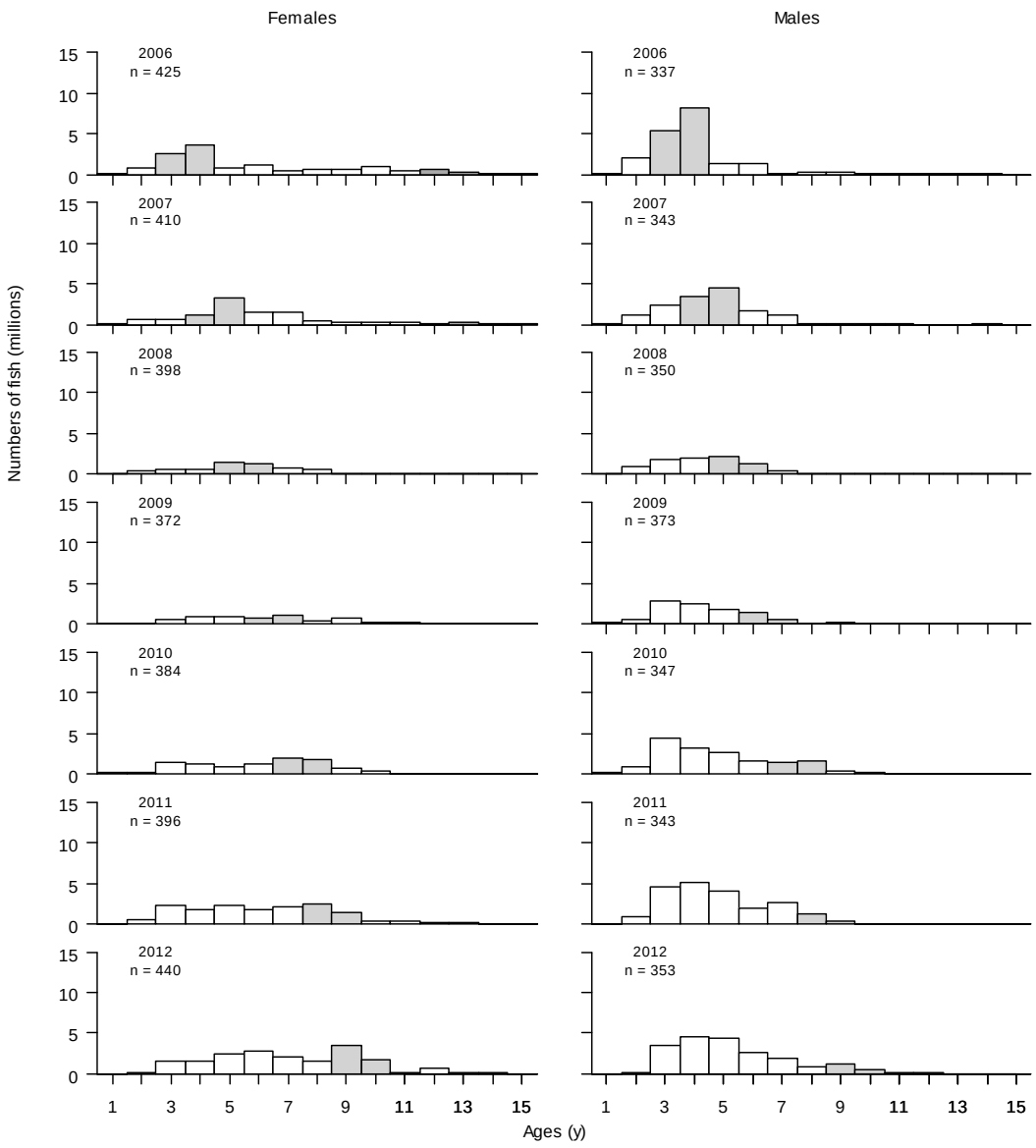

Females
Males
2006
n = 425
2006
n = 337
2007
n = 410
2007
n = 343
2008
n = 398
2008
n = 350
2009
n = 372
2009
n = 373
2010
n = 384
2010
n = 347
2011
n = 396
2011
n = 343
2012
n = 440
2012
n = 353
Numbers of fish (millions)
Ages (y)

Figure 9 ctd.

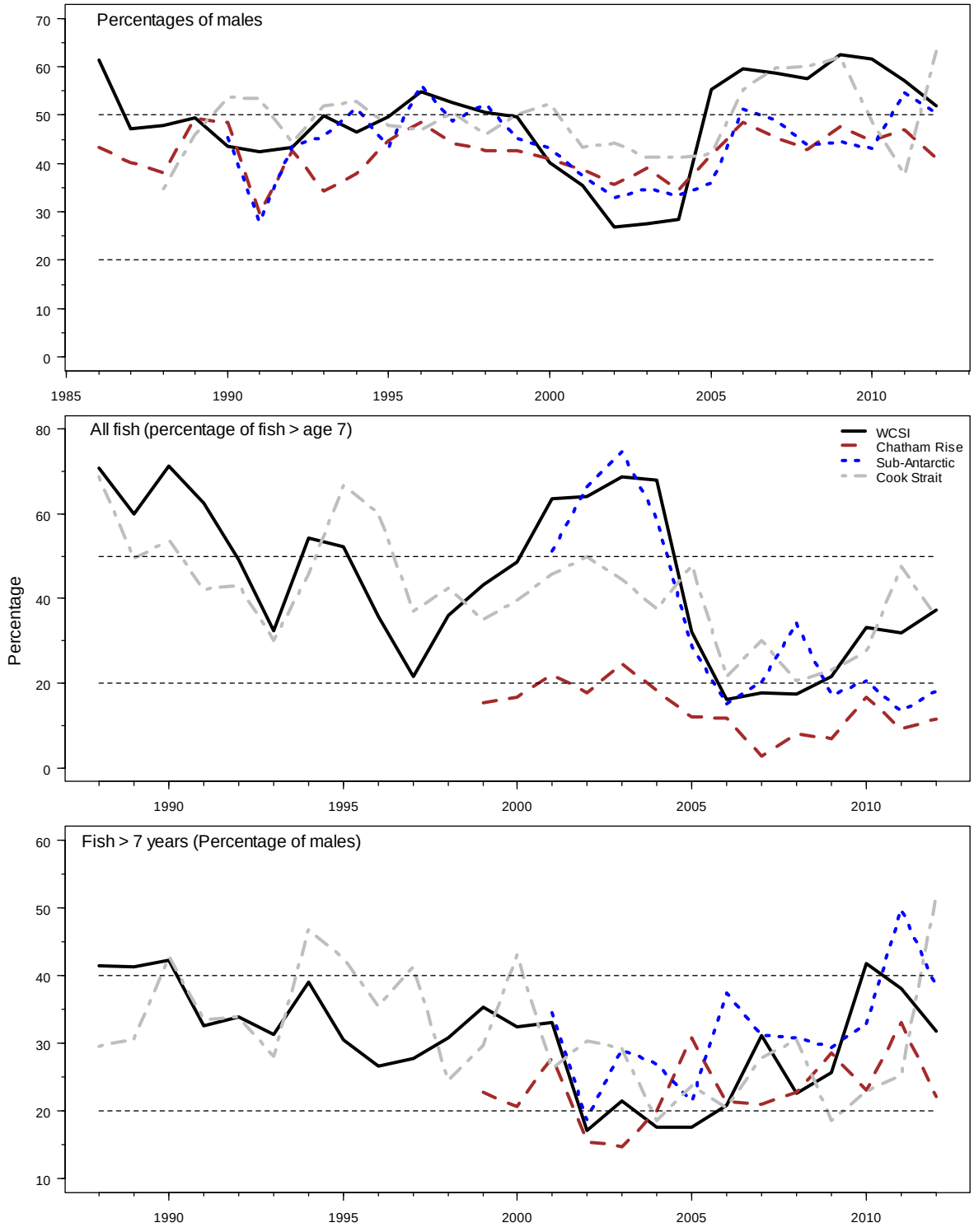


Figure 10a: Percentage of males in the catch, percentage of all fish aged 7 and older in the catch, and percentage of male fish (of those over age 7) in the catch, by area and fishing year.

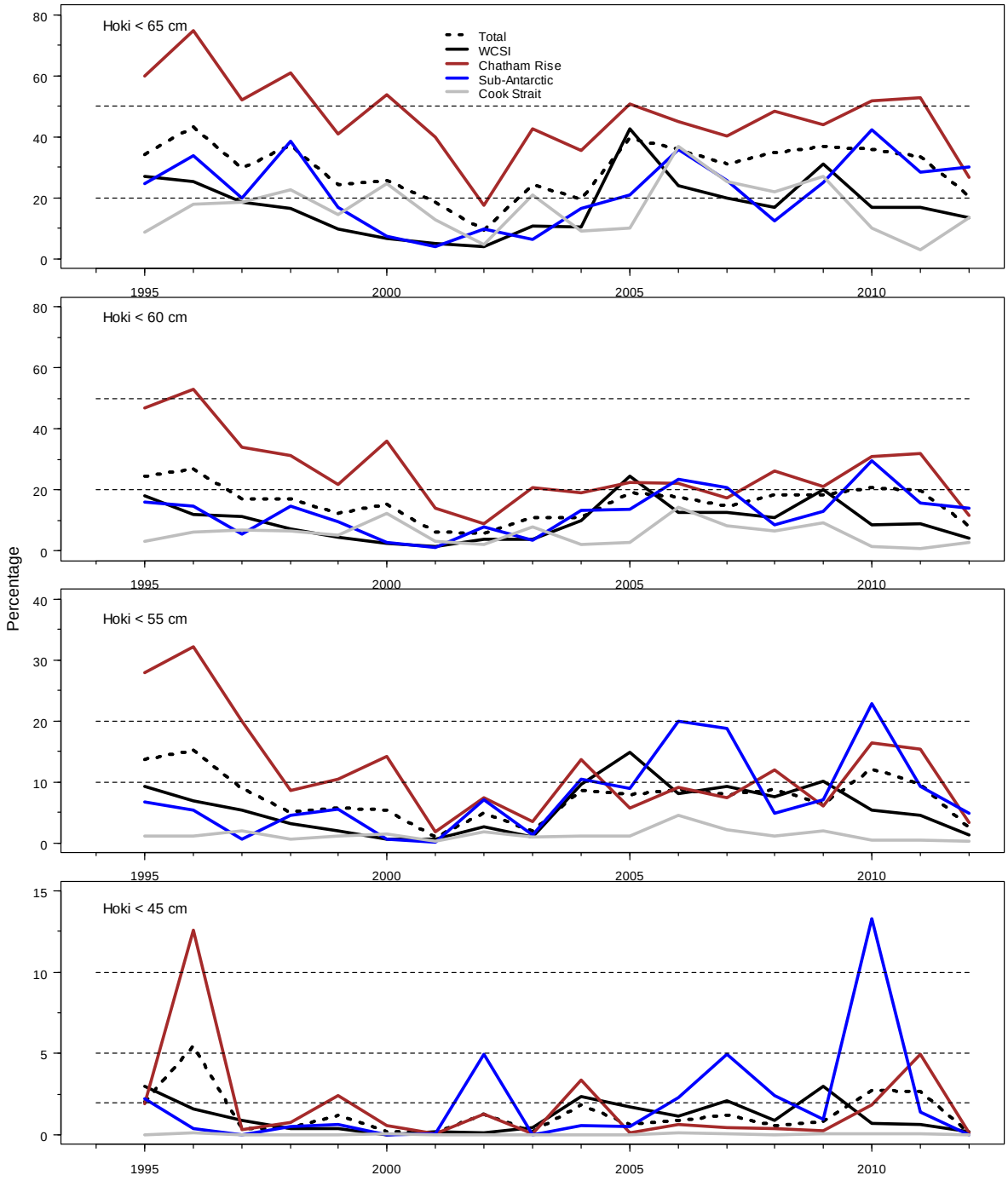


Figure 10b: Percentage of small fish in the catch by area and fishing year.

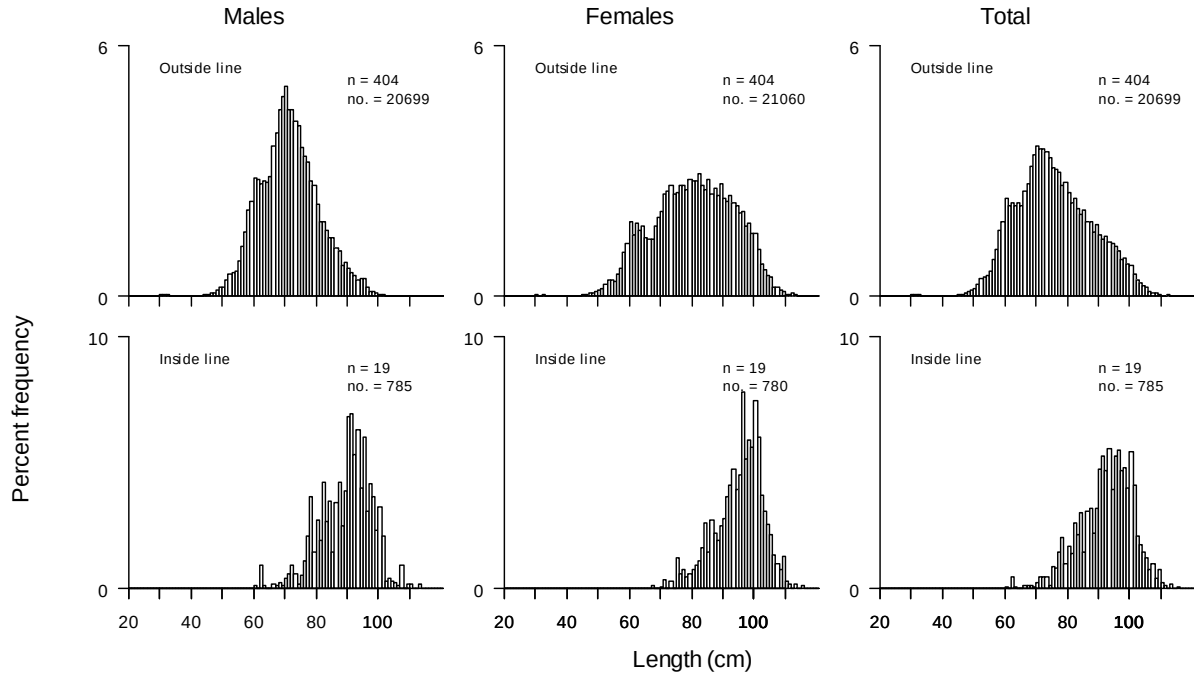


Figure 11: Comparison of length frequencies from inside and outside the 25 n. mile line sampled by sampled at sea by the Observer Programme in 2012. n, number of landings or tows sampled; no., number of fish sampled.

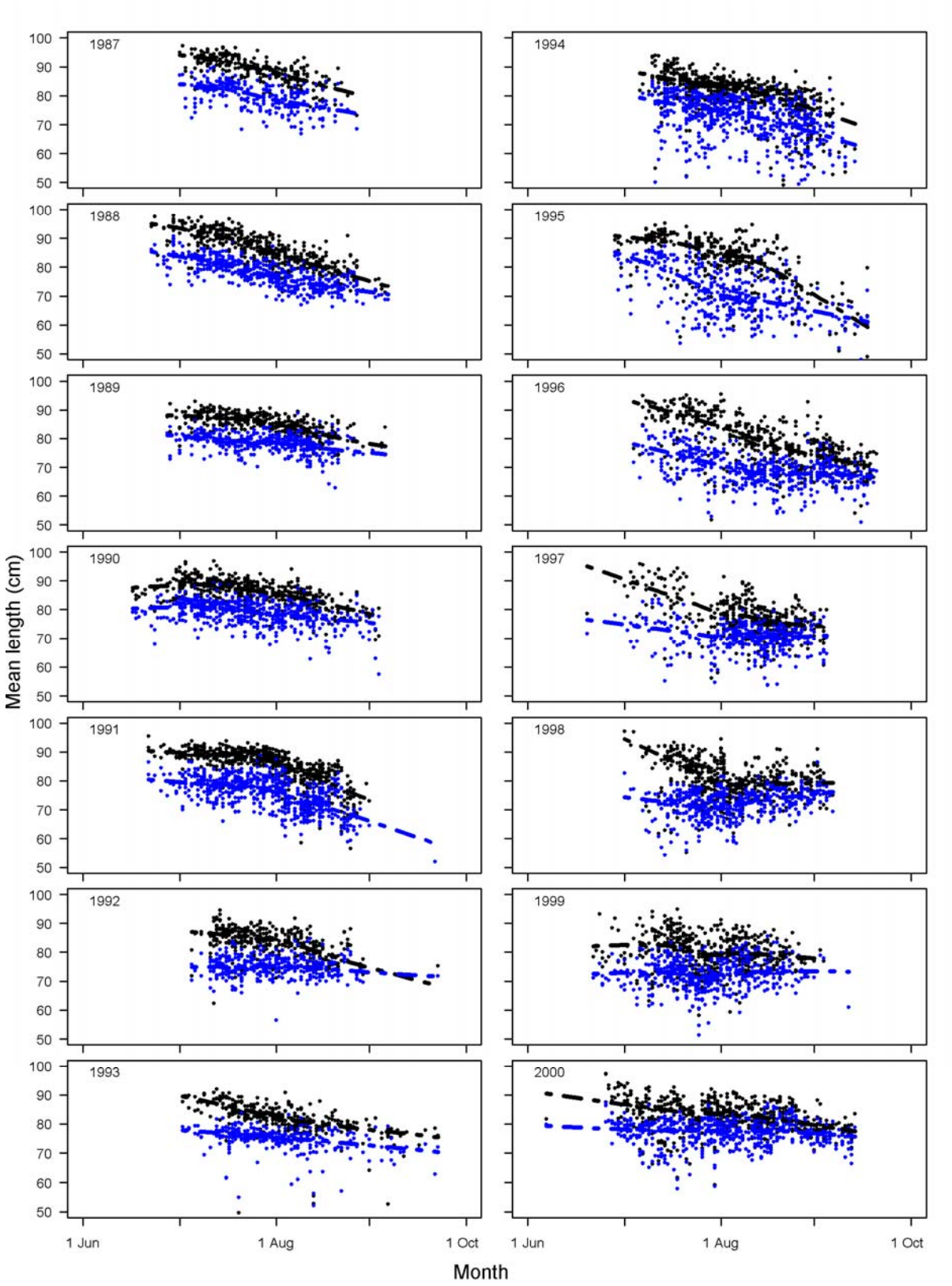


Figure 12: Mean length of female (black) and male (blue) hoki taken in commercial catches from the west coast South Island spawning fishery 1987–2000 sampled at sea by the Observer Programme. Lines are a loess fit.

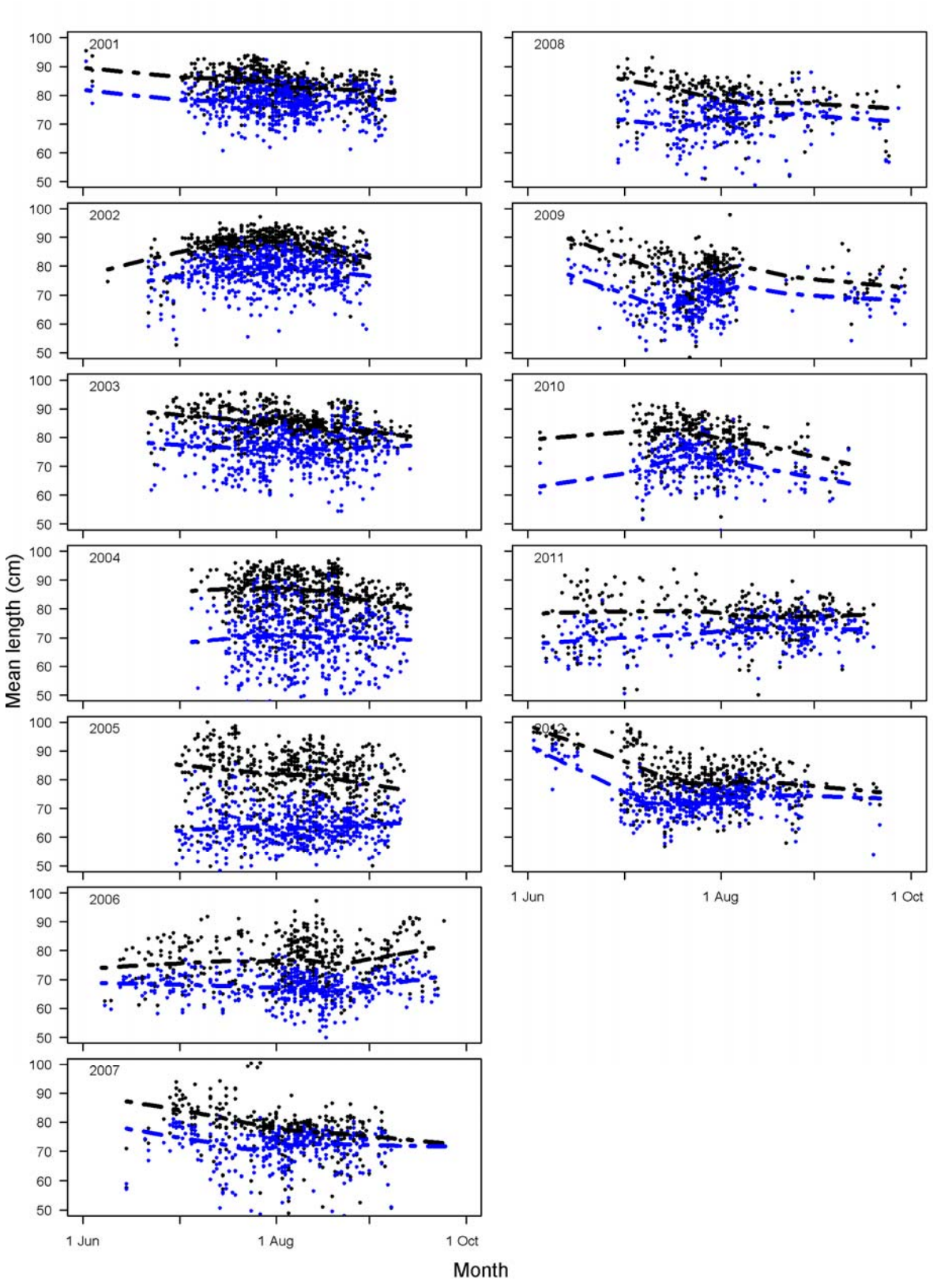


Figure 12 ctd.

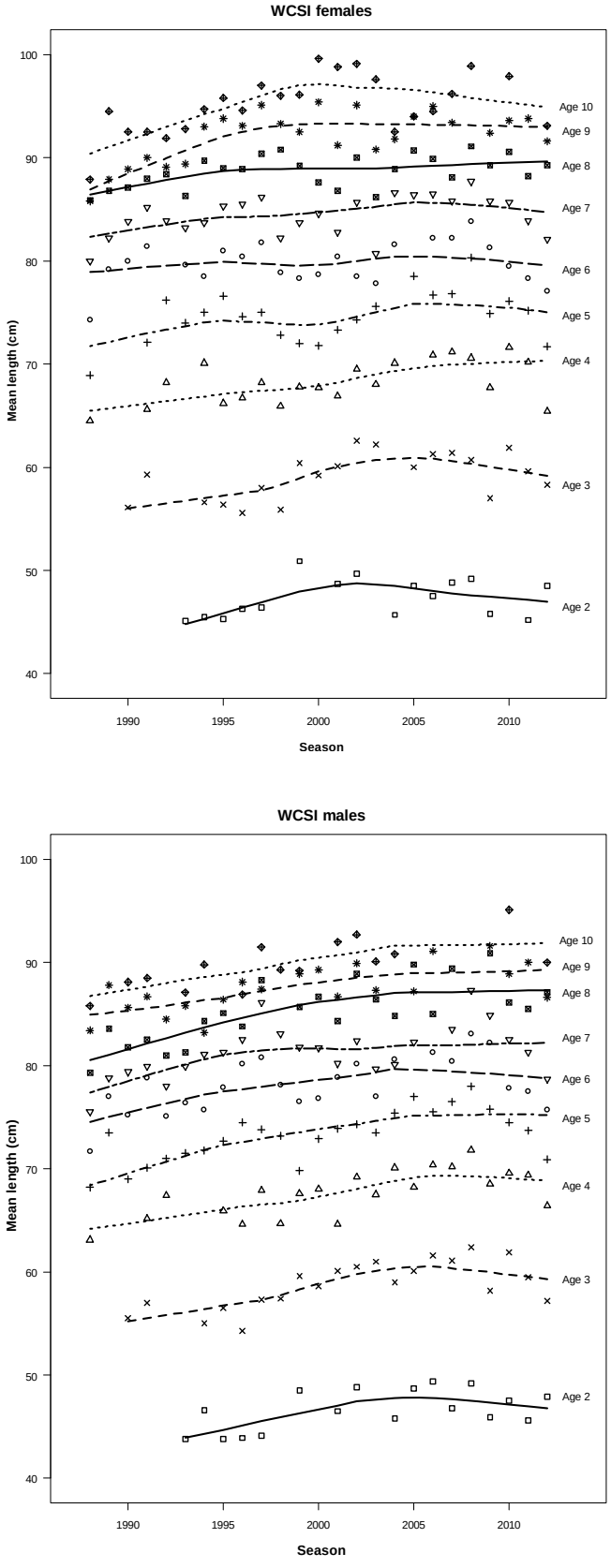


Figure 13: Mean length at age of female and male hoki taken in commercial catches from the west coast South Island spawning fishery 1988–2012 sampled at sea by the Observer Programme. Lines are a loess fit. Points with fewer than ten records are excluded.

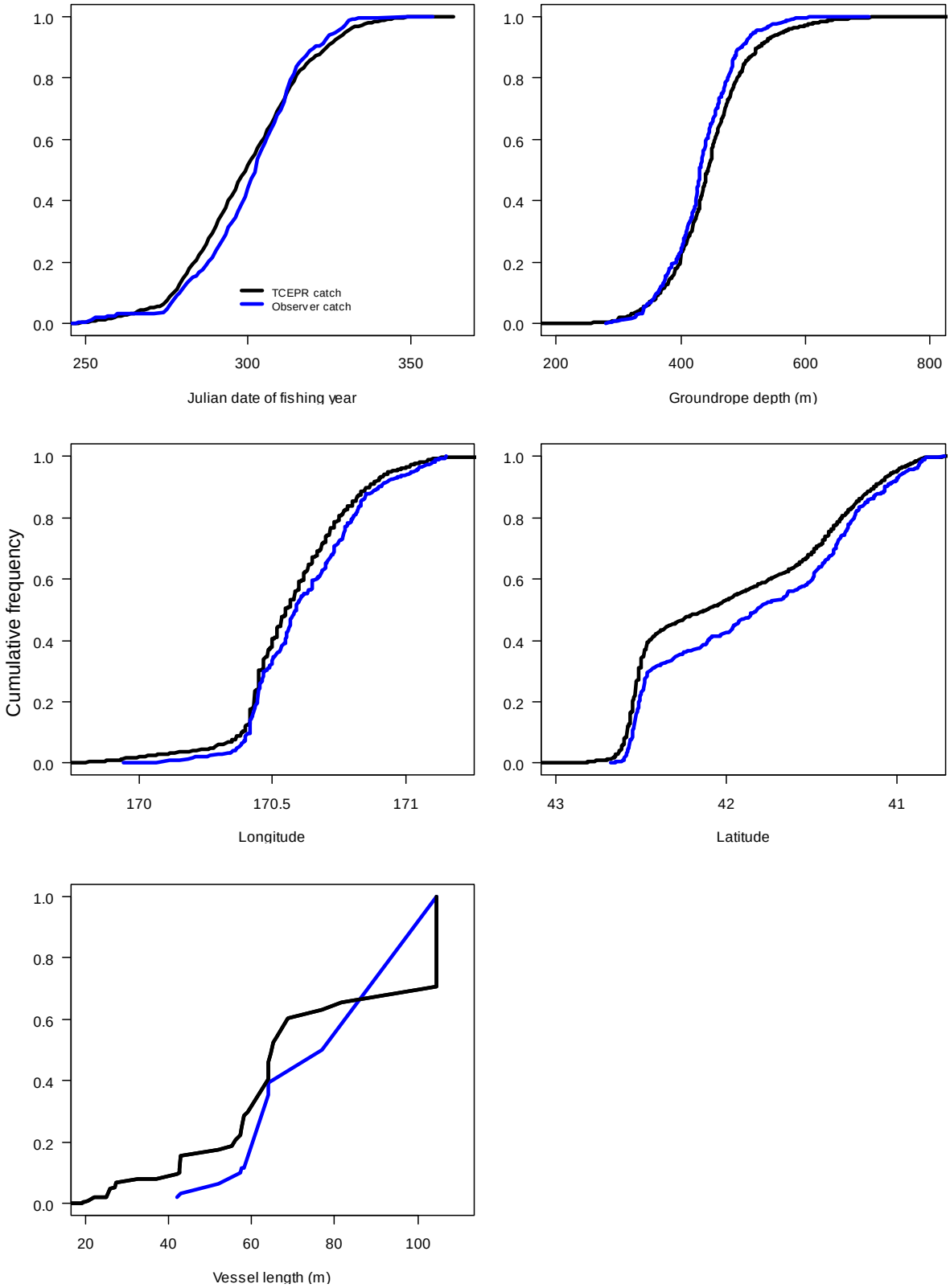


Figure 14: Comparison of WCSI 2011–12 Observer Programme catch coverage with TCEPR catches by day of year, depth, latitude, longitude, and vessel length. If sampling is representative of the fishery, then blue lines (observed catches) should overlay the black lines (TCEPR catch).

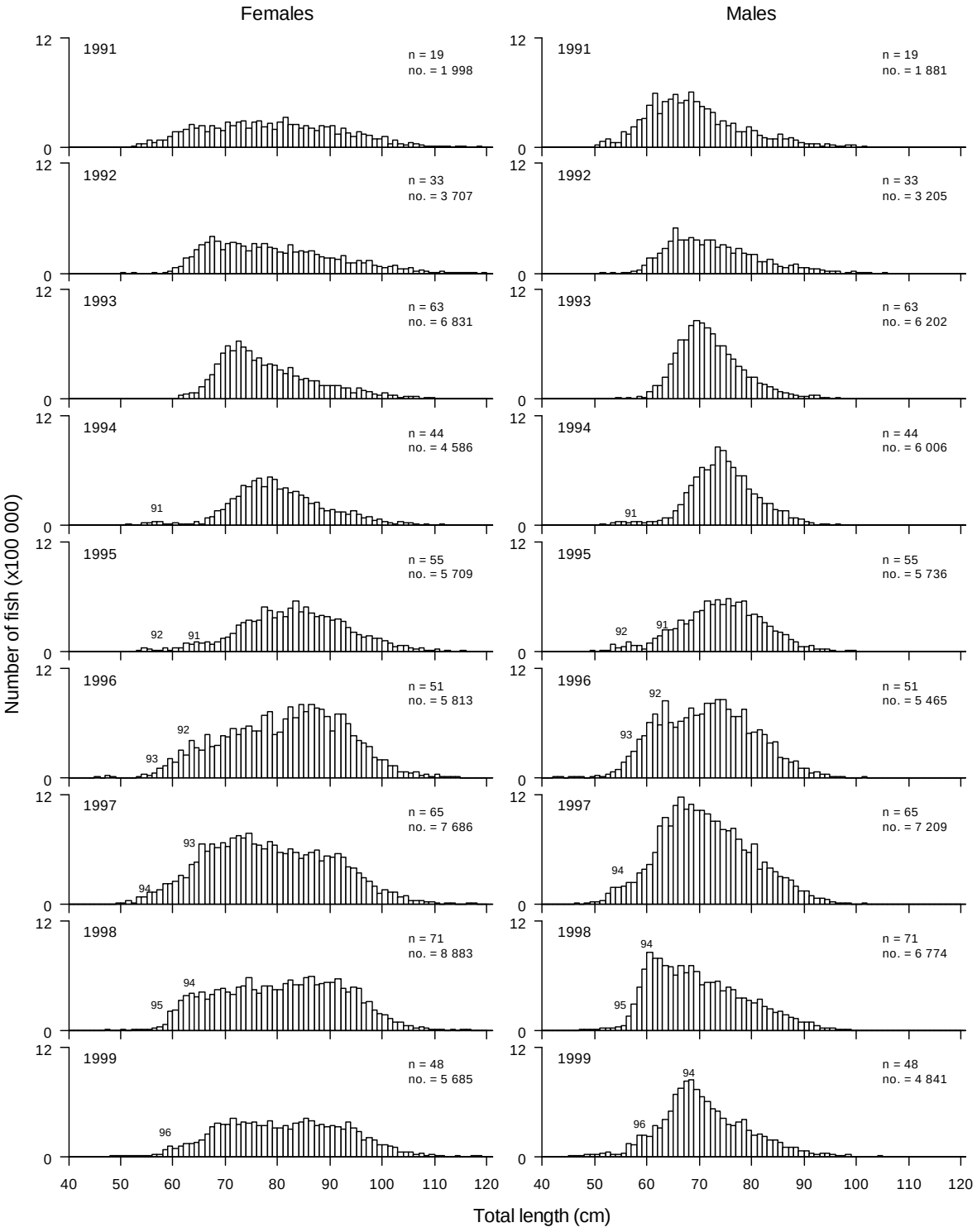


Figure 15: Length frequency of hoki in commercial catches from the Cook Strait spawning fishery from 1991 to 2012 sampled in sheds by the Stock Monitoring Programme and NIWA, and at sea by the Observer Programme. n, number of landings sampled; no., number of fish sampled. Numbers above the histograms mark year-class modes, e.g., 91 = 1991 year-class.

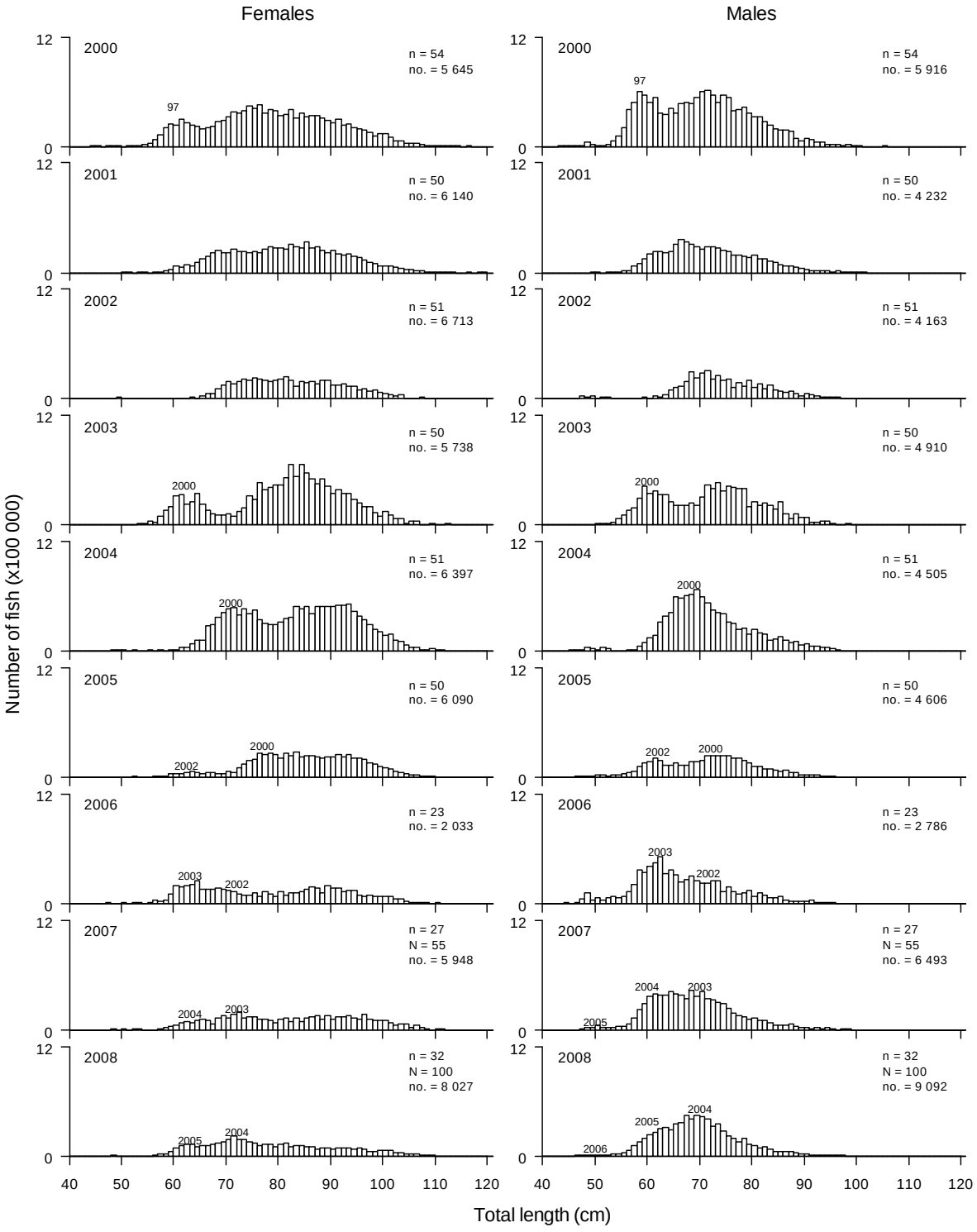


Figure 15 ctd.: 2006 data excludes Nelson vessels at least 40 m which sorted their catch at sea. 2007 and 2008 data includes shed samples (vessels less than 40 m) and observer samples (vessels at least 40 m). n, number of landings sampled; N, number of observed tows; no., number of fish sampled. Numbers above the histograms mark year-class modes, e.g., 97 = 1997 year-class and 2000 = 2000 year-class.

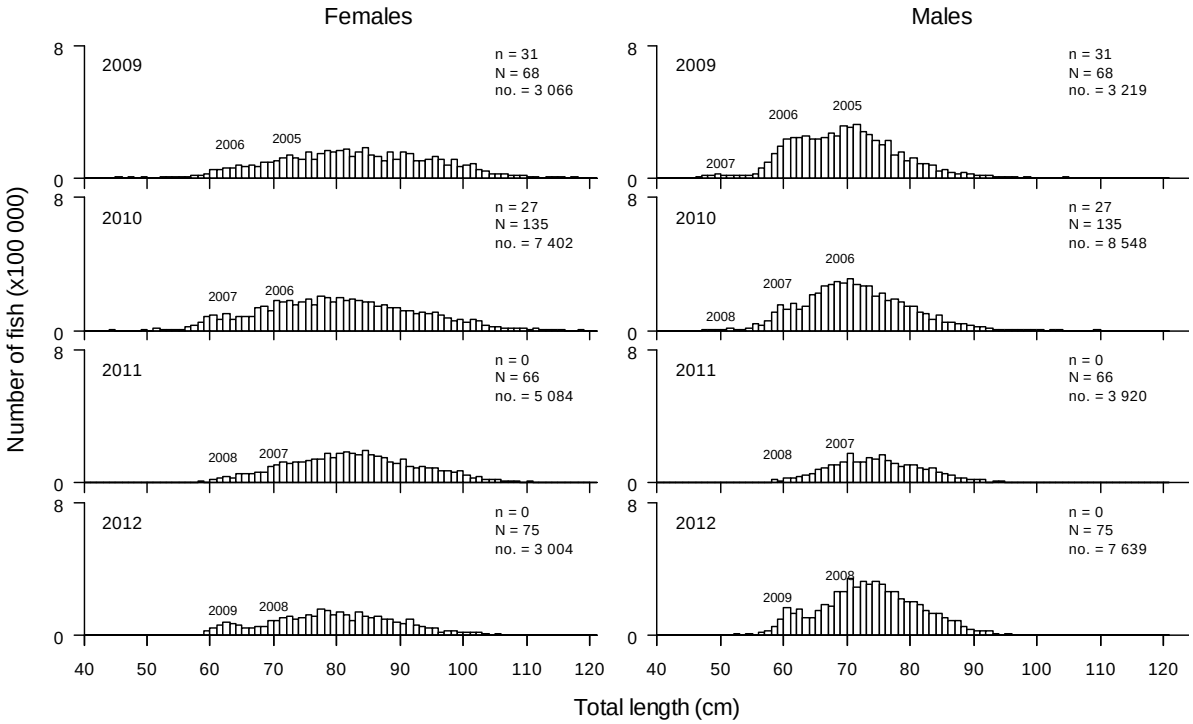


Figure 15 ctd.: 2009 data includes shed samples (vessels less than 40 m) and observer samples (vessels at least 40 m), 2010 data includes shed samples (vessels less than 40 m) and shed and observer samples (vessels at least 40 m) and 2011 and 2012 data comprise only observer samples. n, number of landings sampled; N, number of observed tows; no., number of fish sampled. Numbers above the histograms mark year-class modes, e.g., 2007 = 2007 year-class.

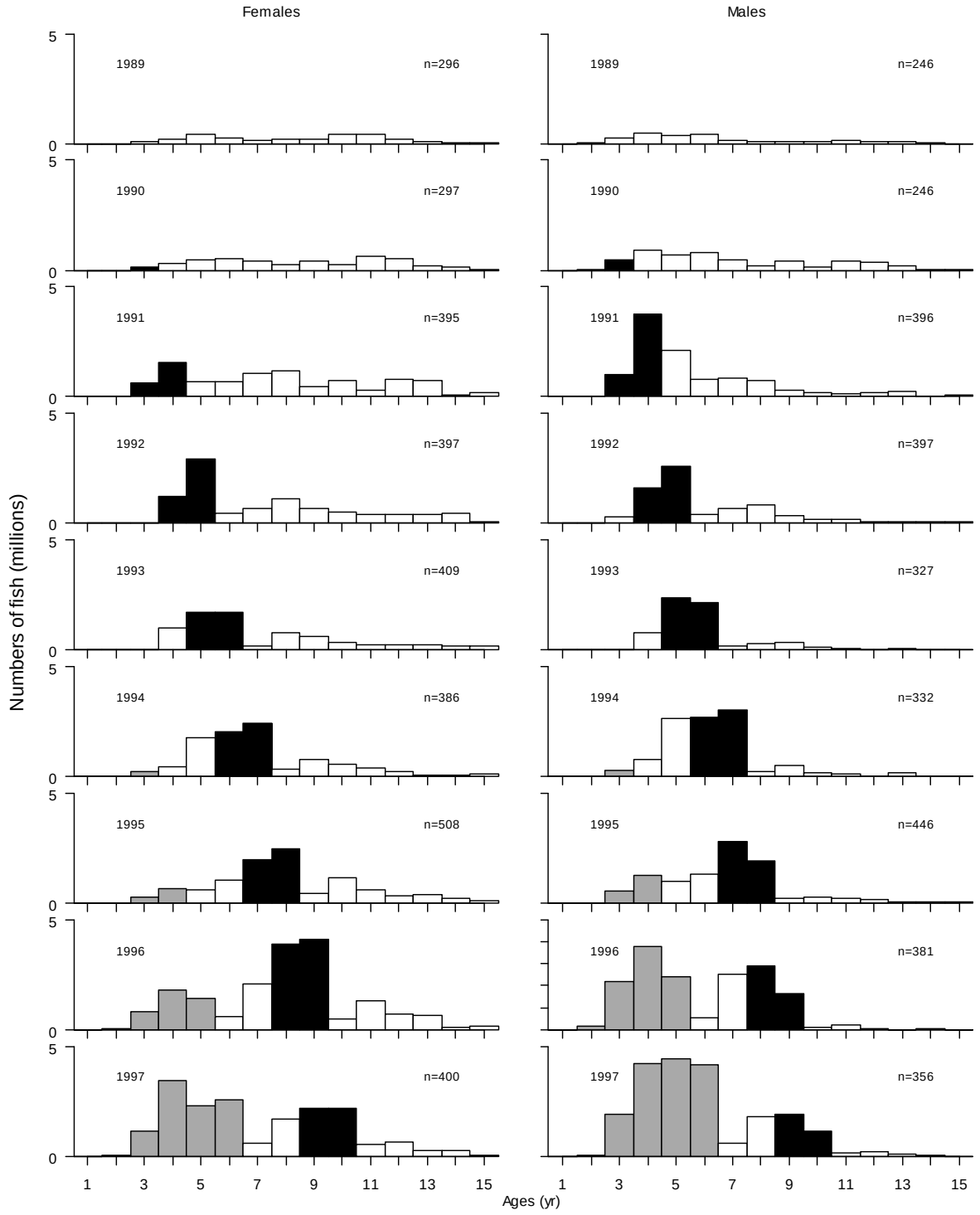


Figure 16: Catch at age of hoki in commercial catches from the Cook Strait spawning fishery from 1988 to 2010 sampled in sheds by the Stock Monitoring Programme and NIWA, and at sea by observers. 2006 data excludes Nelson shed samples from vessels at least 40 m which sorted their catch at sea. 2007–2009 data includes shed samples (vessels less than 40 m) and tows sampled at sea by the Observer Programme (vessels at least 40 m), 2010 data includes shed samples (vessels less than 40 m) and shed and observer samples (vessels at least 40 m), and 2011 and 2012 data includes observer samples only from vessels longer and shorter than 40 m. n, number of fish aged. Black bars show 1987 and 1988 year-classes in the 1990–2003 seasons; 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 from the 2005 season.

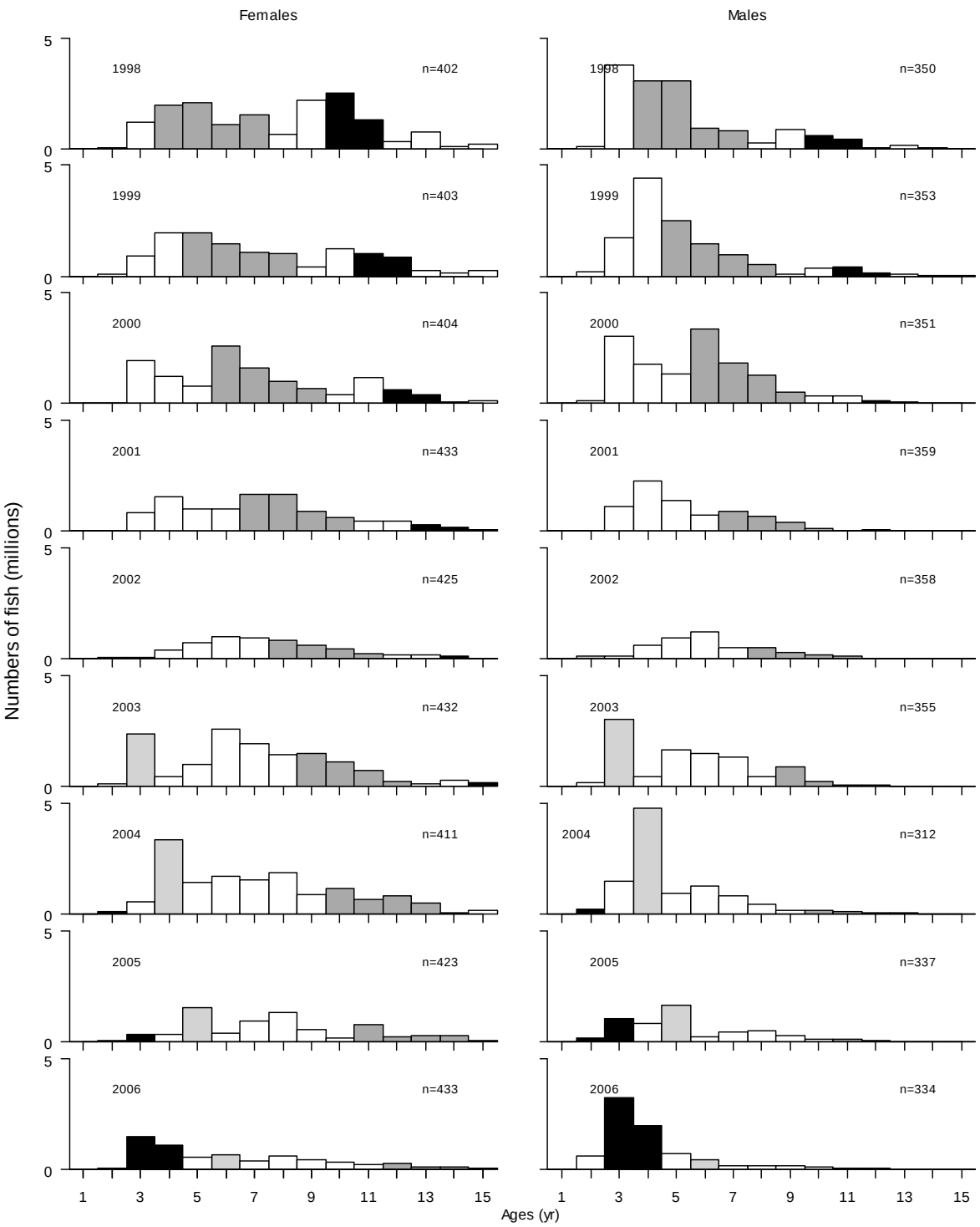


Figure 16 ctd.

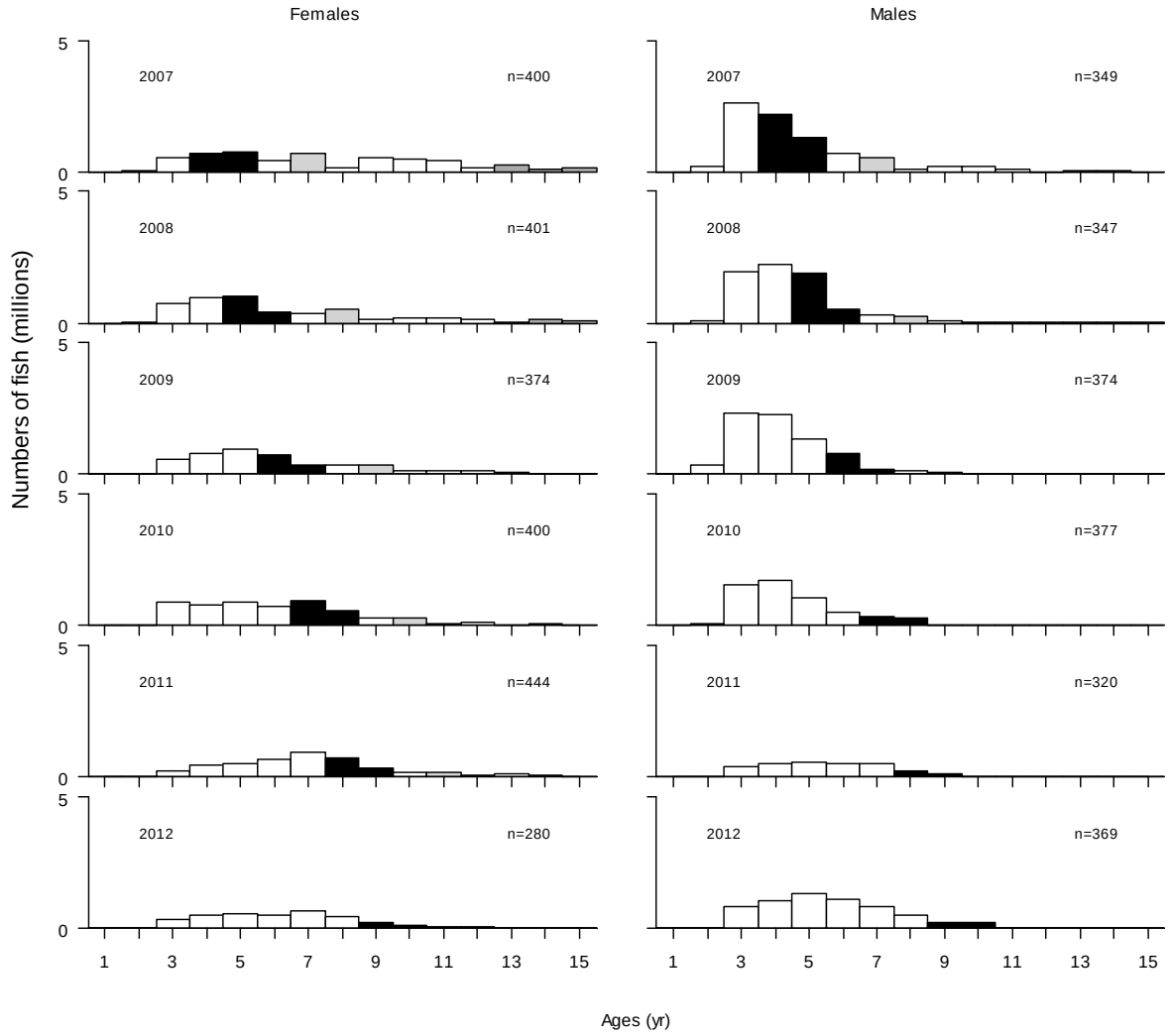


Figure 16 ctd.

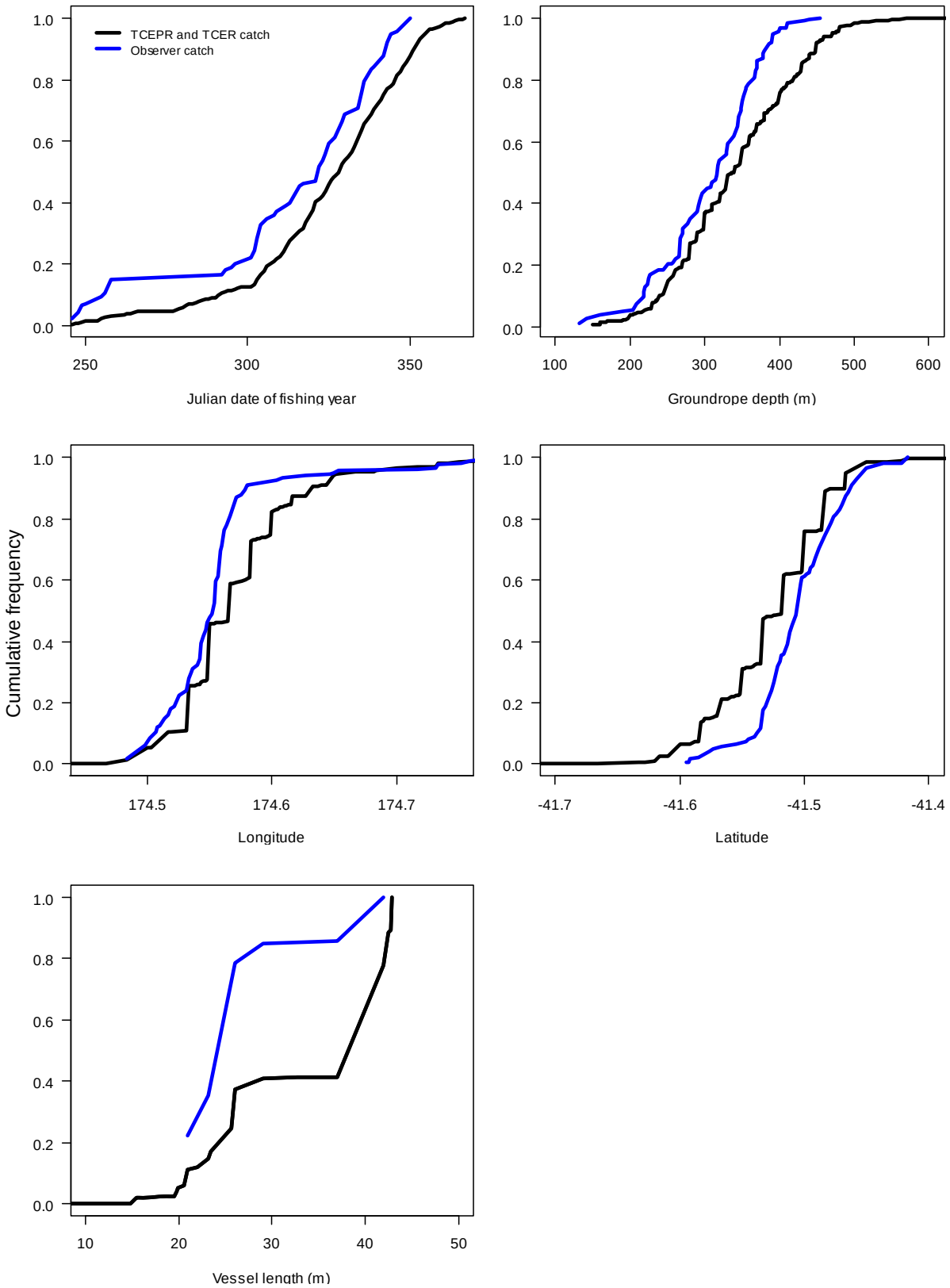


Figure 17: Comparison of Cook Strait 2011–12 Observer Programme catch coverage for TCEPR and TCER catches by day of year, depth, latitude, longitude, and vessel length. If sampling is representative of the fishery, then blue lines (sampled catches) should overlay black lines (catches).

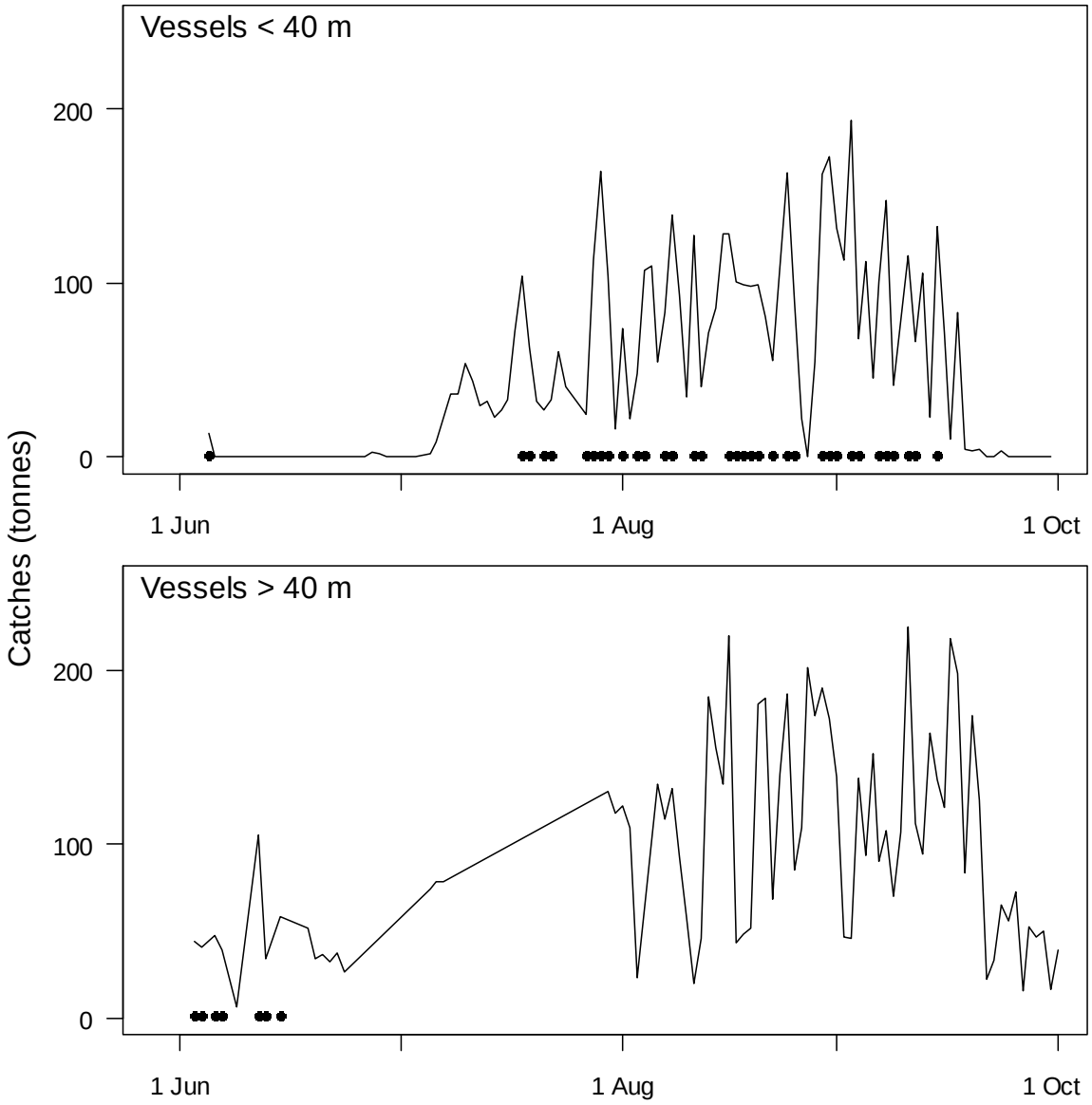


Figure 18: Cook Strait 2011–12 catch by day for vessels less than 40 m and 40 m or longer during the spawning season, showing timing of Observer Programme samples (black dots).

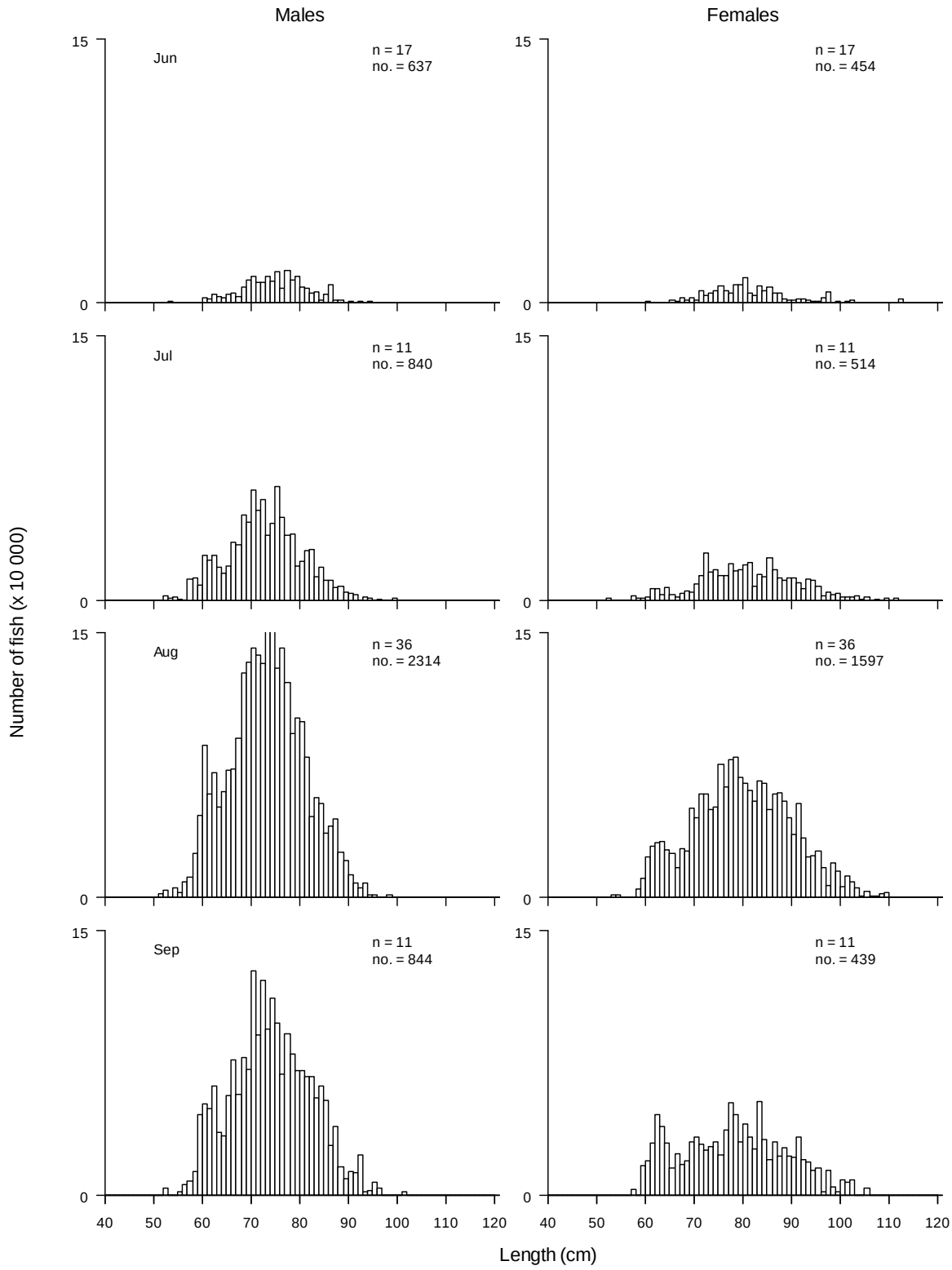


Figure 19: Comparison of Observer Programme length frequencies of hoki taken in commercial catches from Cook Strait during 2012 by month strata. n, number of tows sampled; no., number of fish sampled.

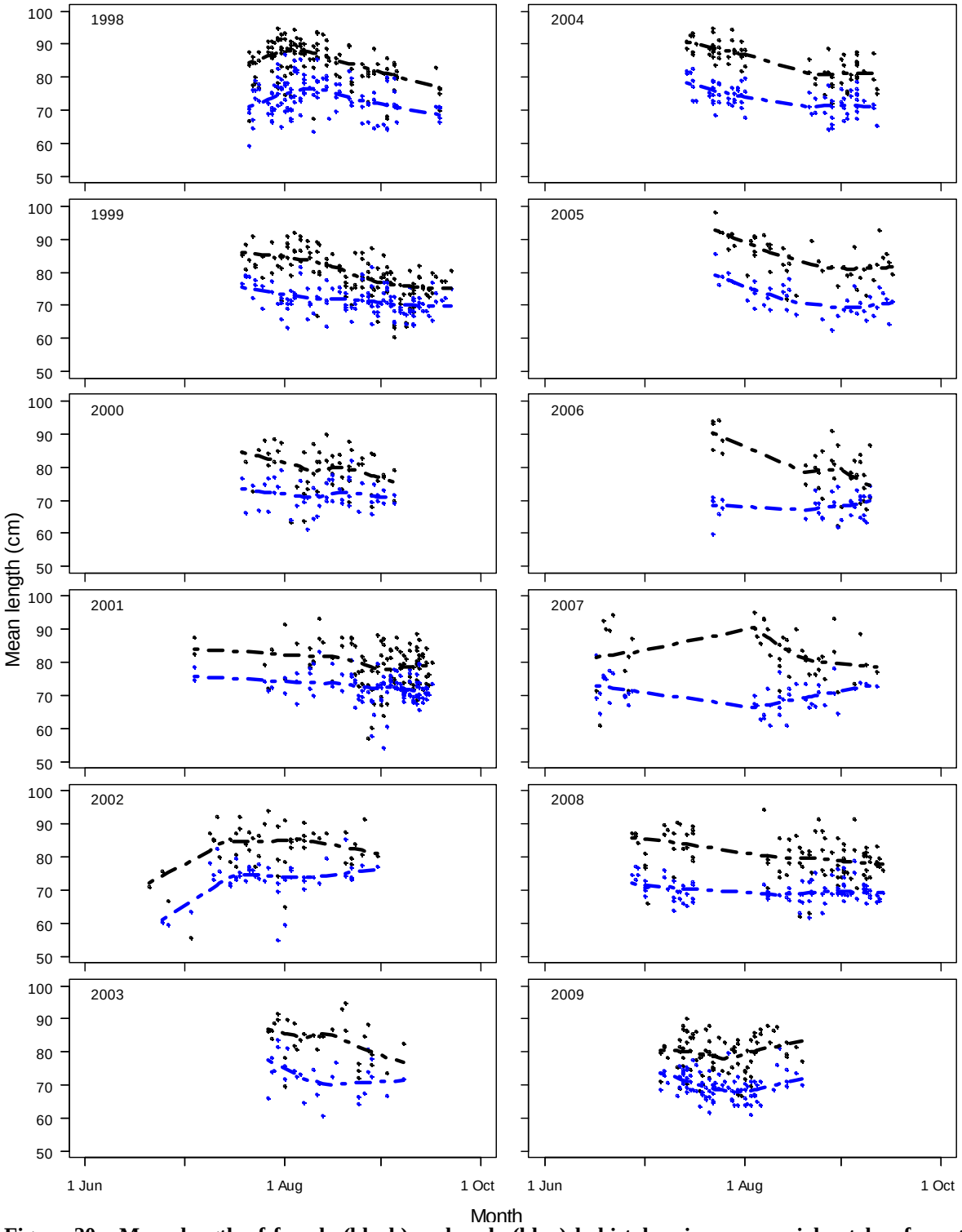


Figure 20: Mean length of female (black) and male (blue) hoki taken in commercial catches from the Cook Strait spawning fishery 1989–2011 from landings sampled by the Observer Programme. Lines are a loess fit.

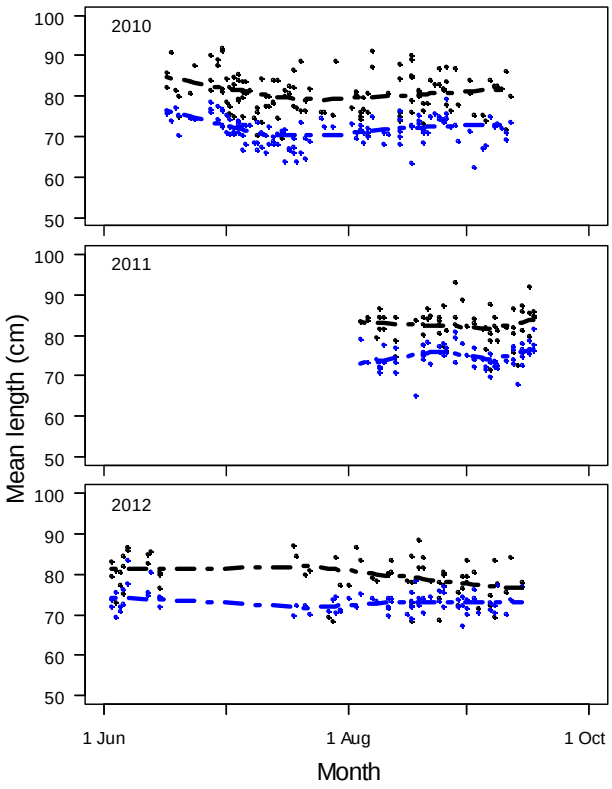
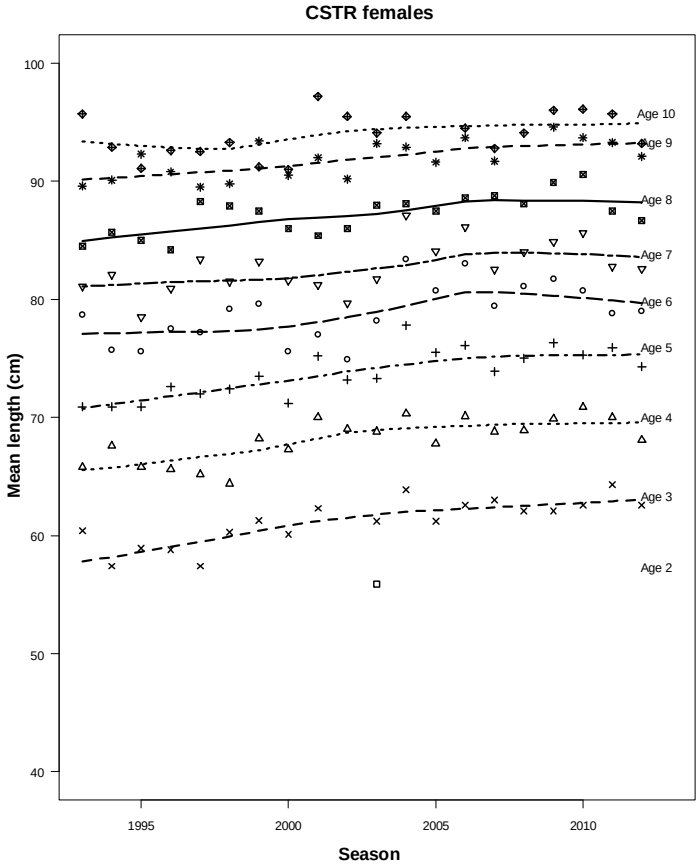


Figure 20 ctd.



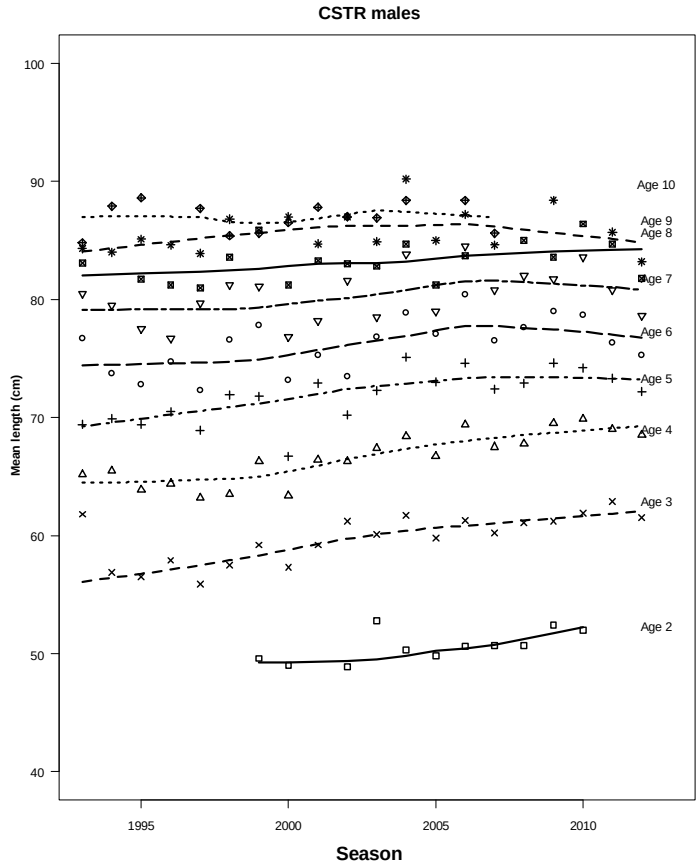


Figure 21: Mean length at age of female and male hoki taken in commercial catches from the Cook Strait spawning fishery 1988–2012 sampled at sea by the Observer Programme. Lines are a loess fit. Points with fewer than ten records are excluded.

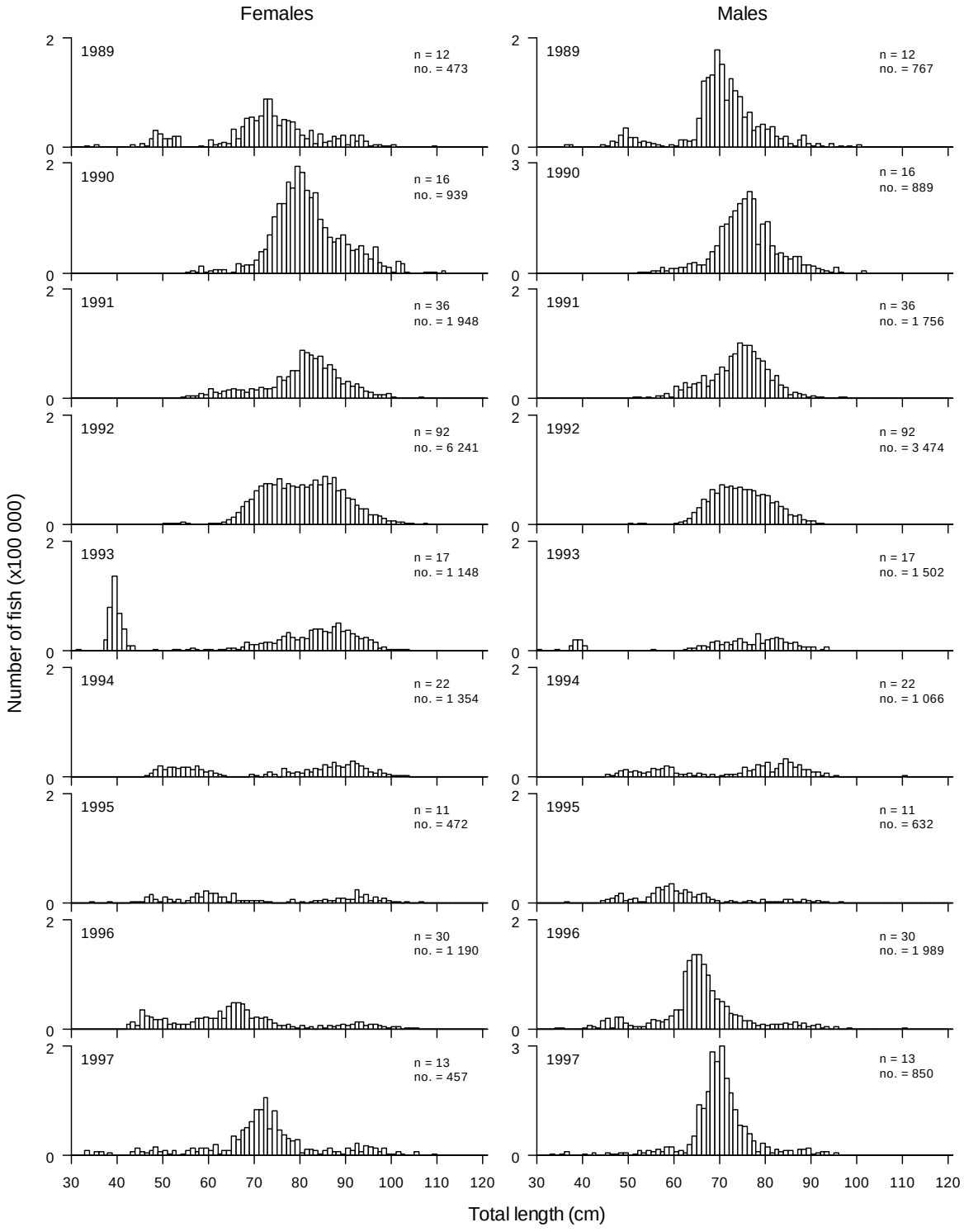


Figure 22: Length frequency of hoki in commercial catches from the Puysegur spawning fishery from 1989 to 1997, and 1999 to 2012 sampled at sea by the Observer Programme. n, number of tows sampled; no., number of fish sampled.

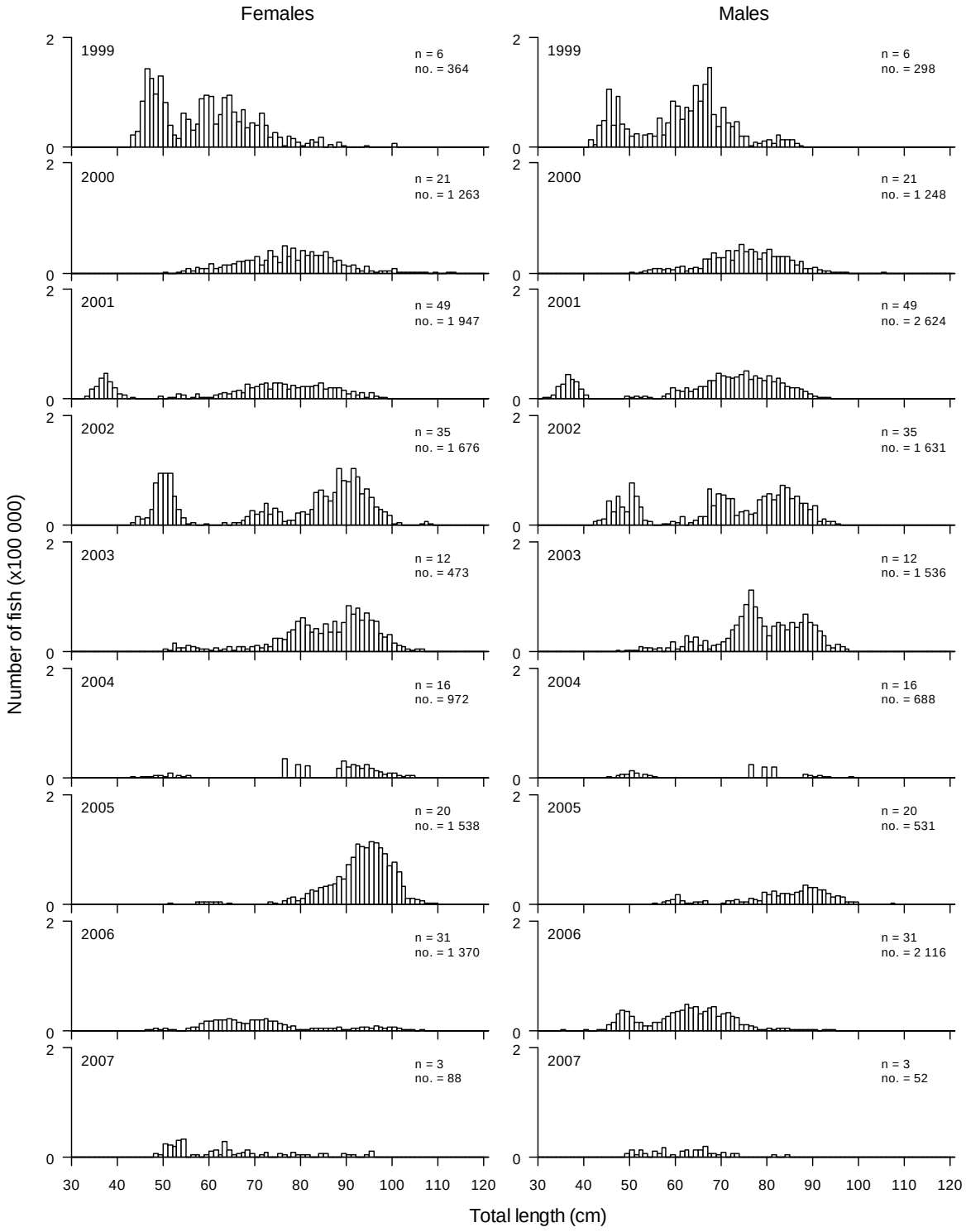


Figure 22 ctd.

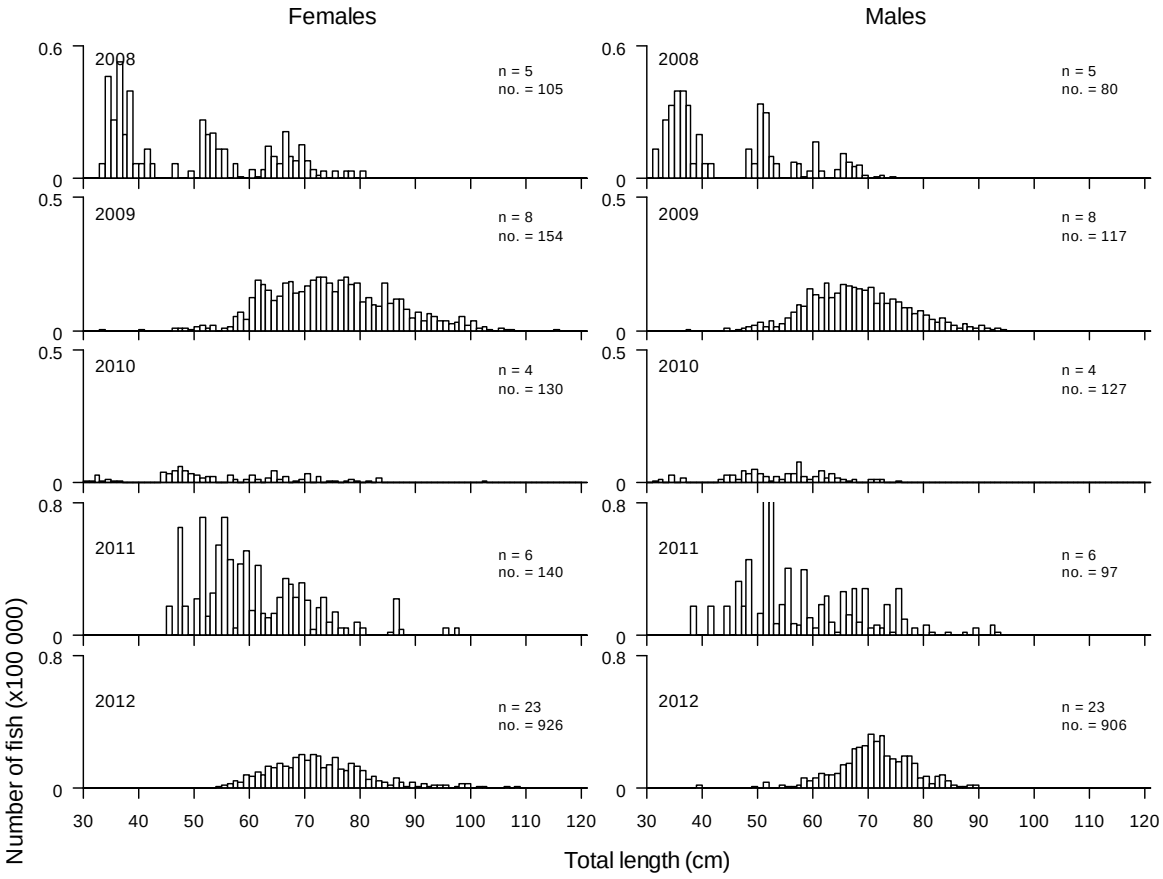


Figure 22 ctd.

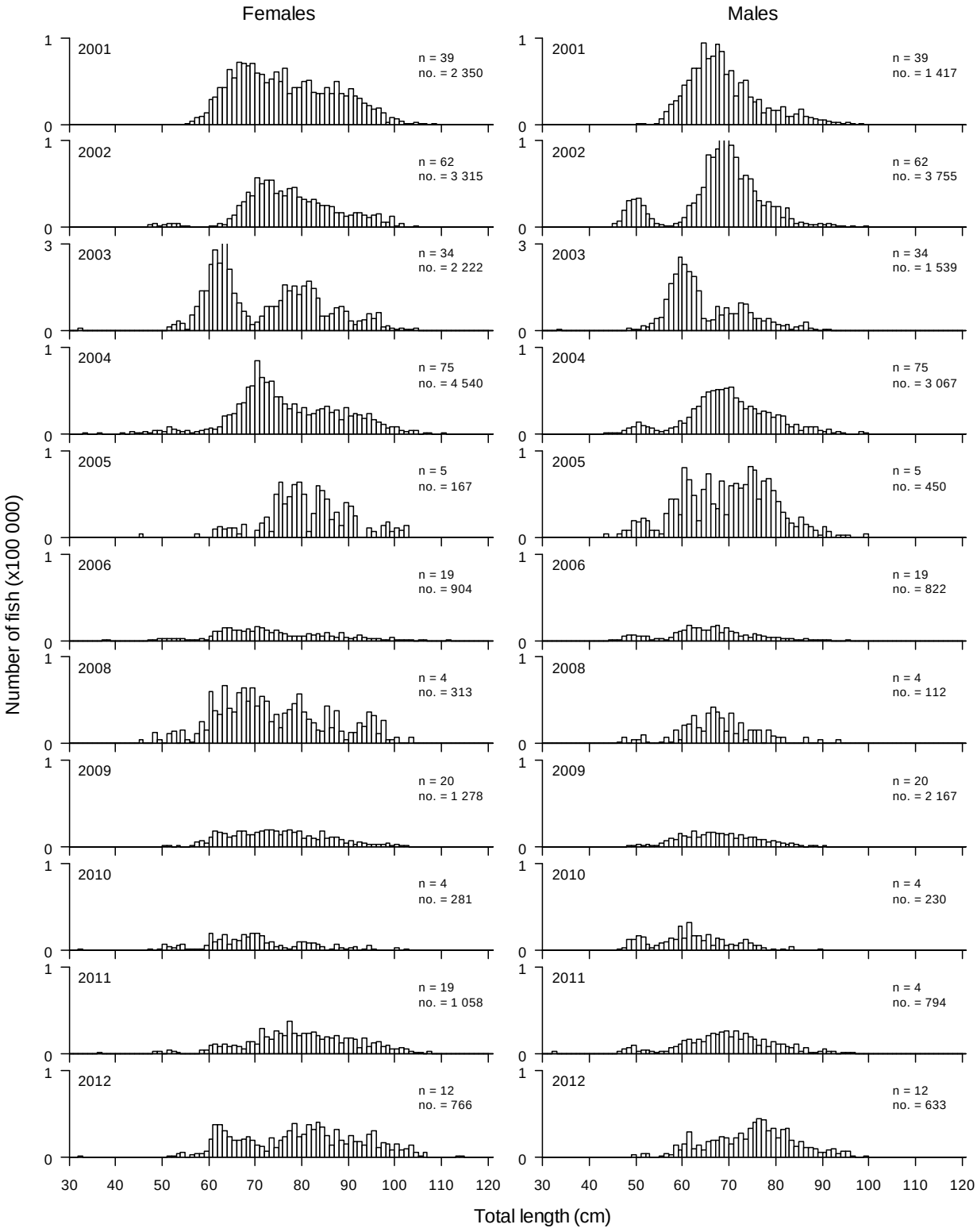


Figure 23: Length frequency of hoki taken in commercial catches from the ECSI spawning fishery from 2001 to 2012 sampled by the Scientific Observer Programme (2001–2006, 2008–2012) and combined with Hoki Management Company data (2001 to 2005). There were no samples in 2007. N, number of tows sampled; no., number of fish sampled.

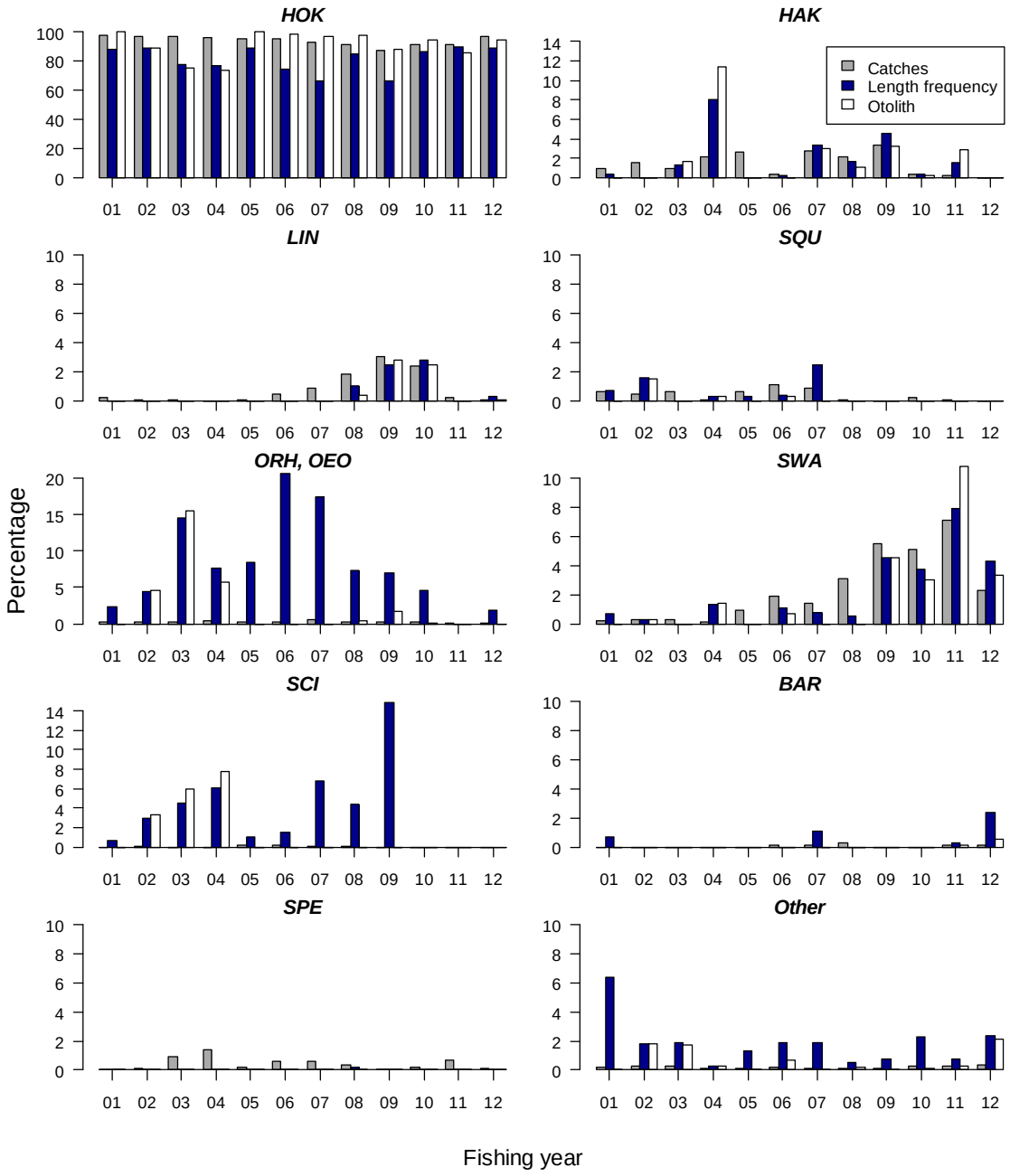


Figure 24: Percentage of hoki TCEPR, CELR and TCER catch, hoki length frequencies and hoki otoliths collected by the Observer Programme, by target species for the Chatham Rise fishery from 2000–01 to 2011–12. Three-letter codes denote target species: HOK, hoki; ORH, orange roughy; OEO, oreos; SQU, squid; SWA, silver warehou; HAK, hake; SCI, scampi; LIN, ling; BAR, barracouta; SPE, sea perch; Other, all other target species combined.

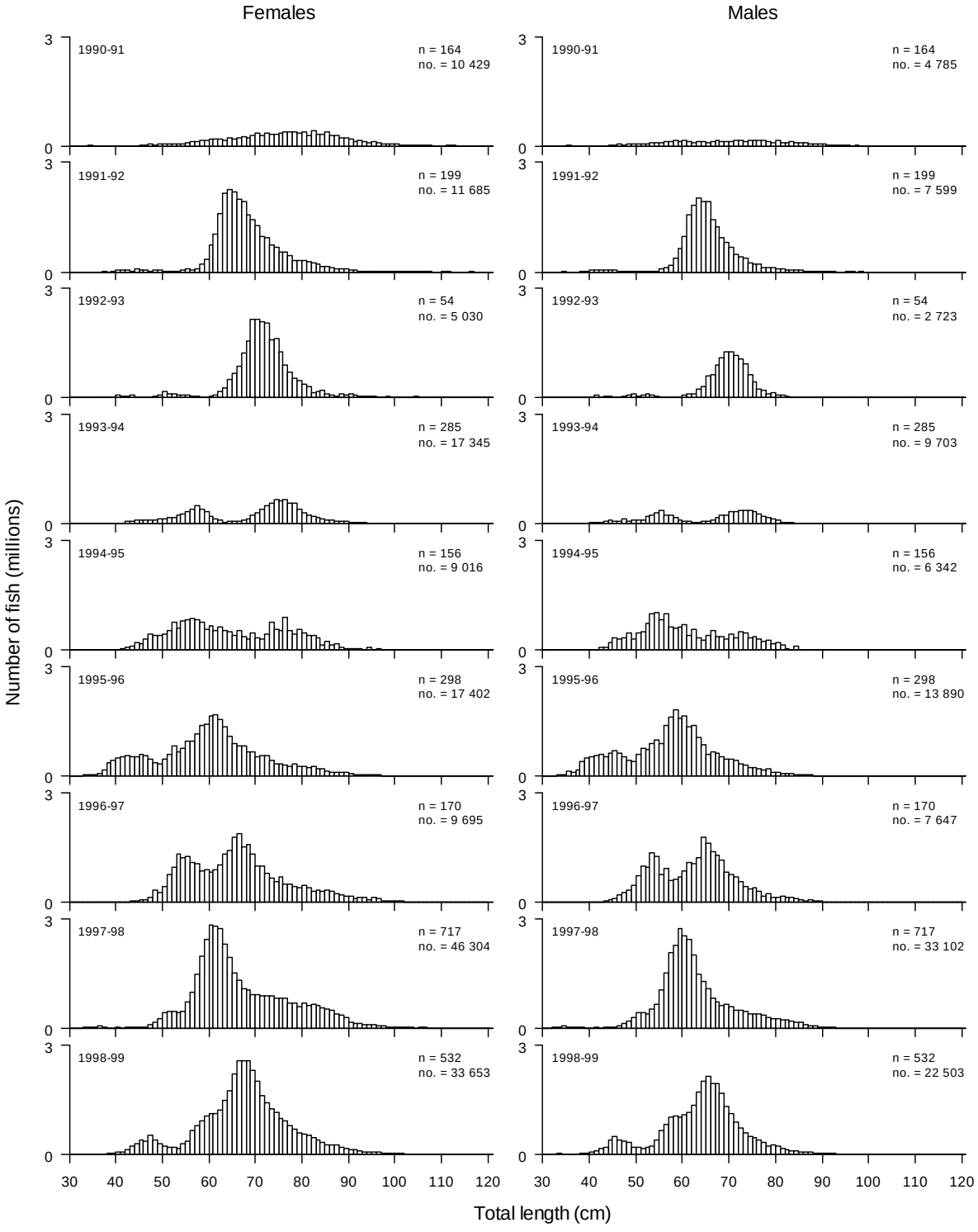


Figure 25: Length frequency of hoki taken in commercial catches from the Chatham Rise fishery from 1990–91 to 2011–12 sampled by the Observer Programme (and combined with Hoki Management Company data in 2000–01 to 2003–04). 2006–07 data includes only target hoki and hake tows. n, number of tows sampled; no., number of fish sampled.

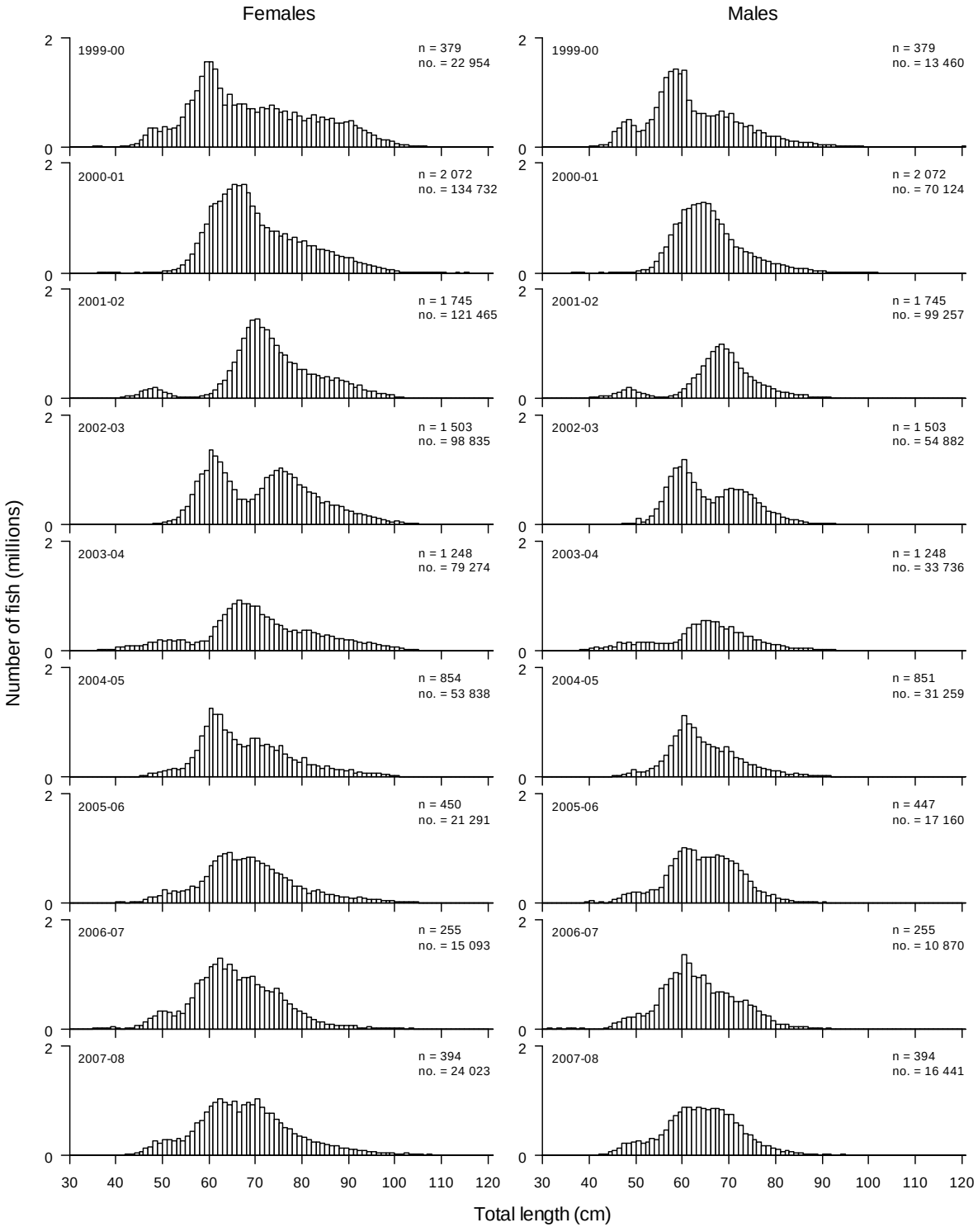


Figure 25 ctd.

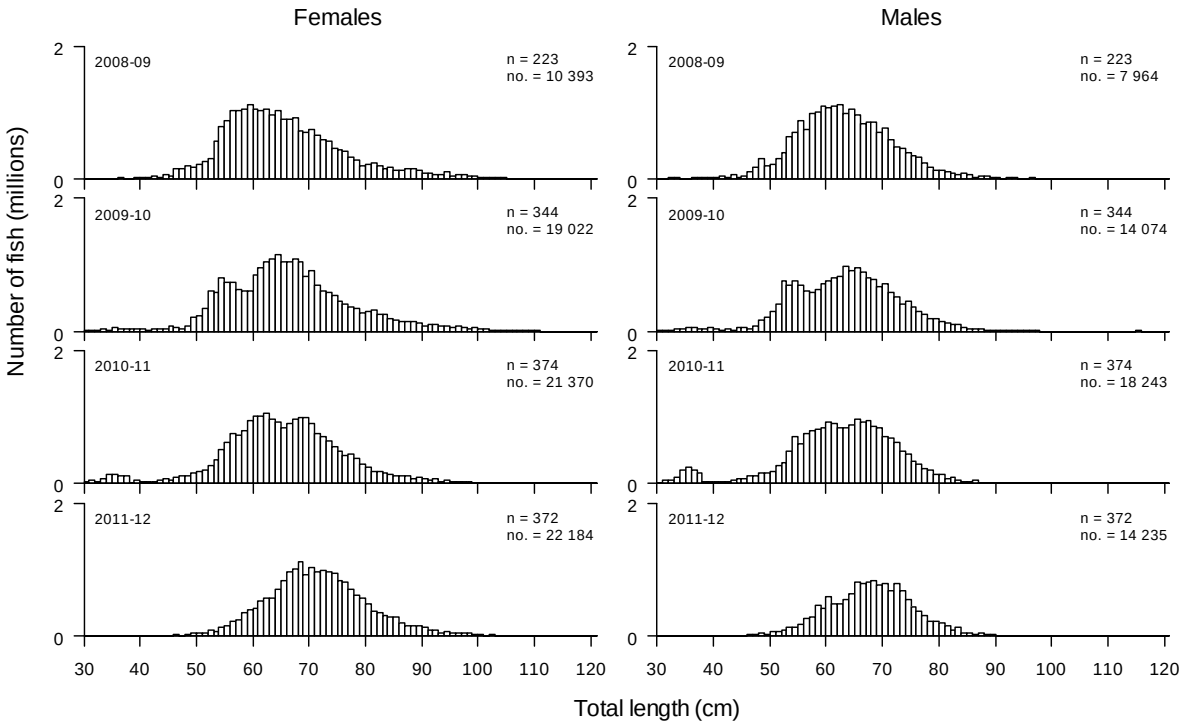


Figure 25 ctd.

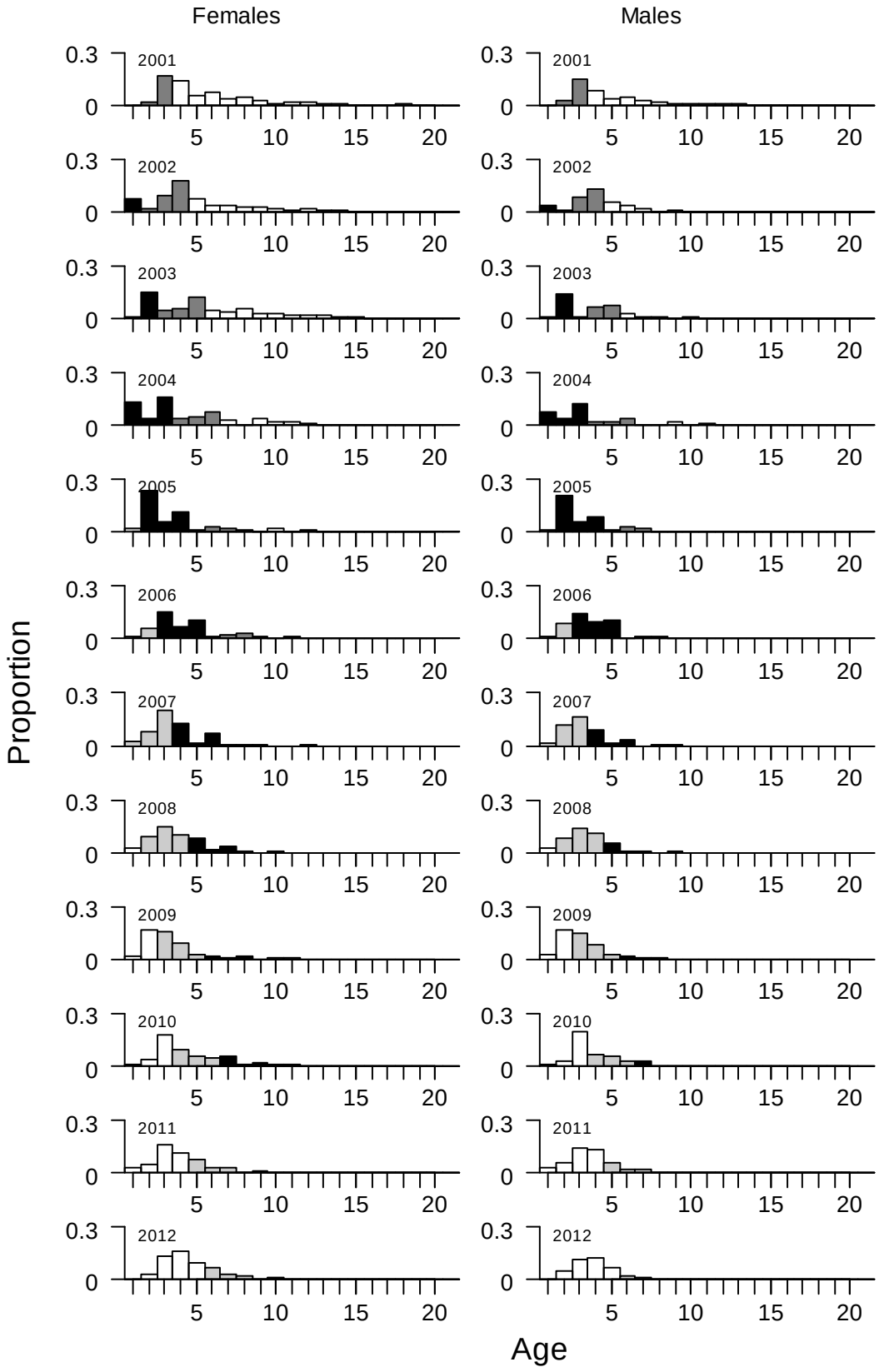


Figure 26: Proportions at age and sex in the catch from the Chatham Rise fishery as estimated by direct ageing of otoliths from 2000–01 to 2011–12. Dark grey bars show 1997–99 year-classes; black bars show 2000–02 year-classes; light grey bars show 2003–2005 year-classes.

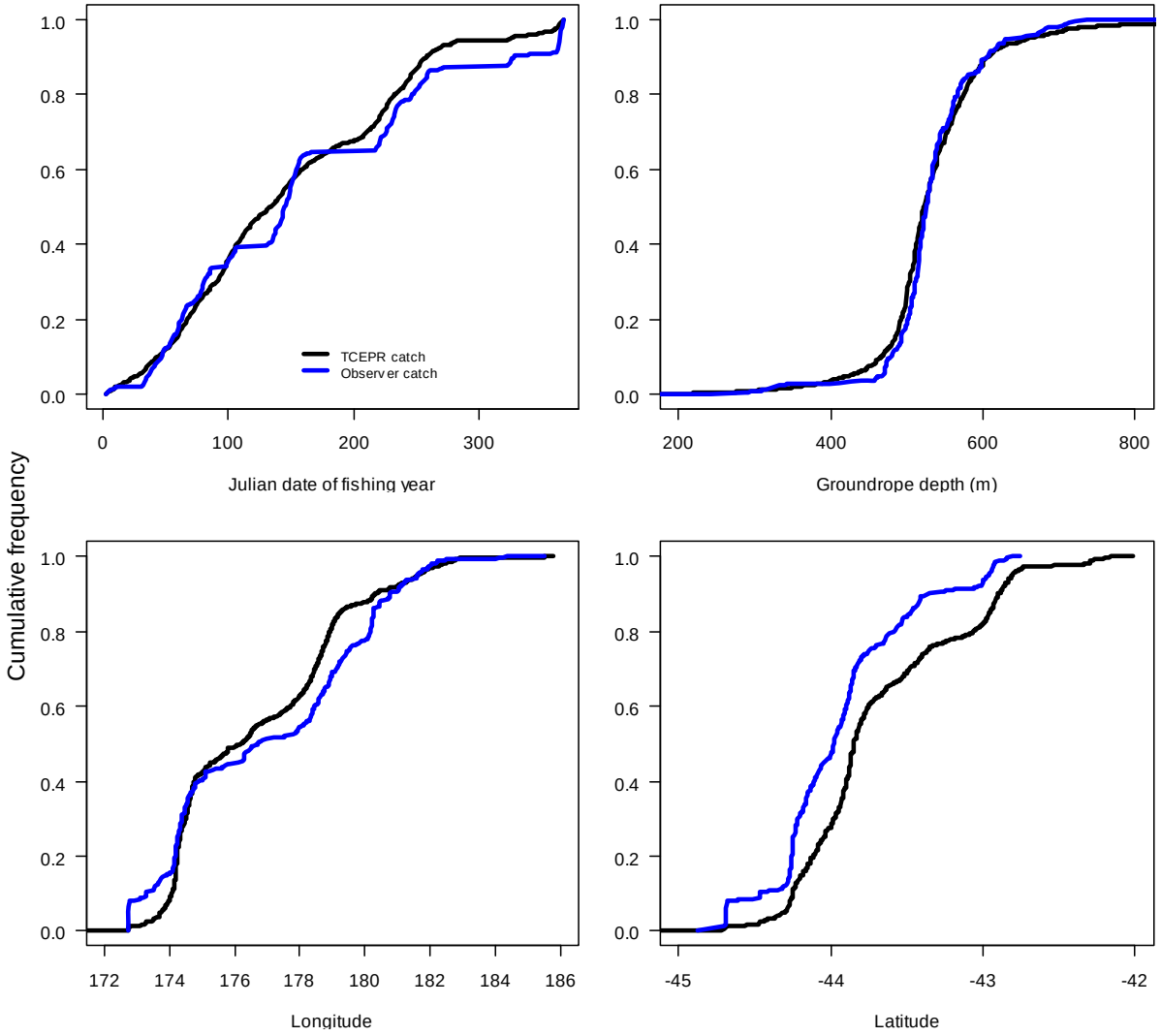


Figure 27: Comparison of Chatham Rise 2011–12 Observer Programme catch coverage with TCEPR catches by day of year, depth, latitude and longitude. If sampling is representative of the fishery, then blue lines (observed catches) should overlay black lines (TCEPR catch).

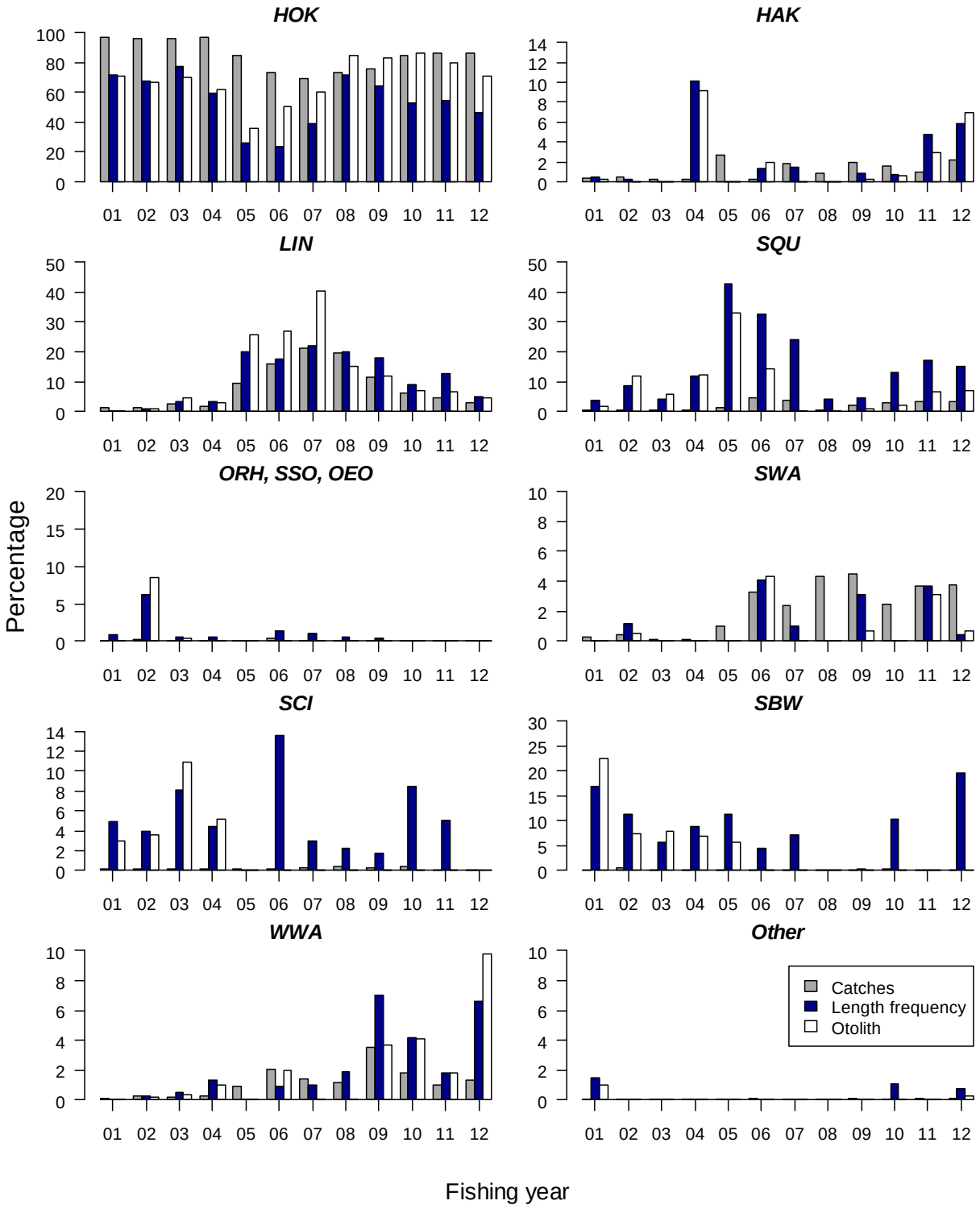


Figure 28: Percentages of hoki TCEPR, TCER and CELR catch, hoki length frequencies, and hoki otoliths collected by the Observer Programme, by target species for the Sub-Antarctic fishery from 2000–01 to 2011–12. Three-letter codes denote target species: HOK, hoki; HAK, hake; SQU, squid; ORH, orange roughy, SSO, smooth oreo; OEO, oreo; SWA, silver warehou; SBW, southern blue whiting; SCI, scampi; LIN, ling; WWA, white warehou; Other, other target species combined.

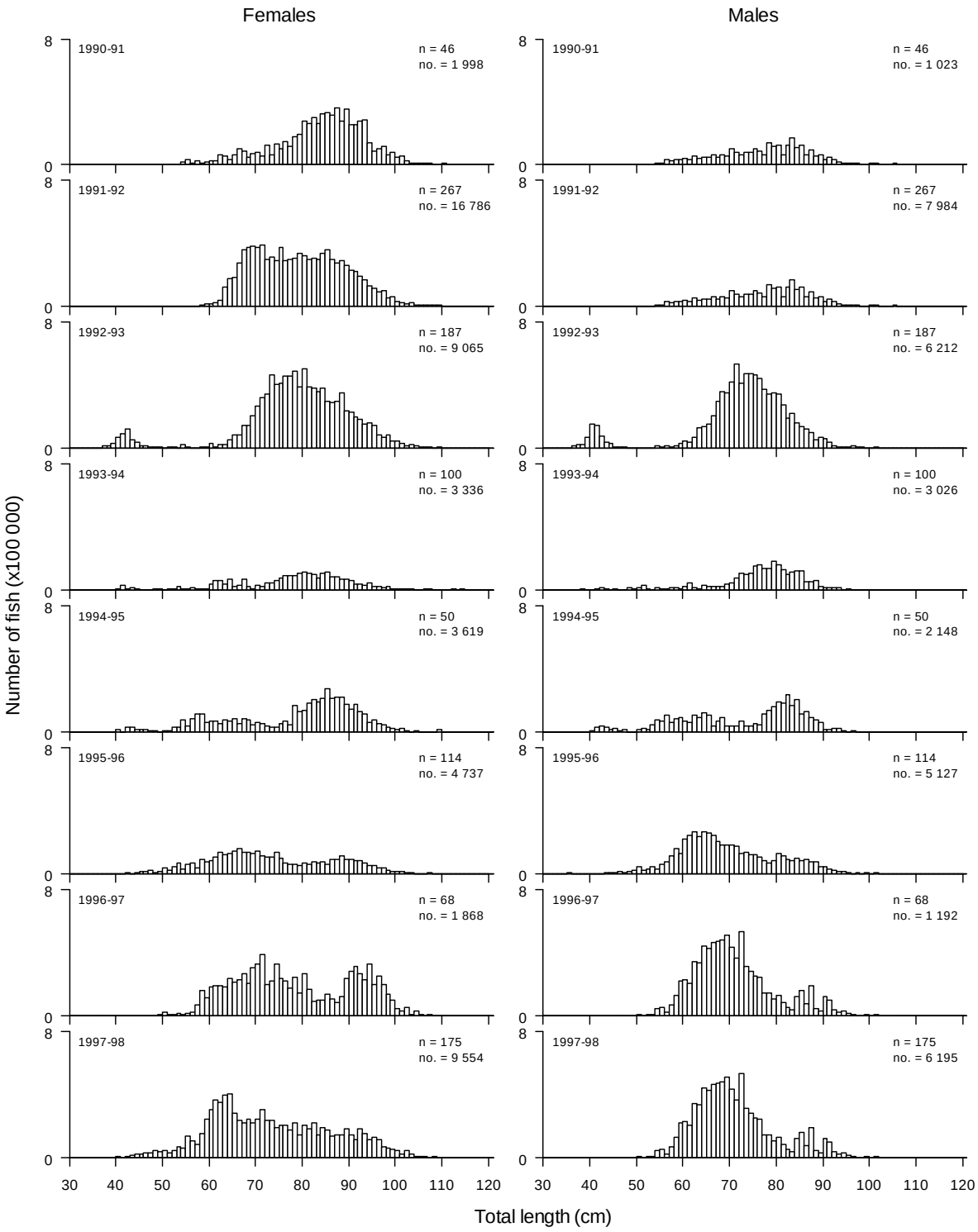


Figure 29: Length frequency of hoki taken in commercial catches from the Sub-Antarctic fishery from 1990–91 to 2011–12 sampled by the Observer Programme (and combined with Hoki Management Company data in 2000–01 to 2004–05). 2006–07 data includes only target hoki and ling tows. n, number of tows sampled; no., number of fish sampled.

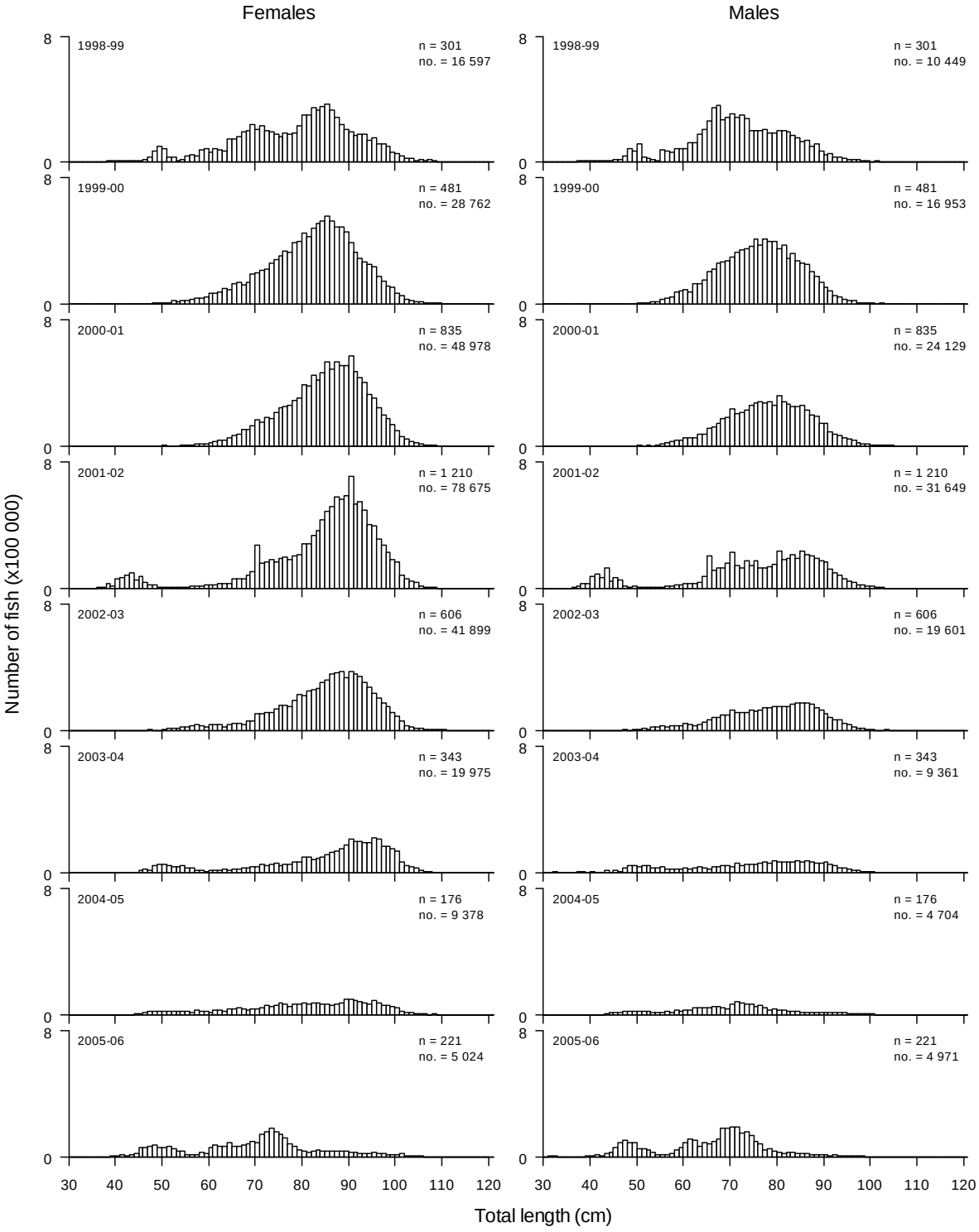


Figure 29 ctd.

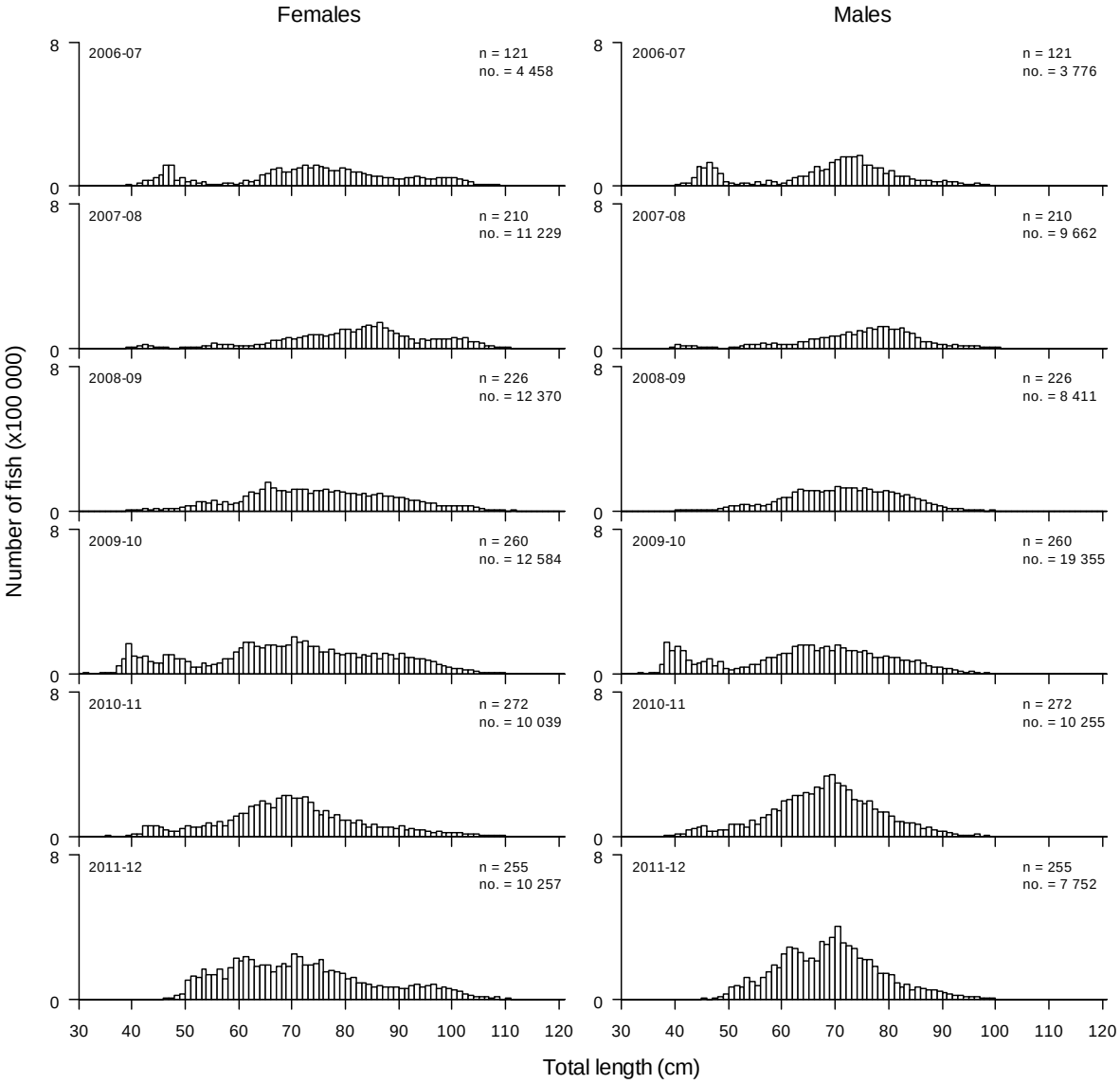


Figure 29 ctd.

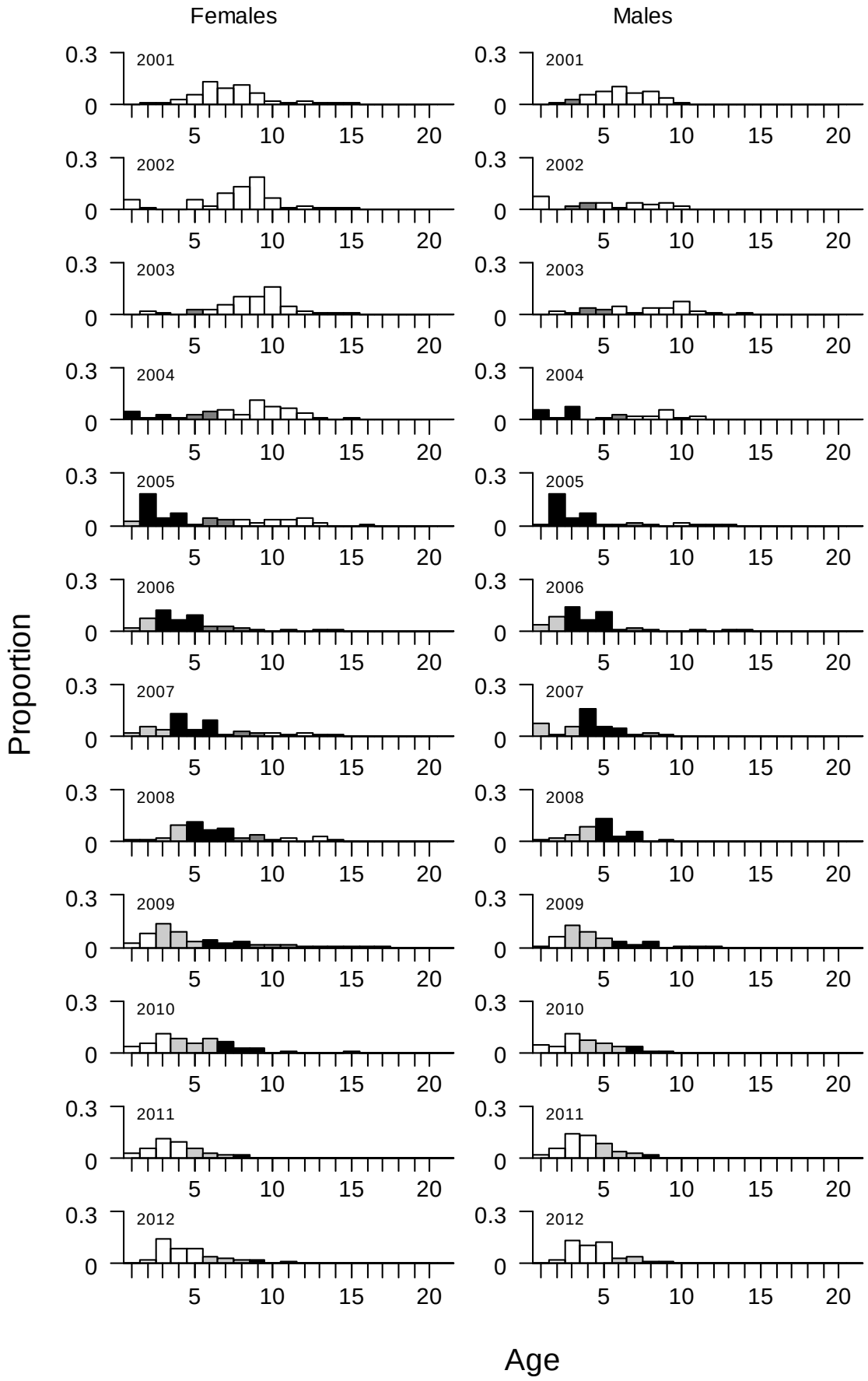


Figure 30: Proportions at age and sex in the catch from the Sub-Antarctic fishery as estimated by direct ageing of otoliths from 2000–01 to 2011–12. Dark grey bars show 1997–99 year-classes; black bars show 2000–02 year-classes; light grey bars show 2003–2005 year-classes.

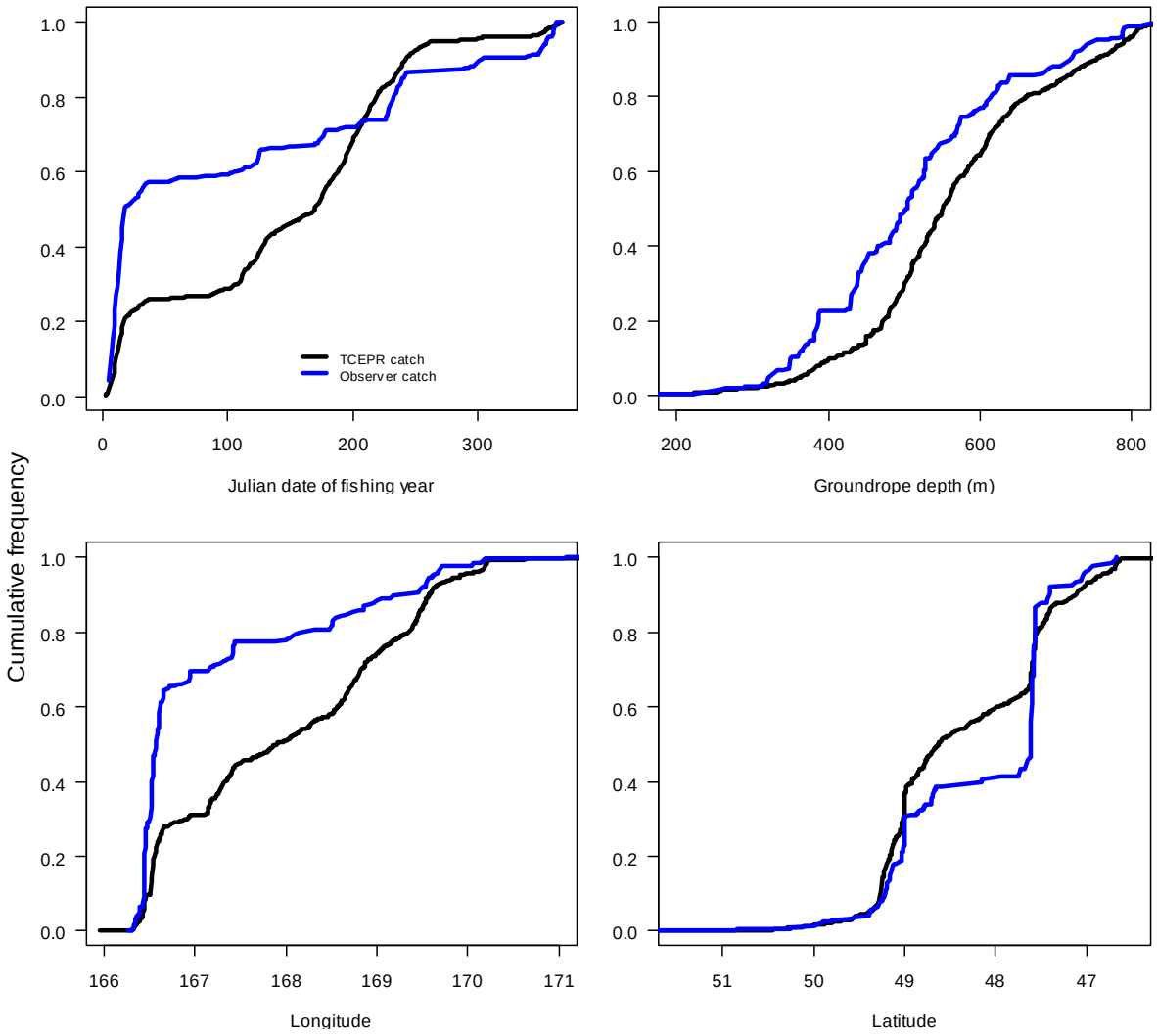
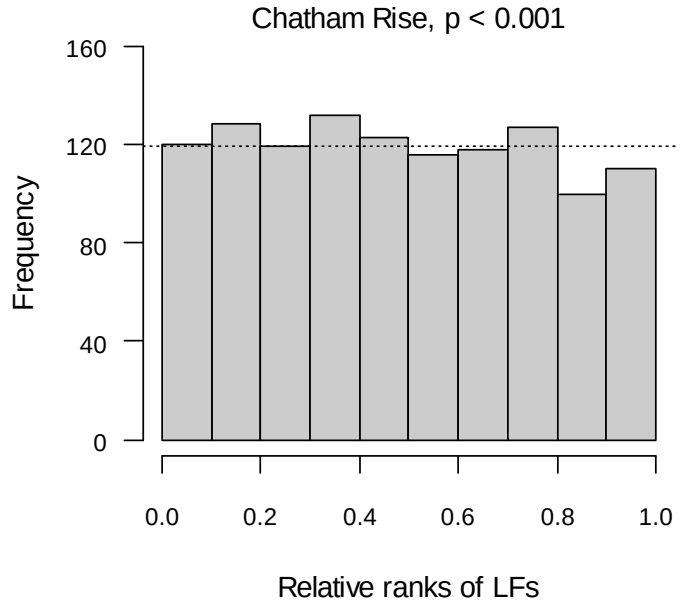


Figure 31: Comparison of Sub-Antarctic 2011–12 Observer Programme catch coverage with TCEPR catches by day of year, depth, latitude and longitude. If sampling is representative of the fishery, then blue lines (observed catches) should overlay black lines (TCEPR catch).



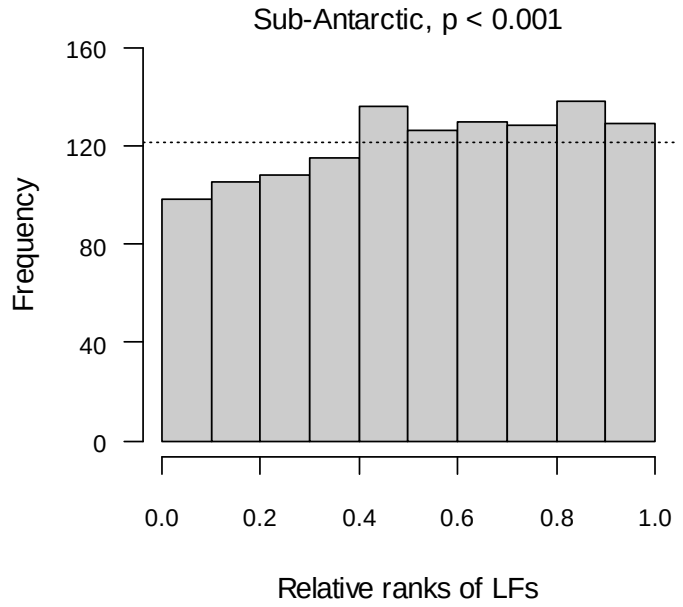


Figure 32: Histograms of ranks of the lengths that yielded 2011–12 Chatham Rise and Sub-Antarctic otoliths relative to the lengths of hoki measured for each tow. If sampling is random then the expected counts are given by the dotted line. The p-value is calculated using the rank-sum test.

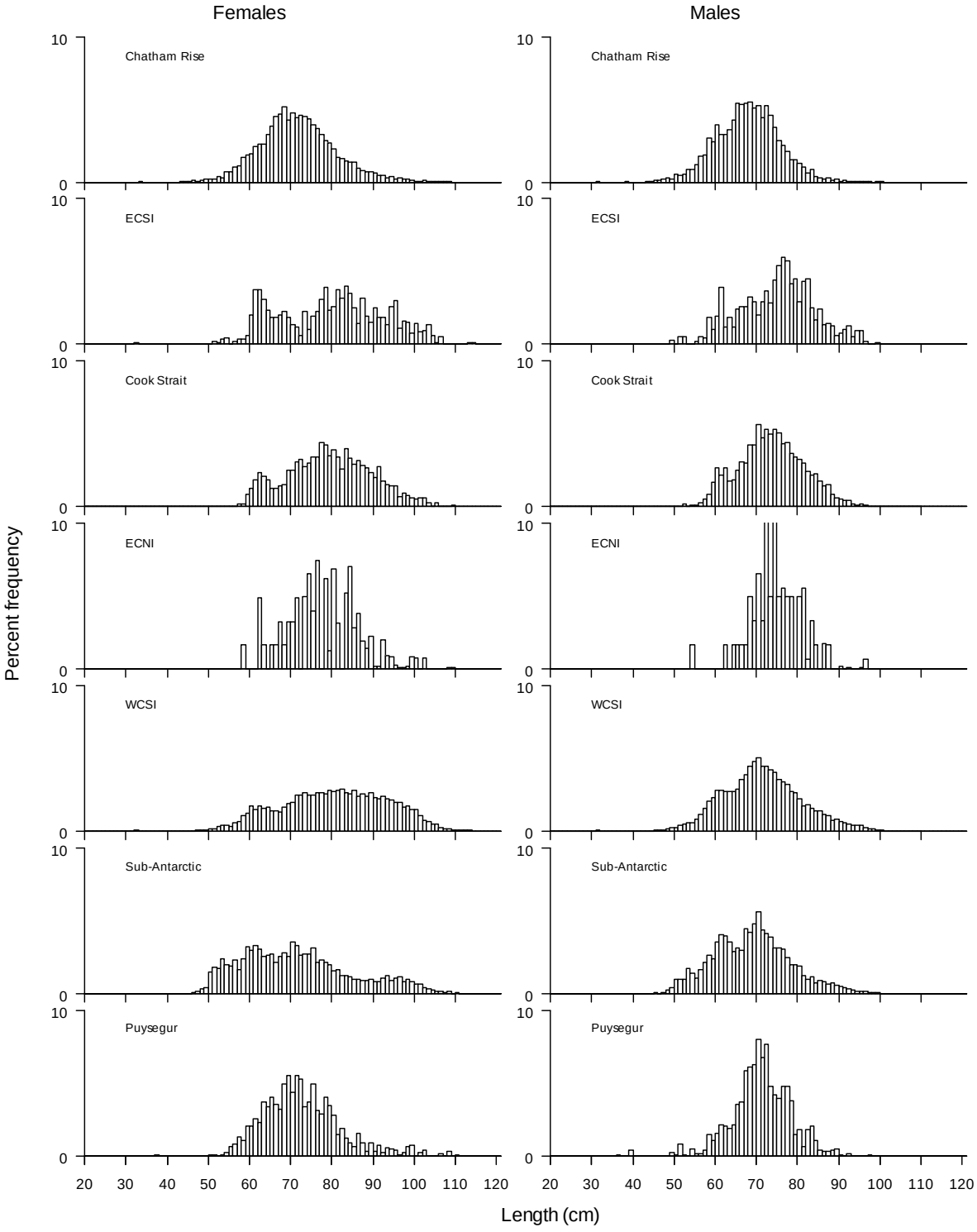


Figure 33: Length frequency of female and male hoki taken in commercial catches from different areas during the 2011–12 fishing year. All areas sampled by the Observer Programme.

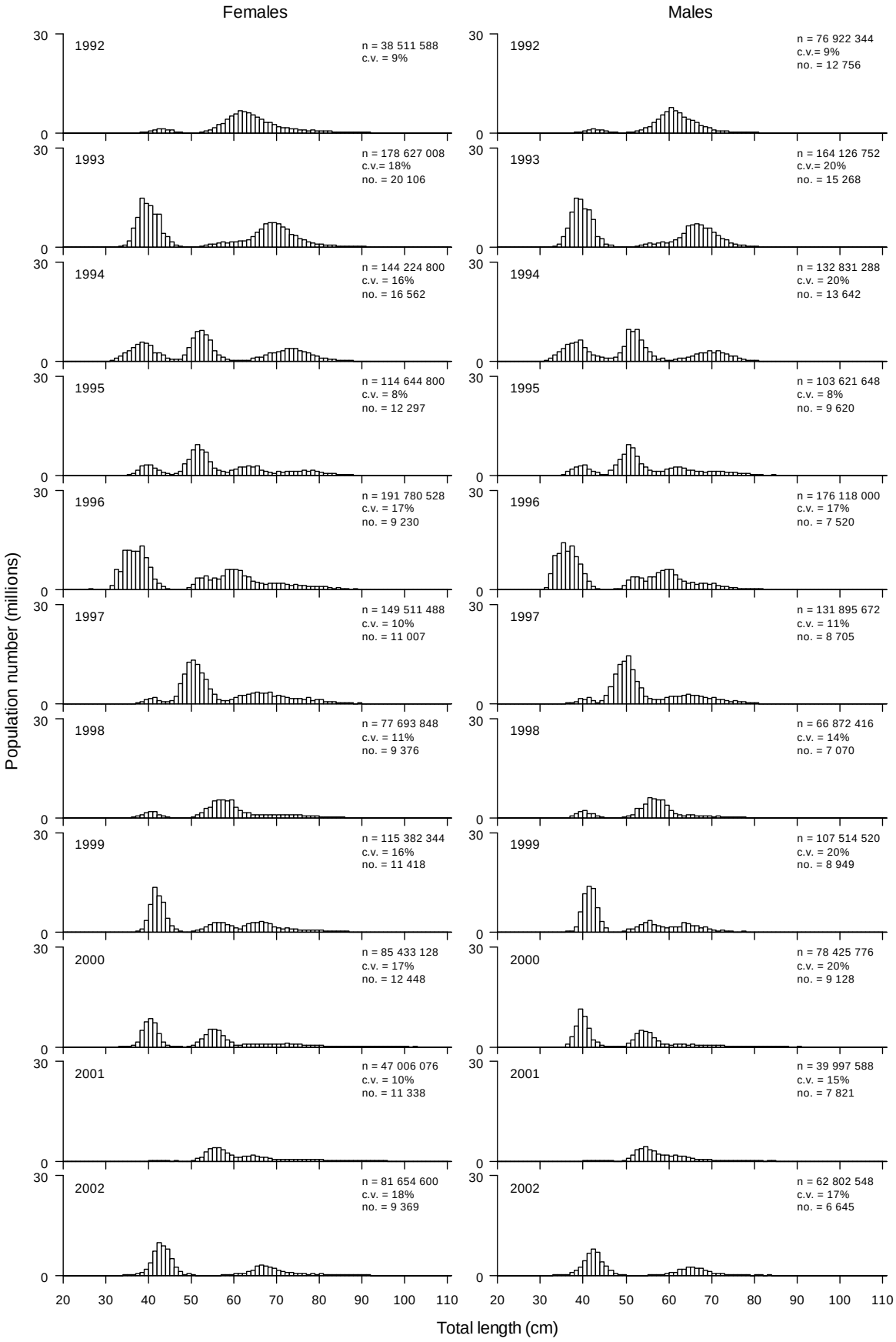


Figure 34: Scaled length frequency for hoki from Chatham Rise *Tangaroa* trawl surveys. n, population numbers of fish; c.v., coefficients of variation; no., number of fish measured.

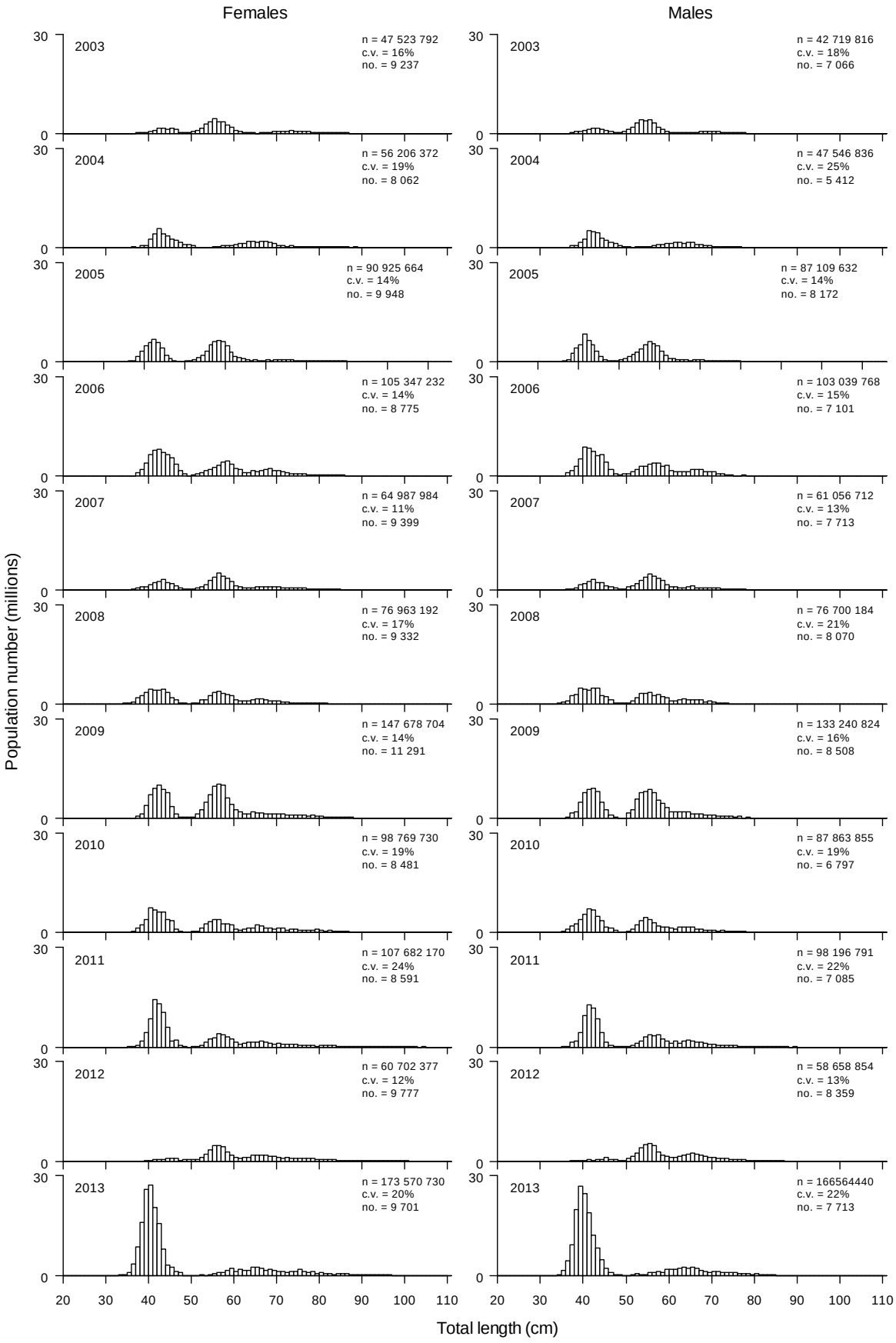


Figure 34 ctd.

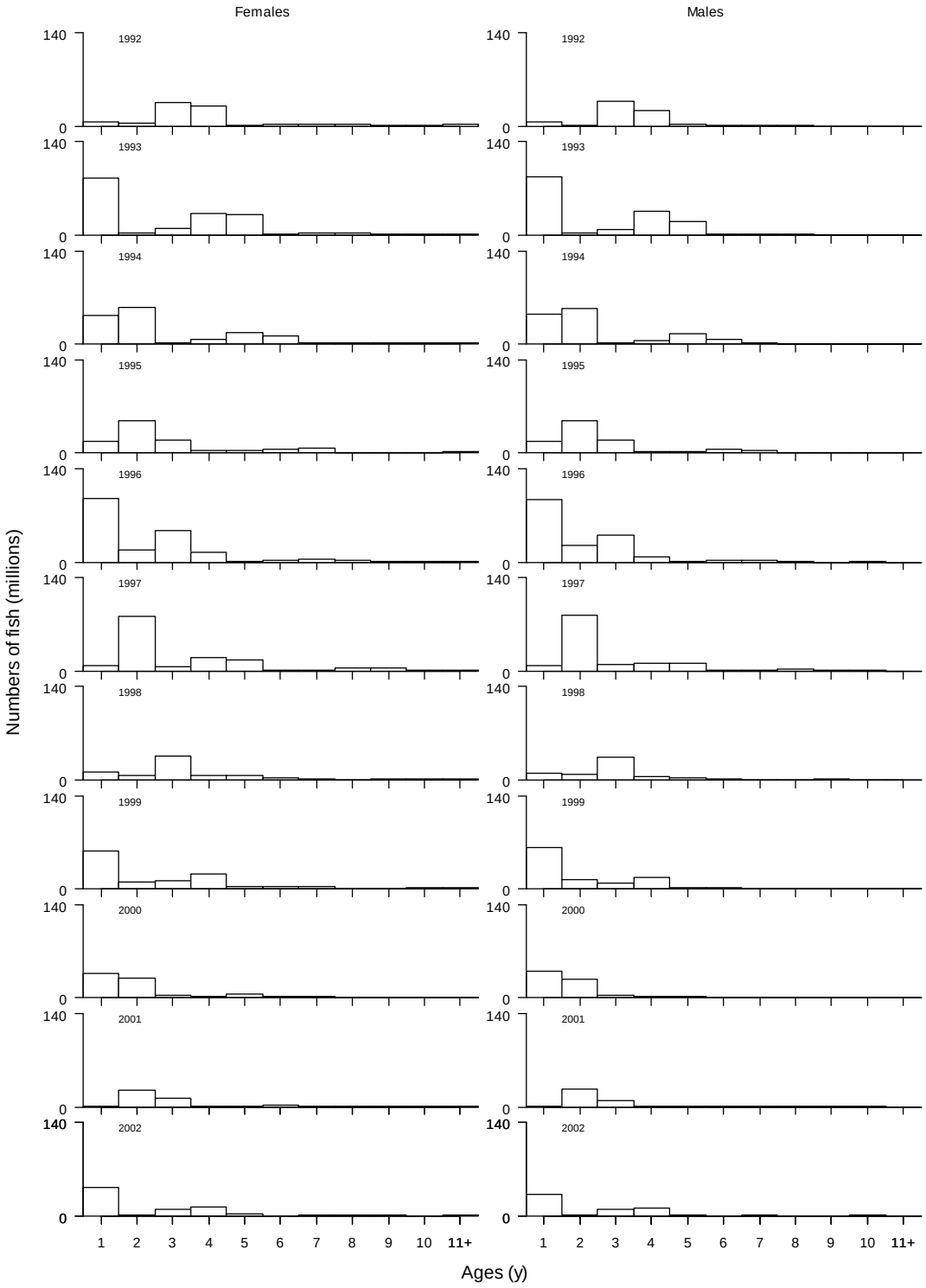


Figure 35: Scaled age frequency for hoki from Chatham Rise *Tangaroa* trawl surveys 1992–2011.

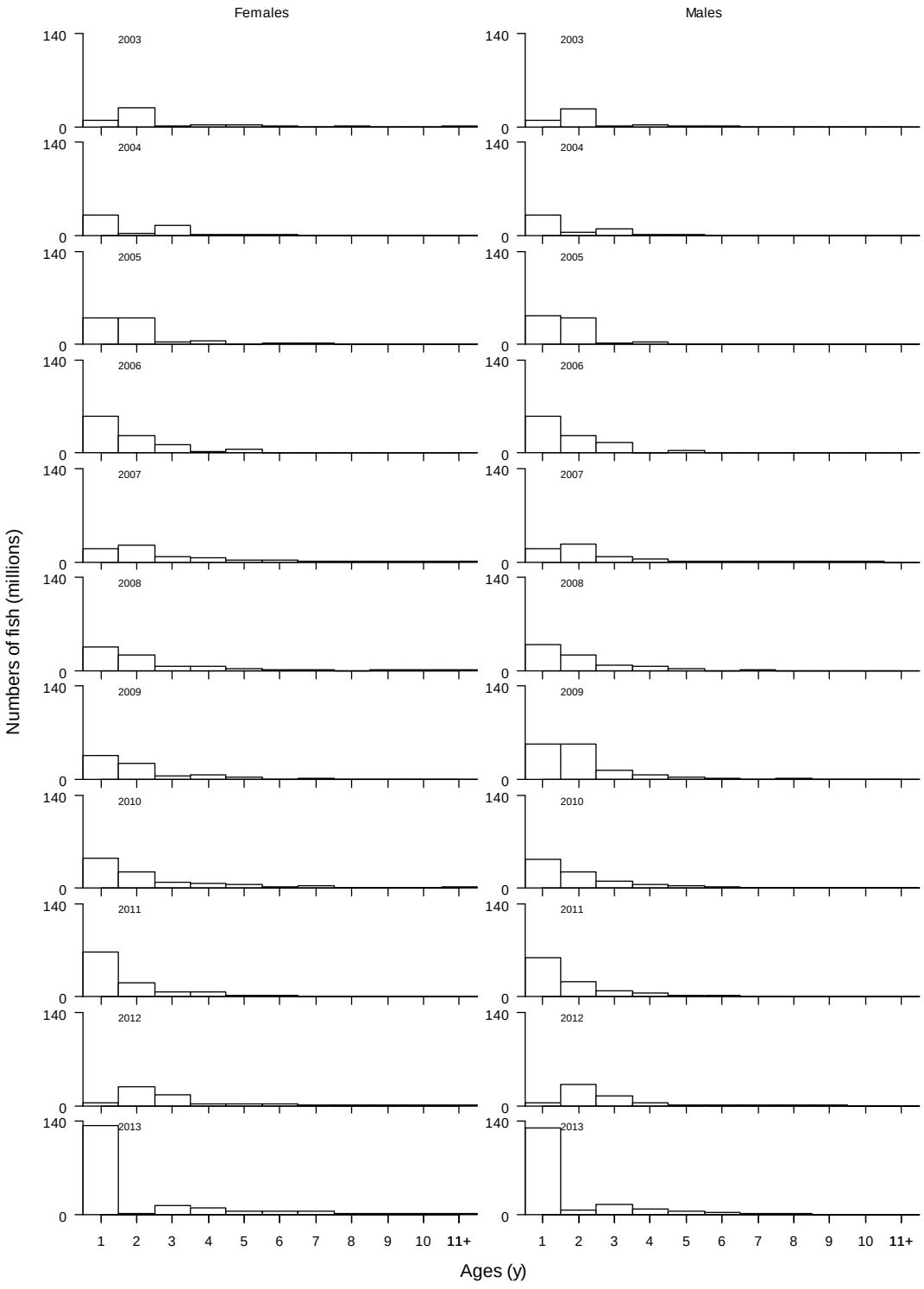


Figure 35 ctd.

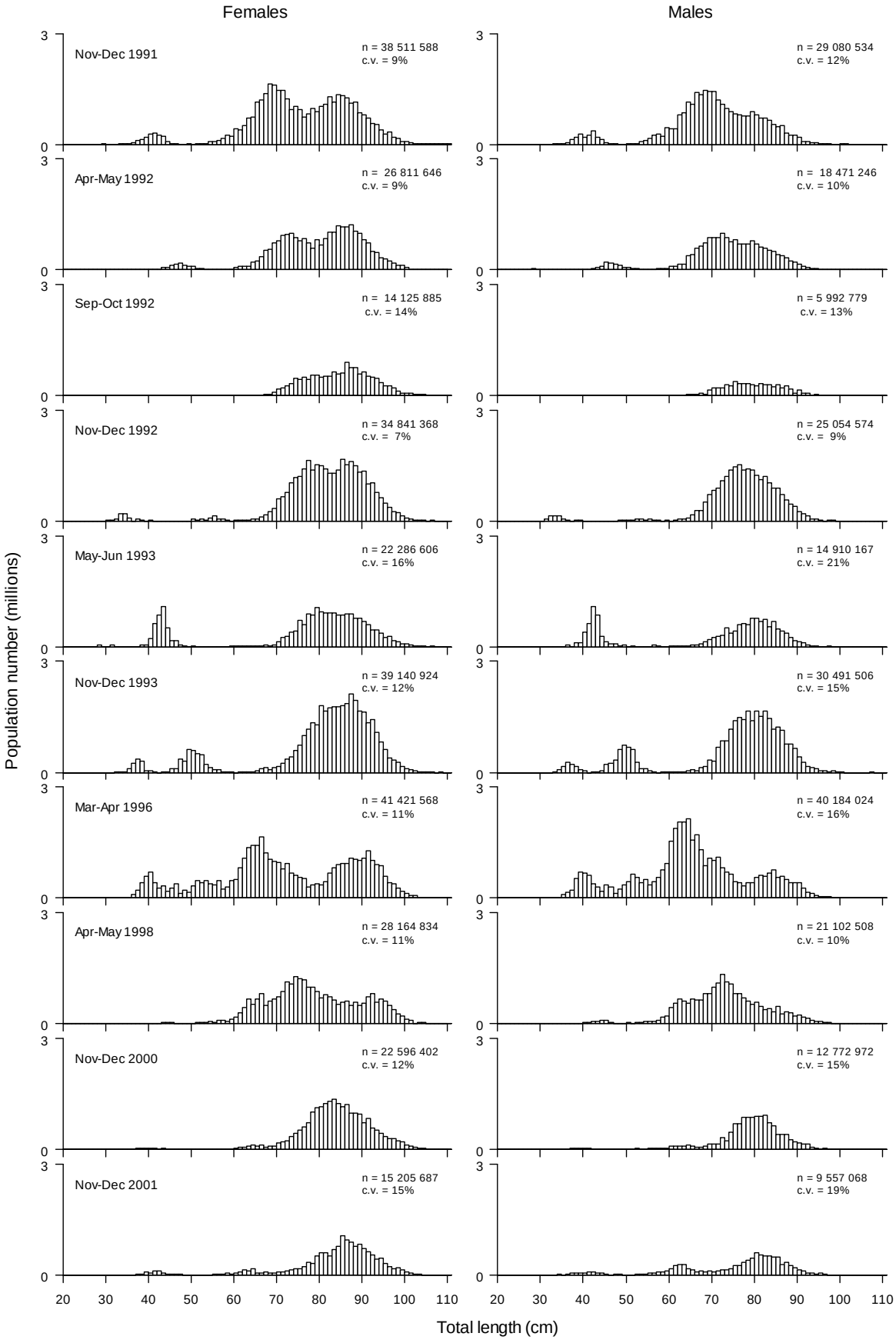


Figure 36: Scaled length frequency for hoki from all Sub-Antarctic *Tangaroa* trawl surveys for the core 300–800 m survey area. n, population numbers of fish; c.v., coefficients of variation.

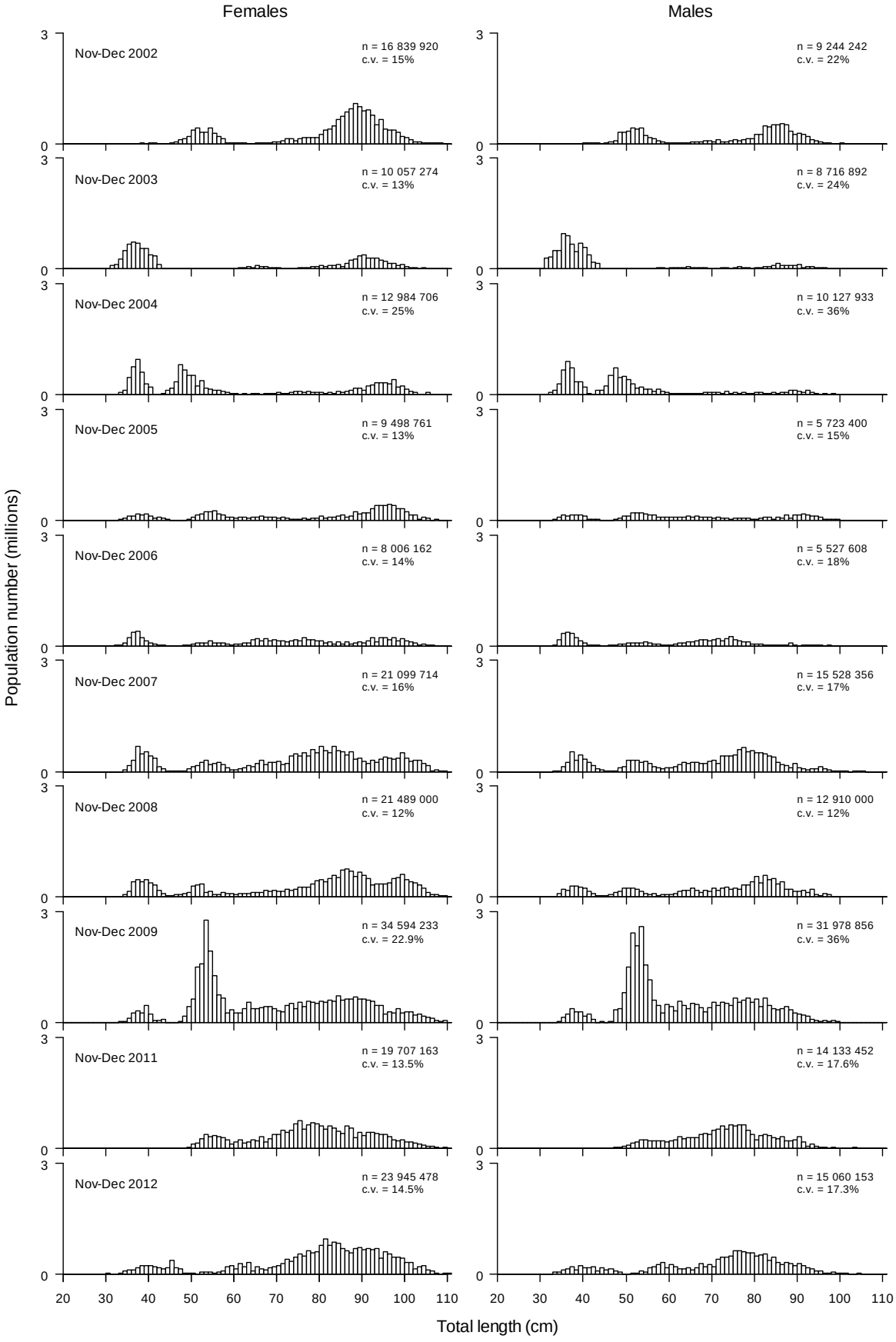


Figure 36 ctd.

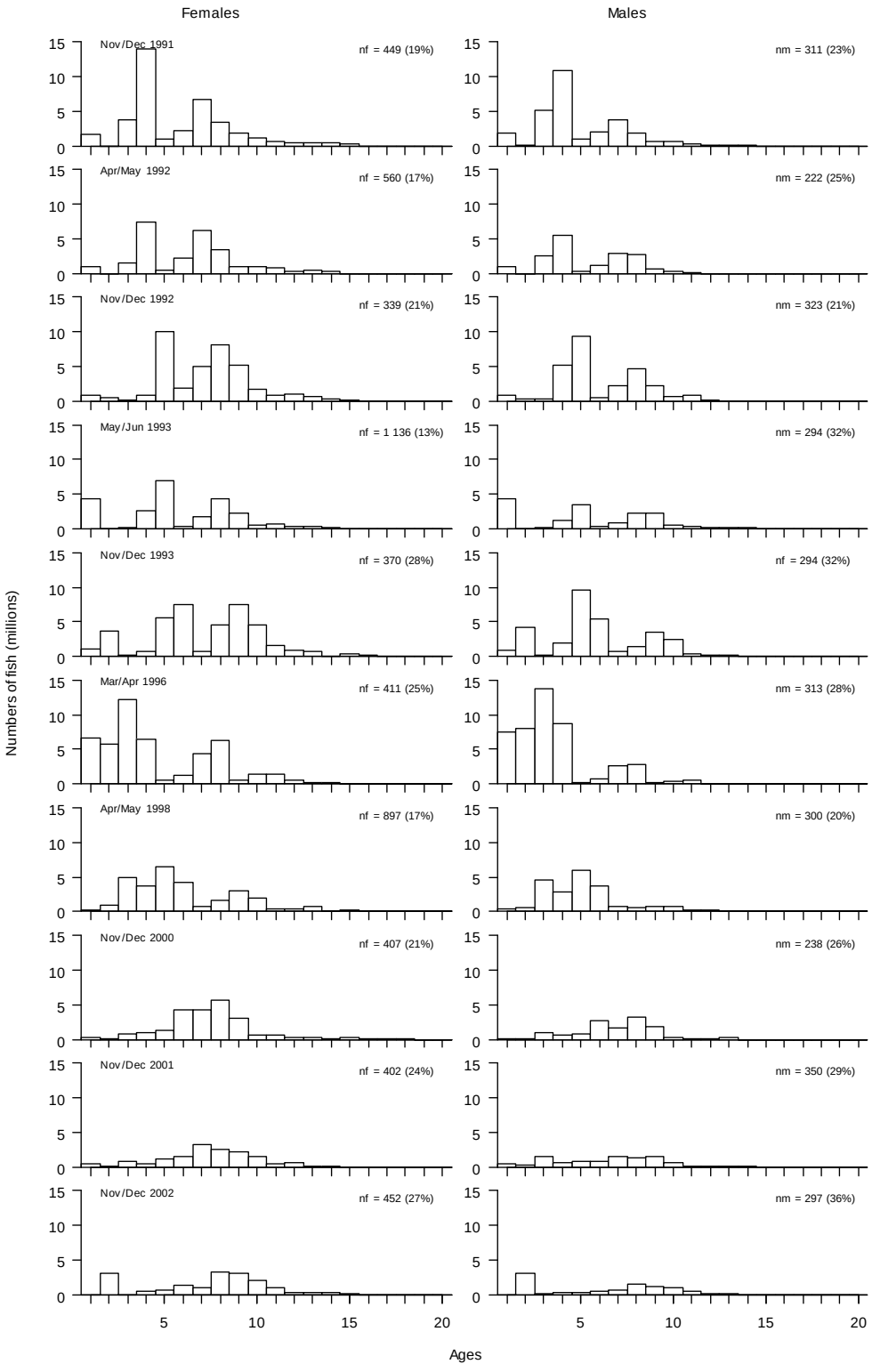


Figure 37: Scaled age frequency for hoki from all Sub-Antarctic *Tangaroa* trawl surveys for the core 300–800 m survey area. Number of fish aged (*nf* female and *nm* male values) are given with c.v.s in parentheses. Black bars show the 1991–94 year-classes.

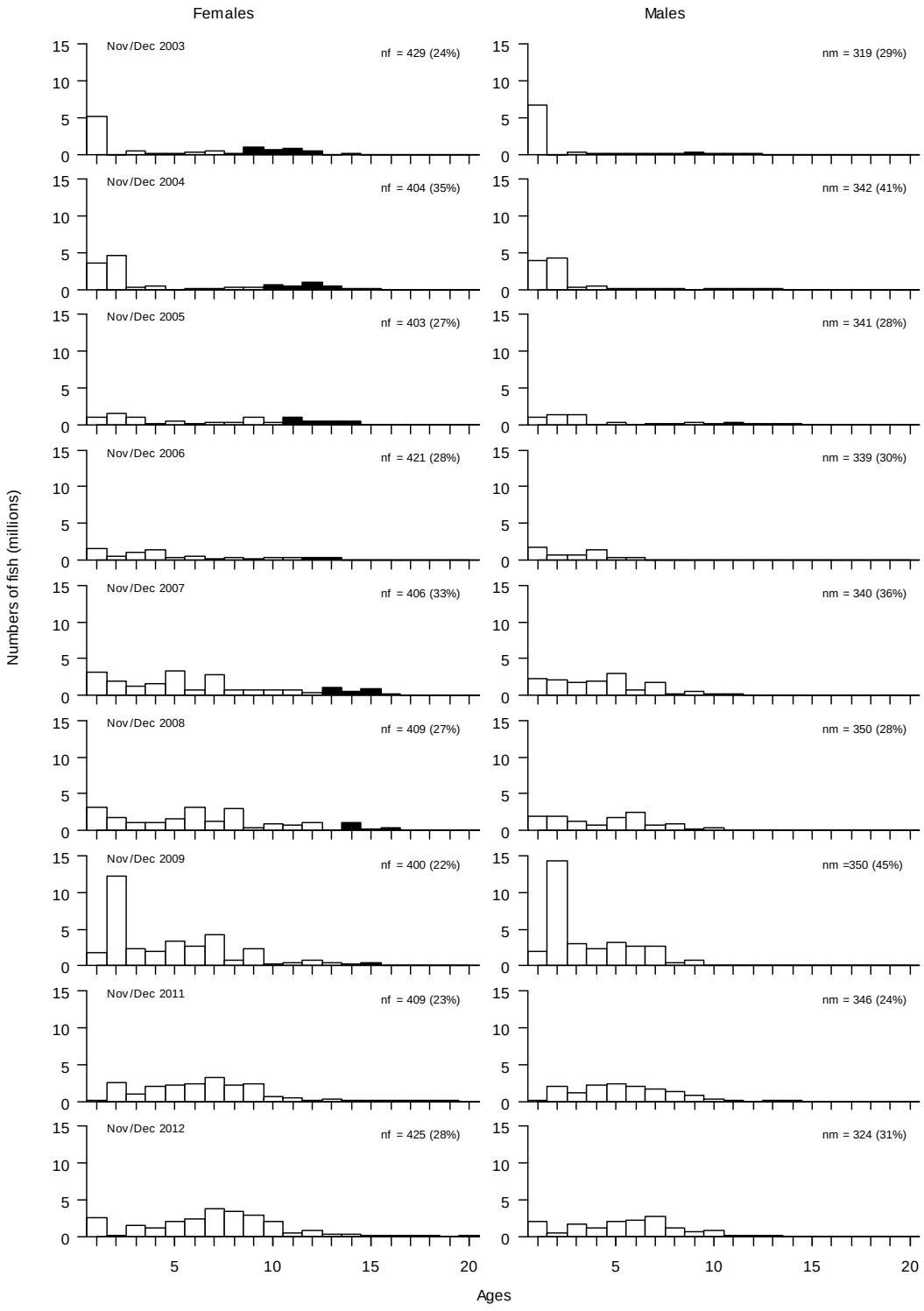


Figure 37 ctd.

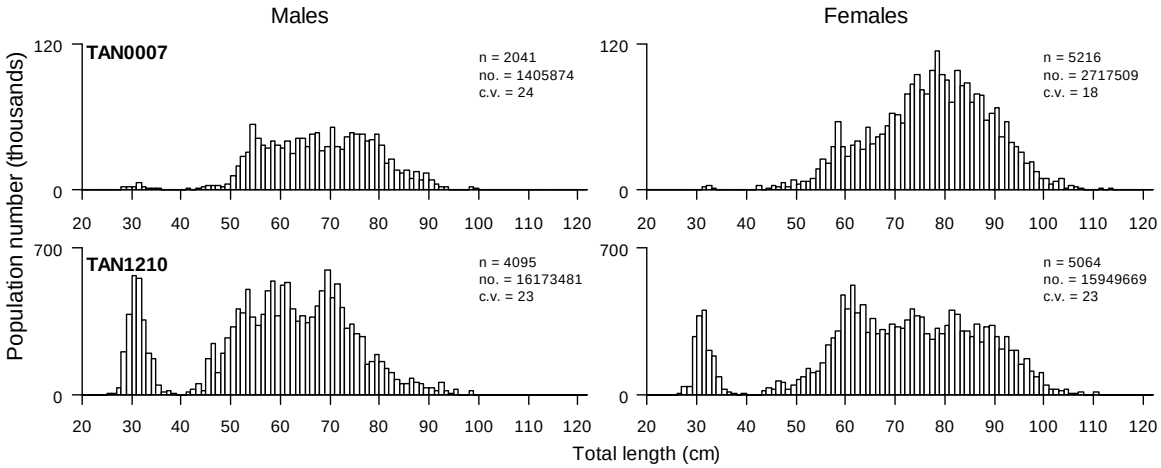


Figure 38: Scaled length frequency for male and female hoki in core strata from WCSI *Tangaroa* trawl surveys in 2000 (TAN0007) and 2012 (TAN1210). n, number of fish measured; no., population numbers of fish; c.v., coefficients of variation.

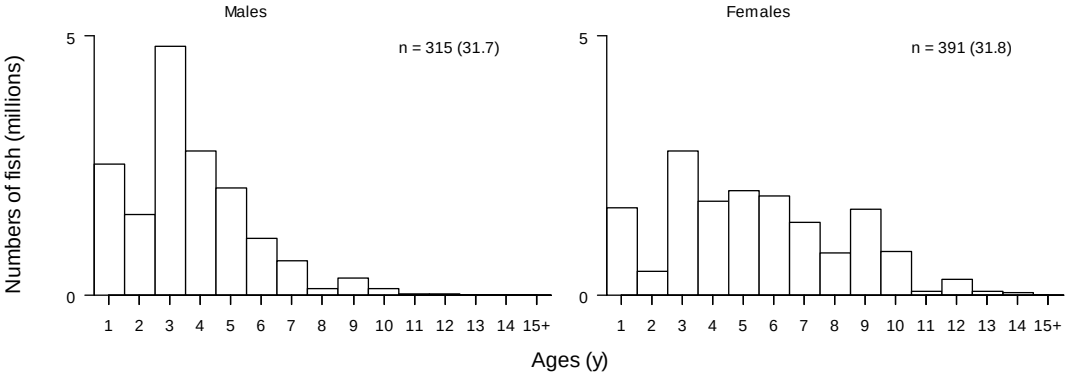


Figure 39: Scaled age frequency for hoki from core strata in the 2012 WCSI *Tangaroa* trawl survey. Number of fish aged (*n* values) are given with c.v.s in parentheses. Hoki were not aged from the 2000 survey.

APPENDICES

Table A1a: Number of vessels, tows, and total catch inside and outside the 25 nautical mile line off WCSI, by year. Data source ungroomed non-zero TCEPR, TCER, and CELR data. Year defined as June to October. There were no October data available for 2012. It is assumed that CELR data all comes from inside the 25 nautical mile line, and includes mid-water and bottom trawl tows reported on the CELR form only.

	Number of vessels					Number of tows				
Fishing year	TCEPR Outside	TCER Outside	TCEPR Inside	TCER Inside	CELR	TCEPR Outside	TCER Outside	TCEPR Inside	TCER Inside	CELR
1990	79	-	37	-	13	7 989	-	83	-	196
1991	75	-	41	-	17	8 135	-	68	-	302
1992	71	-	25	-	17	6 171	-	47	-	358
1993	64	-	22	-	18	6 886	-	108	-	511
1994	69	-	30	-	18	8 463	-	137	-	425
1995	65	-	36	-	21	8 521	-	189	-	319
1996	59	-	27	-	23	6 631	-	157	-	583
1997	73	-	45	-	23	7 597	-	440	-	747
1998	67	-	35	-	23	7 609	-	365	-	449
1999	53	-	34	-	18	6 835	-	280	-	624
2000	47	-	28	-	15	6 624	-	725	-	855
2001	52	-	45	-	16	6 960	-	1 380	-	819
2002	47	-	37	-	13	6 401	-	1 253	-	563
2003	44	-	29	-	8	6 619	-	829	-	680
2004	42	-	31	-	10	5 133	-	1 271	-	748
2005	37	-	15	-	10	3 623	-	530	-	464
2006	35	-	20	-	5	3 993	-	210	-	348
2007	30	-	9	-	6	2 620	-	146	-	253
2008	24	5	8	9	-	2 335	18	45	155	-
2009	25	6	3	11	-	1 961	15	3	253	-
2010	28	5	8	12	-	2 318	13	56	313	-
2011	29	6	9	16	-	2 802	40	298	474	-
2012	29	9	12	14	-	2 848	54	379	488	-

Table A1a ctd.

	Catches (kg)								
Fishing year	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	-	184	1 033	101 540	1
1993	95 402	-	95 402	737	-	522	1 259	96 661	1
1994	113 833	-	113 833	1 110	-	693	1 803	115 636	1
1995	79 083	-	79 083	1 851	-	747	2 598	81 681	3
1996	67 247	-	67 247	2 492	-	1 908	4 400	71 647	3
1997	82 141	-	82 141	5 637	-	2 360	7 997	90 138	6
1998	96 144	-	96 144	5 522	-	2 610	8 132	104 276	5
1999	85 486	-	85 486	4 295	-	3 846	8 141	93 627	5
2000	87 547	-	87 547	9 443	-	4 719	14 162	101 709	9
2001	80 508	-	80 508	16 627	-	4 979	21 606	102 114	16
2002	70 674	-	70 674	17 846	-	4 180	22 026	92 700	19
2003	57 211	-	57 211	11 583	-	4 944	16 527	73 738	16
2004	26 287	-	26 287	13 922	-	4 885	18 807	45 094	31
2005	24 820	-	24 820	5 574	-	2 223	7 797	32 617	17
2006	33 131	-	33 131	2 681	-	2 438	5 119	38 250	7
2007	30 192	-	30 192	1 128	-	1 962	3 090	33 282	3
2008	19 926	32	19 958	327	567	-	894	20 852	4
2009	19 285	23	19 308	36	1 102	-	1 138	20 446	6
2010	33 178	36	33 214	951	1 983	-	2 934	36 148	8
2011	40 653	168	40 821	4 047	3 441	-	7 488	48 309	16
2012	45 844	148	45 992	4 642	3 598	-	8 240	54 232	15

Table A1b: Number of TCEPR, TCER and CELR Cook Strait tows, total catch, and number of vessels by year. Data source is un-groomed non-zero TCEPR, TCER, and CELR tows catching hoki. 'CELR trawl' includes mid-water and bottom trawl tows reported on the CELR form only. Year defined as June to October. There were no October data available for 2012.

	Number of vessels				Number of tows			
Fishing year	TCEPR	TCER	CELR	Total	TCEPR	TCER	CELR	Total
1990	18	-	30	48	1 071	-	568	1 639
1991	22	-	41	63	2 097	-	1 510	3 607
1992	24	-	31	55	1 684	-	845	2 529
1993	20	-	30	50	1 532	-	934	2 466
1994	31	-	39	70	1 957	-	1 377	3 334
1995	26	-	33	59	2 291	-	1 266	3 557
1996	42	-	37	79	4 699	-	1 485	6 184
1997	40	-	28	68	4 921	-	1 061	5 982
1998	31	-	28	59	3 022	-	1 317	4 339
1999	21	-	28	49	2 656	-	942	3 598
2000	22	-	32	54	2 372	-	1 157	3 529
2001	25	-	23	48	2 042	-	981	3 023
2002	19	-	22	41	1 127	-	531	1 658
2003	21	-	25	46	1 933	-	998	2 931
2004	20	-	31	51	1 863	-	1 134	2 997
2005	15	-	15	30	1 454	-	476	1 930
2006	13	-	13	26	1 067	-	328	1 395
2007	8	-	14	22	980	-	491	1 471
2008	7	20	-	27	668	581	-	1 249
2009	10	21	1	32	878	551	1	1 430
2010	8	18	-	26	841	523	-	1 364
2011	7	20	-	27	519	571	-	1 090
2012	9	20	-	29	779	401	-	1 180

	Catches (kg)			
Fishing year	TCEPR	TCER	CELR	Total
1990	12 109	-	2 596	14 705
1991	22 153	-	7 013	29 166
1992	19 583	-	4 973	24 556
1993	17 533	-	4 199	21 732
1994	26 785	-	9 071	35 856
1995	26 600	-	7 361	33 962
1996	50 982	-	8 018	59 001
1997	49 946	-	6 562	56 508
1998	36 308	-	9 408	45 716
1999	34 040	-	6 222	40 262
2000	30 603	-	8 986	39 588
2001	24 630	-	8 188	32 818
2002	17 628	-	4 104	21 732
2003	27 341	-	7 271	34 613
2004	28 509	-	10 520	39 030
2005	18 482	-	4 369	22 851
2006	16 670	-	3 035	19 704
2007	12 594	-	5 403	17 997
2008	9 215	6 661	-	15 876
2009	10 044	5 112	-	15 156
2010	10 916	4 875	-	15 791
2011	7 315	4 519	-	11 834
2012	10 000	3 155	-	13 154

Table A1c: Number of Chatham Rise and ECSI vessels, tows and catch for all vessels by year for the non-spawning season. Data source is un-groomed non-zero TCEPR, TCER, and CELR tows catching 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 includes data from October to September, and ECSI data includes data from October to May.

	Number of vessels				Number of tows			
Year	TCEPR	TCER	CELR	Total	TCEPR	TCER	CELR	Total
1990	47	-	23	70	3 325	-	529	3 854
1991	69	-	38	107	5 724	-	900	6 624
1992	76	-	30	106	8 601	-	539	9 140
1993	75	-	29	104	8 575	-	512	9 087
1994	78	-	26	104	6 447	-	525	6 972
1995	87	-	31	118	10 028	-	675	10 703
1996	102	-	26	128	11 652	-	405	12 057
1997	105	-	18	123	12 609	-	303	12 912
1998	97	-	18	115	16 176	-	212	16 388
1999	87	-	24	111	14 984	-	421	15 405
2000	70	-	16	86	13 432	-	330	13 762
2001	68	-	11	79	12 360	-	373	12 733
2002	60	-	14	74	10 343	-	280	10 623
2003	63	-	15	78	11 400	-	255	11 655
2004	59	-	11	70	9 511	-	211	9 722
2005	51	-	12	63	7 418	-	132	7 550
2006	52	-	14	66	7 314	-	134	7 448
2007	47	-	11	58	7 324	-	153	7 477
2008	42	11	-	53	7 012	65	-	7 077
2009	37	12	1	50	6 227	79	2	6 308
2010	39	16	-	55	6 003	278	-	6 281
2011	39	14	-	53	5 446	140	-	5 586
2012	37	13	-	50	5 636	190	-	5 826

	Catches (kg)			
Year	TCEPR	TCER	CELR	Total
1990	13 091	-	71	13 161
1991	29 965	-	162	30 126
1992	48 036	-	99	48 134
1993	44 169	-	63	44 231
1994	22 662	-	63	22 725
1995	38 991	-	182	39 173
1996	50 287	-	86	50 372
1997	55 726	-	93	55 819
1998	77 105	-	93	77 197
1999	72 656	-	929	73 585
2000	55 912	-	98	56 010
2001	49 307	-	532	49 840
2002	39 105	-	38	39 144
2003	39 071	-	17	39 088
2004	33 608	-	39	33 647
2005	30 423	-	8	30 432
2006	34 934	-	6	34 941
2007	37 797	-	10	37 806
2008	37 855	60	-	37 915
2009	38 997	8	-	39 005
2010	39 086	47	-	39 133
2011	38 402	40	-	38 442
2012	39 153	72	-	39 226

Table A1d: Number of ECSI vessels, tows and catch for all vessels by year for the spawning season. Data source is un-groomed non-zero TCEPR, TCER, and CELR tows catching hoki. Year defined as June to October. 'CELR trawl' includes mid-water and bottom trawl tows reported on the CELR form only. There were no data available for October 2012.

	Number of vessels				Number of tows			
Fishing year	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

	Catches (kg)			
Fishing year	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

Table A1e: Number of Sub-Antarctic vessels, tows and catch for all vessels by fishing year. Data source is un-groomed non-zero TCEPR, TCER, and CELR tows catching hoki. 'CELR trawl' includes mid-water and bottom trawl tows reported on the CELR form only.

	Number of vessels				Number of tows			
Fishing year	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	2 729	3	-	2 732

	Catches (kg)			
Fishing year	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	15 745	-	-	15 745

Table A1f: Number of Puysegur vessels, tows and catch for all vessels by year for the spawning season. Data source is un-groomed non-zero TCEPR, TCER, and CELR tows catching hoki. Year defined as June to December. 'CELR trawl' includes mid-water and bottom trawl tows reported on the CELR form only. There were no October to December data available for 2012.

	Number of vessels				Number of tows			
Fishing year	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

	Catches (kg)			
Fishing year	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

Table A2a: Number of tows, vessels, median tow duration, catch per tow, and catch per hour for all WCSI vessels by year. Year defined as June to October. There were no October data available for 2012. Data are non-zero catches for TCEPR midwater tows.

All target species MW 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	6 780	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	82 529	5 263	3.2	10.3	3.7
1994	63	105 195	7 139	3.0	8.9	3.2
1995	59	75 148	7 408	3.5	4.9	1.4
1996	59	64 802	5 171	3.5	6.8	1.9
1997	76	82 639	6 611	3.8	7.4	2.0
1998	66	95 864	6 695	3.5	10.4	2.8
1999	56	76 767	5 256	3.1	10.3	3.3
2000	52	79 535	5 316	2.8	12.0	4.3
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	51 751	4 312	3.0	8.1	2.4
2004	51	32 049	4 230	2.4	4.6	1.5
2005	37	19 682	2 365	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	12 047	886	1.8	6.4	3.8
2009	23	12 590	887	3.2	8.9	3.1
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	30 126	1 567	2.1	16.3	7.9
All years	239	1 415 547	98 533	3.2	9.0	2.8

Target hoki MW 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	82 133	5 030	3.1	10.5	4.1
1994	62	105 007	6 978	3.0	9.5	3.3
1995	59	74 715	7 145	3.5	4.9	1.4
1996	59	64 735	5 115	3.5	6.8	1.9
1997	76	82 222	6 505	3.8	7.9	2.1
1998	66	95 670	6 630	3.5	10.4	2.8
1999	56	76 532	5 142	3.1	10.3	3.4
2000	51	79 269	5 194	2.7	12.0	4.5
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	4 152	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	12 367	685	2.7	14.2	5.0
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	30 076	1 559	2.1	16.3	7.9
All years	239	1 410 612	95 861	3.2	9.4	2.9

Table A2b: Number of tows, vessels, median tow duration, catch per tow, and catch per hour for all WCSI vessels by year. Year defined as June to October. There were no October data available for 2012. Data are non-zero catches for TCEPR bottom tows.

All target species BT 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	38	9 334	1 036	4.1	4.1	1.0
1993	33	13 656	1 727	3.8	5.2	1.4
1994	32	9 703	1 468	4.2	3.7	0.8
1995	27	5 809	1 331	4.5	2.5	0.5
1996	38	4 914	1 586	4.7	2.1	0.4
1997	47	5 145	1 442	5.0	2.2	0.5
1998	40	5 925	1 308	5.2	2.9	0.5
1999	39	12 894	1 835	4.7	4.1	0.8
2000	34	17 487	2 064	4.5	6.0	1.2
2001	40	18 238	2 399	4.5	5.0	0.9
2002	35	26 993	3 005	5.0	5.2	1.0
2003	39	17 057	3 197	5.3	2.3	0.4
2004	35	8 174	2 154	6.0	1.5	0.3
2005	30	10 708	1 801	6.6	2.5	0.4
2006	26	14 723	2 145	8.3	2.8	0.4
2007	22	10 252	1 344	7.1	3.1	0.4
2008	17	8 179	1 472	9.0	2.4	0.3
2009	18	6 735	1 083	9.2	3.0	0.3
2010	21	11 116	1 171	7.2	4.9	0.8
2011	21	15 075	1 565	6.1	6.2	1.0
2012	23	20 356	1 656	5.2	9.9	1.9
All years	144	274 159	39 539	5.0	3.3	0.6

Target hoki BT 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	9 679	1 369	4.3	4.2	0.9
1995	24	5 794	1 290	4.5	2.5	0.5
1996	37	4 885	1 544	4.7	2.1	0.4
1997	42	5 115	1 354	5.0	2.5	0.5
1998	34	5 888	1 217	5.3	3.1	0.5
1999	35	12 856	1 689	4.7	5.1	1.0
2000	32	17 417	1 903	4.4	6.3	1.4
2001	37	18 216	2 314	4.6	5.0	1.0
2002	34	26 724	2 839	5.0	5.9	1.1
2003	39	16 793	2 791	5.1	3.0	0.6
2004	34	7 911	1 799	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	350	4.5	11.2	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	18 856	1 184	3.8	15.0	4.1
All years	130	256 691	31 847	4.7	4.5	0.9

Table A2c: Number of tows, vessels, median tow duration, catch per tow, and catch per hour for all Cook Strait vessels by year. Year defined as June to October. There were no October data available for 2012. Data are non-zero catches for TCEPR midwater tows.

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	11 894	1 048	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	25 106	1 810	1.0	11.8	11.8
1995	24	24 376	2 162	1.0	8.3	9.9
1996	36	41 820	3 087	0.8	11.1	16.7
1997	34	43 248	3 592	1.0	10.6	11.2
1998	28	30 711	2 373	1.0	11.4	11.7
1999	21	28 084	2 037	1.0	12.7	14.8
2000	21	27 935	1 989	0.7	12.0	19.3
2001	25	23 581	1 842	0.8	11.0	14.0
2002	15	17 147	1 068	1.0	14.9	17.2
2003	20	26 979	1 816	1.0	12.6	16.2
2004	19	27 712	1 793	1.0	12.2	14.2
2005	13	18 166	1 344	1.0	13.0	16.9
2006	11	16 330	1 015	0.8	15.1	20.5
2007	7	12 444	952	1.0	11.0	13.8
2008	6	7 558	404	0.8	18.4	23.3
2009	8	9 095	740	0.6	10.1	18.2
2010	8	10 839	820	0.8	11.2	14.9
2011	6	7 346	527	0.8	11.3	16.7
2012	9	9 658	719	0.9	11.5	15.1
All years	71	478 329	36 348	1.0	10.6	12.4

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	11 894	1 048	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	25 065	1 804	1.0	11.8	11.9
1995	24	24 320	2 158	1.0	8.3	9.9
1996	36	41 744	3 076	0.8	11.2	16.7
1997	34	43 179	3 585	1.0	10.6	11.2
1998	28	30 674	2 371	1.0	11.4	11.7
1999	21	28 081	2 036	1.0	12.7	14.8
2000	21	27 935	1 989	0.7	12.0	19.3
2001	25	23 553	1 839	0.8	11.0	14.0
2002	15	17 147	1 068	1.0	14.9	17.2
2003	20	26 979	1 814	1.0	12.6	16.3
2004	19	27 712	1 791	1.0	12.2	14.2
2005	13	18 162	1 343	1.0	13.0	16.9
2006	11	16 330	1 014	0.8	15.1	20.5
2007	7	12 396	949	1.0	10.9	13.8
2008	5	7 555	397	0.8	18.8	24.3
2009	8	9 083	739	0.6	10.1	18.2
2010	8	10 783	818	0.8	11.2	14.8
2011	6	7 346	527	0.8	11.3	16.7
2012	9	9 658	719	0.9	11.5	15.1
All years	71	477 875	36 289	1.0	10.6	12.4

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 data from October to May.

All bottom 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	13 001	3 297	4.0	1.5	0.5
1991	59	18 080	4 787	4.0	2.0	0.5
1992	72	43 456	8 169	4.0	3.1	0.8
1993	61	39 238	7 523	3.9	3.4	1.0
1994	64	18 125	5 305	3.5	2.1	0.7
1995	70	30 585	7 914	3.8	3.0	0.9
1996	84	37 624	9 295	3.6	3.0	0.9
1997	96	42 898	10 330	3.7	3.2	0.9
1998	82	55 824	12 479	4.0	3.3	0.9
1999	77	61 528	12 620	4.0	4.1	1.0
2000	60	44 753	10 746	4.1	3.0	0.8
2001	60	46 150	11 429	4.5	3.0	0.7
2002	55	36 271	9 491	4.5	2.9	0.7
2003	62	37 415	10 912	4.7	2.5	0.5
2004	58	31 656	9 131	5.0	2.3	0.5
2005	50	28 914	7 048	5.0	2.8	0.6
2006	50	34 077	7 145	4.8	3.5	0.8
2007	46	37 640	7 267	4.6	3.5	0.8
2008	38	37 375	6 890	4.8	3.6	0.8
2009	37	38 956	6 186	4.3	4.6	1.1
2010	38	38 454	5 833	4.5	5.3	1.2
2011	38	38 136	5 286	4.7	5.9	1.2
2012	35	38 803	5 417	4.8	5.7	1.3
All years	199	848 959	184 500	4.2	3.1	0.8

Target hoki bottom 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	11 788	1 902	4.0	3.8	1.0
1991	41	16 761	3 285	4.0	3.5	0.9
1992	47	42 305	5 408	3.8	5.7	1.6
1993	40	38 354	5 169	3.5	5.7	1.6
1994	36	17 525	3 372	3.2	4.2	1.3
1995	42	30 097	6 485	3.5	3.9	1.1
1996	58	37 181	7 970	3.5	3.2	1.0
1997	73	42 380	8 988	3.5	3.7	1.1
1998	63	55 315	11 159	4.0	4.2	1.0
1999	46	60 838	11 244	4.0	4.4	1.1
2000	34	44 113	9 413	4.1	3.7	0.9
2001	40	44 928	9 762	4.5	3.5	0.8
2002	31	35 087	7 773	4.4	3.4	0.8
2003	32	36 051	9 196	4.8	3.0	0.6
2004	28	30 207	7 142	4.9	3.0	0.6
2005	21	27 472	4 973	5.0	4.1	0.8
2006	20	32 329	4 997	4.8	5.0	1.0
2007	21	34 746	4 733	4.5	5.8	1.2
2008	22	33 527	4 187	4.8	6.6	1.4
2009	21	33 645	3 896	4.2	7.3	1.7
2010	21	35 151	4 349	4.6	6.9	1.5
2011	23	34 811	4 056	4.8	7.2	1.5
2012	24	37 644	4 380	4.8	7.2	1.6
All years	163	812 256	143 839	4.1	4.2	1.0

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. There were no October data available for 2012. Data are not shown for MW vessels in 2009 or 2010 as there was only 1 vessel.

All target species mid-water 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	462	24	0.7	15.2	21.2
2010	1	-	-	-	-	-
2011	4	879	57	1.0	14.7	10.8
2012	8	1 655	107	1.5	13.2	6.2

Target hoki mid-water 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	4 421	299	2.2	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	477	40	1.5	10.4	6.1
2007	4	299	26	1.1	8.7	8.8
2008	3	213	21	3.8	8.1	2.7
2009	1	304	17	0.8	15.2	18.0
2010	1	-	-	-	-	-
2011	4	879	57	1.0	14.7	10.8
2012	8	1 655	107	1.5	13.2	6.2

All target species bottom 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	696	74	2.3	8.0	2.9

Table A2e ctd.

Target hoki bottom 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	8	250	66	2.5	2.6	1.0
2001	12	441	84	2.7	3.5	1.2
2002	11	821	120	2.7	3.9	1.7
2003	13	2 022	245	2.9	5.6	1.9
2004	4	249	40	2.8	3.5	1.1
2005	6	712	95	2.9	4.6	1.8
2006	4	105	21	2.1	2.9	1.6
2007	8	664	69	2.2	8.3	3.4
2008	8	1 858	174	2.9	9.2	2.9
2009	6	612	67	2.9	8.2	2.4
2010	7	501	62	2.8	7.6	2.2
2011	6	592	55	3.5	10.9	3.0
2012	7	696	69	2.5	9.3	3.2

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 un-groomed non-zero TCEPR bottom tows catching hoki.

All target species bottom 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	13 667	2 578	5.0	2.2	0.5
All years	165	367 701	96 492	4.5	2.2	0.5

Hoki target bottom 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	11 540	1 193	4.6	7.6	1.6
All years	109	342 482	67 139	4.2	3.6	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. There were no October to December data available for 2012. Data have been removed where there is one vessel only.

All target species midwater 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	1 058	141	3.0	5.2	2.0
1993	8	660	71	2.0	6.2	2.8
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	7	884	95	3.0	8.2	2.4
1999	16	1 416	141	3.4	4.8	1.3
2000	13	2 054	161	4.2	8.0	2.0
2001	22	5 212	372	4.3	10.0	2.2
2002	19	3 128	260	3.6	6.8	1.6
2003	20	5 137	309	2.8	12.1	3.6
2004	4	574	33	3.7	12.2	3.0
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	1 047	75	3.2	12.9	3.2
2012	2	818	87	3.1	4.6	1.5
All years	104	47 096	4 010	3.0	8.0	2.6

Hoki target mid-water 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	1 027	129	3.0	5.2	2.0
1993	8	660	71	2.0	6.2	2.8
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	7	884	95	3.0	8.2	2.4
1999	16	1 416	141	3.4	4.8	1.3
2000	13	2 054	161	4.2	8.0	2.0
2001	22	5 206	371	4.3	10.0	2.2
2002	19	3 128	260	3.6	6.8	1.6
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	1 047	75	3.2	12.9	3.2
2012	2	818	87	3.1	4.6	1.5
All years	102	47 004	3 985	3.0	8.0	2.6

Table A2g ctd.: Puysegur.

All target species bottom 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	15	104	207	3.3	0.2	0.1
1991	24	1 663	372	4.3	3.1	0.8
1992	30	4 012	842	4.3	3.0	0.6
1993	12	1 044	220	4.2	3.4	0.8
1994	20	394	175	4.2	1.1	0.3
1995	12	252	200	5.8	0.5	0.1
1996	16	955	354	4.3	1.0	0.2
1997	25	1 162	336	5.5	0.8	0.2
1998	19	1 295	252	4.8	2.8	0.6
1999	22	966	265	5.2	1.1	0.2
2000	20	849	273	5.4	1.0	0.2
2001	24	919	221	4.2	2.0	0.5
2002	18	1 852	193	3.8	6.5	1.5
2003	20	796	181	4.5	1.8	0.4
2004	14	198	81	4.8	0.6	0.1
2005	21	582	291	5.8	0.9	0.1
2006	16	1 002	256	4.0	1.0	0.3
2007	13	253	118	5.0	0.7	0.1
2008	6	134	56	4.8	1.4	0.3
2009	7	126	57	3.1	1.0	0.3
2010	7	121	110	4.8	0.5	0.1
2011	11	208	108	4.5	1.0	0.2
2012	4	76	29	3.7	0.6	0.3
All years	95	18 963	5 197	4.5	1.4	0.3

Hoki target bottom 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	22	20	3.5	0.7	0.2
1991	20	1 541	310	4.1	4.1	0.9
1992	26	3 778	701	4.2	3.1	0.8
1993	11	1 019	201	4.0	4.0	0.9
1994	16	356	138	4.4	1.1	0.3
1995	9	217	144	5.8	0.6	0.1
1996	16	892	272	4.1	1.5	0.3
1997	22	983	295	5.3	0.9	0.2
1998	18	1 262	237	4.8	3.0	0.7
1999	21	931	238	5.1	1.2	0.2
2000	18	817	224	5.0	1.6	0.3
2001	22	910	198	4.2	2.5	0.6
2002	16	1 836	184	3.8	7.0	1.7
2003	14	774	135	4.5	3.0	0.7
2004	5	152	24	3.3	4.2	1.2
2005	8	240	51	3.2	2.2	0.9
2006	6	707	79	3.5	6.0	2.1
2007	2	57	14	3.8	2.1	0.5
2008	1	-	-	-	-	-
2009	1	-	-	-	-	-
2010	1	-	-	-	-	-
2011	1	-	-	-	-	-
2012	1	-	-	-	-	-
All years	77	16 592	3 478	4.3	2.5	0.6

Table A3: CPUE datasets for all vessels and for core vessels for each year (1990–2012) for main hoki areas

WCSI: All target species

	All vessels				Core vessels			
Fishing year	No. vessels	Catch	Effort	CPUE	No. vessels	Catch	Effort	CPUE
1990	79	116 735.5	7 580	15.40	20	45 522.1	2 322	19.60
1991	75	104 129.9	7 755	13.43	28	56 687.1	2 872	19.74
1992	69	87 518.0	5 905	14.82	29	45 502.8	2 607	17.45
1993	63	78 751.4	6 268	12.56	34	49 926.0	3 749	13.32
1994	67	97 929.4	8 290	11.81	42	71 331.9	5 566	12.82
1995	62	65 943.8	8 324	7.92	43	49 747.7	6 097	8.16
1996	62	59 966.6	6 624	9.05	42	53 003.0	5 288	10.02
1997	77	79 448.9	7 735	10.27	52	67 923.2	6 164	11.02
1998	67	91 752.9	7 702	11.91	53	83 867.3	6 938	12.09
1999	59	83 534.8	6 838	12.22	50	81 005.8	6 697	12.10
2000	52	93 861.0	7 188	13.06	44	91 025.3	6 902	13.19
2001	63	93 648.2	8 125	11.53	48	87 025.4	7 327	11.88
2002	56	84 652.5	7 394	11.45	48	79 789.1	6 967	11.45
2003	51	65 973.7	7 166	9.21	44	61 623.2	6 748	9.13
2004	51	39 647.8	6 205	6.39	41	35 064.7	5 656	6.20
2005	38	29 275.1	4 024	7.28	37	27 339.0	3 796	7.20
2006	37	31 447.1	3 795	8.29	34	30 318.4	3 596	8.43
2007	32	30 129.1	2 479	12.15	29	29 411.1	2 378	12.37
2008	25	19 938.5	2 314	8.62	23	19 629.6	2 277	8.62
2009	24	18 969.1	1 825	10.39	21	18 875.1	1 788	10.56
2010	28	31 739.5	2 240	14.17	25	31 654.9	2 202	14.38
2011	28	43 890.6	2 977	14.74	27	43 816.3	2 970	14.75
2012	30	50 205.2	3 179	15.79	27	48 125.7	3 018	15.95

Cook Strait: Target hoki, June–October, mid-water tows

	All vessels				Core vessels			
Fishing year	No. vessels	Catch	Effort	CPUE	No. vessels	Catch	Effort	CPUE
1990	17	11 751.7	1 040	11.30	8	3 682.2	318	11.58
1991	22	21 708.2	2 040	10.64	12	10 732.6	1 129	9.51
1992	22	17 839.8	1 567	11.38	15	10 327.0	887	11.64
1993	18	16 583.4	1 459	11.37	11	10 565.0	855	12.36
1994	28	23 988.6	1 731	13.86	16	16 719.9	1 073	15.58
1995	24	21 918.2	1 965	11.15	16	18 205.4	1 359	13.40
1996	36	35 407.2	2 647	13.38	22	21 324.7	1 517	14.06
1997	34	37 778.0	3 080	12.27	23	27 853.3	2 213	12.59
1998	28	27 356.6	2 106	12.99	20	22 490.5	1 759	12.79
1999	20	25 908.3	1 830	14.16	18	23 961.1	1 712	14
2000	21	22 404.1	1 601	13.99	20	21 080.9	1 492	14.13
2001	25	20 493.3	1 617	12.67	20	17 947.9	1 423	12.61
2002	15	15 353.9	923	16.63	14	14 350.2	862	16.65
2003	19	23 308.6	1 562	14.92	13	19 978.9	1 273	15.69
2004	19	25 397.5	1 640	15.49	15	23 110.9	1 481	15.60
2005	12	15 647.1	1 163	13.45	12	15 401.3	1 147	13.43
2006	11	13 993.1	893	15.67	11	13 651.0	865	15.78
2007	7	10 829.0	852	12.71	6	10 509.3	821	12.80
2008	5	6 282.8	329	19.10	4	6 199.5	321	19.31
2009	8	6 891.4	592	11.64	6	6 362.4	542	11.74
2010	8	9 529.8	742	12.84	7	9 481.3	733	12.93
2011	6	6 442.6	471	13.68	6	6 349.7	467	13.60
2012	9	8 823.8	668	13.21	7	8 325.4	608	13.69

Table A3 ctd.

Chatham Rise and ECSI non-spawning: All target species

	All vessels				Core vessels			
Fishing year	No. vessels	Catch	Effort	CPUE	No. vessels	Catch	Effort	CPUE
1991	41	14 889.5	3 190	4.67	4	5 483.0	886	6.19
1992	59	38 204.7	6 284	6.08	7	11 984.5	2 124	5.64
1993	51	32 184.3	6 073	5.30	7	14 728.8	3 000	4.91
1994	53	13 975.7	4 184	3.34	5	8 816.9	1 813	4.86
1995	59	21 328.3	5 470	3.90	11	15 638.9	3 228	4.84
1996	64	28 101.6	6 594	4.26	10	23 777.4	4 152	5.73
1997	83	34 697.5	7 792	4.45	13	26 959.3	4 791	5.63
1998	77	43 284.6	9 340	4.63	15	36 004.3	6 638	5.42
1999	66	54 739.7	10 409	5.26	18	50 089.4	8 779	5.71
2000	52	38 134.9	8 797	4.33	15	35 805.2	7 478	4.79
2001	57	39 052.7	9 418	4.15	16	36 830.8	8 109	4.54
2002	51	29 623.7	7 565	3.92	17	27 993.0	6 394	4.38
2003	58	30 037.3	8 718	3.45	18	27 464.5	7 371	3.73
2004	55	20 411.1	6 594	3.10	18	19 269.4	5 474	3.52
2005	46	22 140.3	5 281	4.19	17	21 152.6	4 246	4.98
2006	43	28 033.3	5 340	5.25	14	25 820.7	4 142	6.23
2007	39	29 508.8	5 158	5.72	13	26 618.6	3 854	6.91
2008	33	28 554.2	4 916	5.81	13	24 821.0	3 387	7.33
2009	30	32 067.8	4 766	6.73	12	26 088.4	3 433	7.60
2010	33	32 228.8	4 546	7.09	13	29 243.6	3 755	7.79
2011	32	33 082.9	4 399	7.52	9	27 946.6	3 306	8.45
2012	31	32 077.1	4 235	7.57	10	27 500.5	3 057	9

Sub-Antarctic: All target species

	All vessels				Core vessels			
Fishing year	No. vessels	Catch	Effort	CPUE	No. vessels	Catch	Effort	CPUE
1990	32	11 382.8	2 499	4.55	3	4 576.2	852	5.37
1991	39	16 080.8	4 365	3.68	5	7 003.2	1 983	3.53
1992	55	29 347.4	6 775	4.33	8	20 696.9	4 125	5.02
1993	35	22 226.5	5 602	3.97	8	19 659.7	4 422	4.45
1994	41	9 017.9	3 126	2.88	5	7 882.4	1 718	4.59
1995	40	11 700.0	3 206	3.65	5	10 479.8	1 920	5.46
1996	43	10 825.9	3 336	3.25	5	6 697.4	1 461	4.58
1997	58	19 111.9	4 444	4.30	10	15 777.3	2 457	6.42
1998	48	23 941.6	5 145	4.65	10	21 455.7	3 654	5.87
1999	47	20 550.2	4 583	4.48	10	16 577.4	2 840	5.84
2000	39	31 267.1	6 948	4.50	13	27 653.9	5 054	5.47
2001	44	26 063.6	6 586	3.96	14	22 089.9	4 797	4.60
2002	46	29 273.4	7 976	3.67	15	25 619.4	5 763	4.45
2003	43	19 797.7	5 490	3.61	14	16 455.3	3 771	4.36
2004	39	11 150.6	3 682	3.03	10	9 543.3	2 546	3.75
2005	38	6 135.9	2 518	2.44	11	4 328.6	1 379	3.14
2006	33	6 439.1	2 265	2.84	8	4 214.7	1 261	3.34
2007	29	7 342.4	2 798	2.62	9	5 039.1	1 818	2.77
2008	28	7 956.7	2 566	3.10	9	7 060.8	1 896	3.72
2009	24	9 172.8	2 607	3.52	6	7 907.9	1 704	4.64
2010	27	11 518.2	2 880	4	6	9 877.2	1 758	5.62
2011	27	10 950.3	2 527	4.33	5	8 529.2	1 578	5.41
2012	27	13 581.2	2 408	5.64	8	10 340.0	1 435	7.21

Table A4: CPUE estimated values and 95% confidence intervals by year for core vessels for main hoki areas.

	WCSI All target species		WCSI Target hoki		Cook Strait Target hoki, MW	
Year	Index	CI	Index	CI	Index	CI
1990	1.15	1.10–1.20	1.15	1.10–1.21	1.15	1.03–1.29
1991	1.23	1.18–1.28	1.24	1.19–1.30	0.83	0.77–0.88
1992	1.22	1.17–1.27	1.23	1.18–1.28	1.03	0.96–1.11
1993	0.98	0.95–1.02	1.06	1.02–1.10	1.09	1.01–1.17
1994	0.99	0.96–1.01	0.99	0.96–1.02	1.22	1.15–1.30
1995	0.69	0.67–0.71	0.68	0.66–0.70	1.25	1.18–1.33
1996	0.76	0.74–0.78	0.76	0.73–0.78	1.01	0.96–1.07
1997	0.78	0.76–0.80	0.77	0.75–0.79	0.90	0.86–0.94
1998	0.96	0.94–0.98	0.97	0.94–0.99	0.96	0.91–1.01
1999	1.01	0.99–1.04	1.02	0.99–1.04	0.94	0.89–0.99
2000	1.19	1.16–1.22	1.19	1.16–1.22	0.98	0.93–1.04
2001	0.87	0.85–0.89	0.86	0.84–0.88	0.80	0.76–0.84
2002	0.87	0.84–0.89	0.85	0.83–0.87	1.26	1.18–1.35
2003	0.67	0.65–0.68	0.65	0.63–0.67	1.05	1.00–1.12
2004	0.45	0.43–0.46	0.42	0.41–0.43	0.93	0.88–0.98
2005	0.55	0.53–0.57	0.51	0.49–0.53	0.84	0.79–0.89
2006	0.79	0.77–0.82	0.79	0.76–0.82	1.01	0.94–1.08
2007	1.18	1.13–1.22	1.26	1.21–1.33	0.77	0.71–0.82
2008	1.34	1.28–1.40	1.27	1.20–1.35	1.20	1.08–1.34
2009	1.54	1.46–1.61	1.74	1.64–1.85	0.82	0.75–0.89
2010	1.65	1.58–1.73	1.69	1.61–1.77	1.02	0.94–1.11
2011	1.75	1.69–1.82	1.63	1.56–1.70	1.24	1.13–1.36
2012	1.85	1.78–1.92	1.89	1.81–1.97	0.94	0.87–1.02

	Chatham Rise All target species, BT		Chatham Rise Target hoki, BT	
Year	Index	CI	Index	CI
1991	0.96	0.90–1.03	0.87	0.81–0.94
1992	1.23	1.17–1.29	1.13	1.07–1.18
1993	1.10	1.06–1.15	1.06	1.02–1.11
1994	1.03	0.98–1.08	1.02	0.97–1.07
1995	1.01	0.98–1.05	0.99	0.95–1.02
1996	1.03	0.99–1.06	1.05	1.01–1.08
1997	0.93	0.91–0.96	0.94	0.91–0.97
1998	0.88	0.85–0.90	0.88	0.86–0.90
1999	1.01	0.98–1.03	1.03	1.00–1.05
2000	0.84	0.82–0.86	0.85	0.83–0.87
2001	0.80	0.78–0.82	0.80	0.78–0.82
2002	0.81	0.79–0.84	0.82	0.79–0.84
2003	0.60	0.59–0.62	0.61	0.59–0.62
2004	0.57	0.55–0.59	0.57	0.55–0.59
2005	0.81	0.79–0.84	0.83	0.80–0.86
2006	1.04	1.00–1.07	1.08	1.04–1.11
2007	1.08	1.05–1.12	1.08	1.05–1.12
2008	1.35	1.30–1.40	1.36	1.31–1.41
2009	1.44	1.39–1.49	1.53	1.47–1.59
2010	1.33	1.28–1.37	1.34	1.29–1.38
2011	1.38	1.33–1.43	1.39	1.34–1.44
2012	1.45	1.40–1.50	1.50	1.44–1.56

Table A4 ctd.

	Sub-Antarctic		Sub-Antarctic	
	All target species, BT		All target species, BT	
Year	Index	CI	Index	CI
1990	1.05	0.97–1.14	1.05	0.96–1.14
1991	0.71	0.67–0.76	0.64	0.61–0.69
1992	1.16	1.10–1.21	1.11	1.06–1.17
1993	1.02	0.97–1.07	0.95	0.91–1.00
1994	1.17	1.10–1.24	1.19	1.12–1.26
1995	1.27	1.20–1.34	1.21	1.14–1.28
1996	1.04	0.98–1.10	1.02	0.96–1.08
1997	1.30	1.24–1.36	1.28	1.22–1.33
1998	1.12	1.08–1.16	1.11	1.07–1.16
1999	1.00	0.95–1.04	0.96	0.92–1.01
2000	0.99	0.96–1.02	0.97	0.93–1.00
2001	0.90	0.87–0.93	0.86	0.83–0.89
2002	0.91	0.88–0.94	0.86	0.83–0.89
2003	0.83	0.80–0.86	0.81	0.78–0.84
2004	0.61	0.59–0.64	0.62	0.59–0.65
2005	0.59	0.56–0.63	0.64	0.59–0.68
2006	0.79	0.74–0.84	0.92	0.83–1.02
2007	0.85	0.80–0.90	0.72	0.67–0.78
2008	1.06	1.01–1.12	1.16	1.09–1.25
2009	1.15	1.09–1.21	1.36	1.27–1.46
2010	1.36	1.29–1.43	1.39	1.31–1.49
2011	1.16	1.10–1.23	1.30	1.21–1.38
2012	1.63	1.54–1.73	1.61	1.50–1.72