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Catches, size, and age structure of the 2010–11 hoki fishery, and a summary of input data used for the 2012 stock assessment

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S.L. Ballara,
R.L. O'Driscoll

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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 2010–11 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 2012.

The total reported hoki catch in 2010–11 was 118 719 t, about 1300 t below the TACC of 120 000 t, and 11 500 t higher than the catch in 2009–10. Catches in 2010–11 increased in the western spawning area (west coast South Island, WCSI), decreased in the eastern spawning area (Cook Strait), remained at similar levels in the non-spawning areas (Chatham Rise and Sub-Antarctic), and increased slightly in other, smaller, areas (Puysegur, and east coast North and South Islands). With the increase in the western catch allocation to 60 000 t in 2010–11, the WCSI fishery was the largest fishery for the first time in five years, with 48 300 t taken. The Chatham Rise was the second largest fishery, with a catch of 38 400 t. The catch from Cook Strait of 14 900 t was the lowest from this area since 1989–90. About 62 200 t of the total catch was taken from western areas in 2010–11 and 56 700 t was taken from eastern areas.

Length frequencies and catch-at-age results from the commercial fishery show that most of the catch in 2010–11 was dominated by fish from 45 to 90 cm (mainly the 2003–09 year-classes, aged 2–7 years). The 2006–08 year-classes (ages 3–5) were relatively abundant in all areas. In 2010–11, 53% of hoki caught on the Chatham Rise were smaller than 65 cm, a higher percentage of small fish than in 2009–10. Large fish (over 90 cm) were proportionately more abundant in Cook Strait, the Sub-Antarctic, and on the WCSI than in the other areas.

The relative biomass index from the Chatham Rise trawl survey in 2012 was 7% lower than in 2011. The biomass estimate for recruited hoki increased but estimates for upcoming year-classes were average (2009 year-class at age 2+) and low (2010 year-class at age 1+). The estimated biomass from the Sub-Antarctic 2011 trawl survey was 29% lower than the 2009 survey, and at about the same level as that seen in 2007 and 2008, with low estimates for the 1+ and 2+ hoki. The acoustic estimate of spawning hoki biomass in Cook Strait was 19% lower than the equivalent index from 2009 and near average for the time series.

1. INTRODUCTION

This report provides data relevant to the 2012 hoki stock assessment. Catch statistics and data from commercial sampling during the 2010–11 fishing year are presented and results from other research programmes since March 2011 are summarised. These include results of the trawl surveys of the Chatham Rise in January 2012 and Sub-Antarctic in November–December 2011. Details of model structure, results, and yield estimates from the hoki stock assessment carried out in 2012 will be published separately.

This report provides the final reporting requirement for Objective 2 of DEE2010/02HOKA ("Provide descriptive analysis of the hoki fishery in 2010–11 fishing year"), and Objectives 1 and 2 of MID2010/01B ("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 2010–11 year", and "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 2010–11 year").

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) 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 since 2008) 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 since 2008 assumed natal fidelity because of technical problems concerning the definition of unfished biomass without this assumption (Francis 2009). Many of these problems are now resolved and model runs which do not assume natal fidelity will be available before the 2012 assessment (Andy McKenzie, NIWA, pers. comm.). Two 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). Francis et al. (2011) carried out a pilot study to determine 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 stocks.

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 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 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 the east coast of the North Island, 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 2010–11 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 2008–08 and catches declined (Table 2). In 2009–10 and 2010–11 the TACC increased to 110 000 t and 120 000 t respectively, and hence catches in 2009–10 and 2010–11 have 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, and to 48 300 t in 2010–11, which was about 41% of the total hoki catch, making it the largest fishery in New Zealand for the most recent year (Table 3). In Cook Strait, catches peaked at 67 000 t in 1995–96, but have been declining for the last seven years. The catch from Cook Strait in 2010–11 of 14 900 t was the lowest 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 in 2008–09 and 2009–10. The Chatham Rise was the largest New Zealand fishery from 2006–07 to 2009–10. Catches from the Chatham Rise dropped slightly to 38 400 t in 2010–11, contributing about 32% of the total catch. 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 12 200 t in 2009–10, and remaining at a similar level (12 600 t) in 2010–11. Catches from other areas increased by 1000 t in 2010–11: Puysegur increased from 270 t to 1200 t; ECSI increased from 670 t to 1600 t; and ECNI from 620 t to 1600 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. In 2010–11, the target catch from the western fishing grounds was increased to 60 000 t within the overall TACC of 120 000 t, and western catches at 62 000 t were above industry-agreed catch split. In the current fishing year (2011–12), the target catch from the western fishing grounds has been increased further to 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. Research results presented in the past year are summarised here.

McKenzie (2011) reported the stock assessment carried out in 2011, using the Bayesian model developed in 2002 (Francis et al. 2003) and implemented in the general-purpose stock-assessment program CASAL (Bull et al. 2008). The Hoki Working Group agreed on a single base run, with three 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 two catchabilities were fitted to the Sub-Antarctic trawl time-series instead of just one in an attempt to fit recent large changes in estimated biomass. Both the eastern and western hoki stocks are estimated to be increasing after reaching their lowest levels in about 2005. The western stock was estimated to be 39–55%B_0 in 2011, and the eastern stock 53–61%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 four years (McKenzie 2011).

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 a large proportion of the population would stray routinely. He suggested that the analysis of geochemical signatures in otolith cores might provide an experimental method to determine the proportion of hoki exhibiting natal fidelity. Francis et al. (2011) describes such a 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 in hoki. For each of 50 fish from the 2006 cohort (35 from Chatham Rise and 15 from Sub-Antarctic) the concentrations of six trace elements (^{7}Li, ^{23}Na, ^{24}Mg, ^{55}Mn, ^{88}Sr, ^{138}Ba) and two stable isotopes (^{18}O, ^{13}C) were measured at three locations in the otolith: the core, halfway to the first annual zone, and within the first annual zone. However, none of the trace elements or stable isotopes considered in this pilot study unambiguously differentiated the two stocks. A more extensive study could clarify this picture, but it is unclear whether it would resolve the question of natal fidelity (Francis et al. 2011).

Bradford-Grieve & Livingston (2011) collated and reviewed information on the ocean environment on the WCSI in relation to hoki and other spawning fisheries. Hypotheses about which variables drive hoki recruitment were presented, but the authors noted that understanding of the underlying mechanisms and causal links between the WCSI marine environment and hoki year-class survival remain elusive. Key uncertainties were identified including: uncertainty about stock structure and the proportion of juvenile hoki on Chatham Rise that were spawned on WCSI; lack of basic data on the distribution and physiological requirements of larval hoki; and lack of measurements and understanding of links between mixed layer depth, phytoplankton growth, nutrient availability, light, ocean currents, and small copepod growth at the spatial and temporal scales influencing young hoki.

Stevens et al. (2011) reviewed and summarised diet information for New Zealand fish species available from research trawl database records from 1960–2000. Teleost fish were the most important prey of hoki, occurring in 60% of the 14 170 stomachs containing food. Of those groups identified, myctophids (occurring in about 13% of stomachs containing food) were most important. Crustaceans occurred in 43% of stomachs, and were mainly natant decapods (27%) and euphausiids (12%). Cephalopods, particularly squid (5%) and salps (3%), were the next most common invertebrate prey groups. In total, at least 15 main invertebrate groups in five phyla and 49 teleost species were identified. A comprehensive feeding study of hoki diet on the Chatham Rise showed that (by weight) euphausiids and sternoptychid fishes were important for smaller hoki (26–55 cm TL), myctophid fishes and natant decapods for larger hoki, and macrourids for the largest hoki (more than 84 cm TL) (Connell et al. 2010). Also on the Chatham Rise, the proportion of fish prey (primarily myctophids) in the diet appeared to have increased between 1990 and 2009, relative to prawn and euphausiid prey (Horn & Dunn 2010).

O'Driscoll et al. (2011a) developed a time series of acoustic indices of mesopelagic fish abundance for the Chatham Rise and Sub-Antarctic from data collected during trawl surveys from 2001 to 2009. Spatial patterns in mesopelagic fish abundance closely matched the distribution of hoki, but temporal changes in mesopelagic fish abundance were not strongly correlated with hoki biomass. O'Driscoll et al. (2011a) hypothesised that prey availability influences hoki distribution, but that hoki abundance is being driven by other factors such as recruitment variability and fishing. There was no evidence for a link between hoki condition and mesopelagic prey abundance, but there was a strong correlation between liver condition and hoki condition on the Chatham Rise and Sub-Antarctic, which O'Driscoll et al. (2011a) suggested may be related to timing of spawning.

A large body of work has been carried out on the environmental impacts of hoki fisheries, including summaries of incidental captures of seabirds, marine mammals, and turtles (Abraham & Thompson 2011, Thompson & Abraham 2011), and estimates of the nature and extent of commercial fishing effort on or near the seafloor (Baird et al. 2011).

The trawl survey of the Sub-Antarctic in November–December and of the Chatham Rise in January 2012, and an acoustic survey by commercial vessels carried out in August in Cook Strait, were the new fisheries-independent estimate of hoki abundance since the 2011 hoki assessment. Results from these surveys are summarised in Section 3.1. An extensive review of Chatham Rise trawl surveys from 1992–2010, including biomass trends, and spatial and depth distributions for 142 species (including hoki) was published in 2011 (O'Driscoll et al. 2011b).

2. HOKI FISHERY, 2010–11

2.1 Catch and effort information

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

In the 2010–11 fishing year the TACC for HOK1 was 120 000 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 of Fisheries that no more than 60 000 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 118 719 t was about 11 500 t higher than the catch in 2009–10 and about 1300 t lower than the TACC (see Table 2). The total estimated catch from catch-effort-and-landing-return (CELR), lining-catch-effort-return (LCER), net-catch-effort-and-landing-return (NCELR), trawl-catch-effort-return (TCER), lining-trip-catch-effort-return (LTCER), tuna-long-lining-catch-effort-return (TLCER), and trawl-catch-effort-and-processing-return (TCEPR) data was 115 782 t. As the data extraction was done in mid-December 2011, 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 118 719 t.

Relative to 2009–10, catches in 2010–11 increased on the western spawning area (WCSI), decreased in the eastern spawning area (Cook Strait), remained at similar levels for the non-spawning areas (Chatham Rise and Sub-Antarctic), and increased slightly for other areas (Puysegur, ECSI, and ECNI) (Figure 2a, Table 3). This was expected, given the increase in the target catch from western areas from 50 000 t in 2009–10 to 60 000 t in 2011–12. The WCSI was the largest fishery for the first time in five years, with the catch increasing by nearly 12 000 t to 48 300 t in 2010–11. Catches inside the 25 n. mile line made up 15% of the total WCSI catch in 2010–11, up from 8% in 2009–10, but down from a peak of 41% of the catch in 2003–04 (Table A1). The Chatham Rise was the second largest hoki fishery, with 38 400 t taken from this area in 2010–11. The catch from Cook Strait of 14 900 t was down about 3000 t from that in 2009–10, and the lowest catch since 1989–90. The catch from the Sub-Antarctic of 12 600 t in 2010–11 was at a similar level to 2009–10 (see Table 3). Catches from other areas (Puysegur, ECSI, and ECNI) increased by 1000 t to 1200 t, 1600 t, and 1600 t respectively in 2010–11. Overall, about 62 000 t of the total catch in 2010–11 was taken from western areas (Figure 2a), 2000 t above the level of the industry-agreed catch split. Most hoki catch was recorded on the TCEPR form (110 128 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 then 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 increase in TACC in 2009–10, hoki targeting also increased, with 92% of the overall catch from hoki target tows.In 2010–11, overall hoki targeting remained the same (92% of the overall hoki catch) with 92% of the hoki catch on the WCSI, 86% on the Sub-Antarctic, and 91% on the Chatham Rise from hoki target tows. There has been a decrease in the percentage of hoki catches from tows targeting hake on the WCSI, ling on the Sub-Antarctic, and silver warehou on the WCSI, Sub-Antarctic and Chatham Rise. Cook Strait remains almost exclusively a hoki target fishery.

A high proportion of the hoki catch in 2010–11 was taken during the spawning season from June to September (Figure 4). Peak catches on the WCSI and Cook Strait spawning grounds were in July and August, as in previous years (Figure 5). Most of the WCSI catch was taken by the mid-August, while catches from Cook Strait continued through to mid-September. In Cook Strait, about 3240 t was caught outside the spawning season. 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 2010 to June 2011 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 (Figure 4).

2.1.3 CPUE analysis

Unstandardised catch and effort and standardised CPUE 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. Standardised CPUE analyses for the ECSI and Puysegur areas were not carried out as there were not enough data in some years. Catch rate analysis did not include data from CELR forms (which account for up to a third of the catch 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. 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 2011) 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. 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* x *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. Vessels with minimal participation were excluded from the analyses as they would provide little information for the standardisations and could result in model over-fitting (Francis 2001). "Core" vessels were defined as those vessels which were involved in the fishery for at least four years, and reported about 90% of the catch (after Philips 2001). 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.

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, or Sub-Antarctic lognormal CPUE models were run for core vessel bottom tows with either all target species or target hoki tows, and a January CPUE model was run for the Chatham Rise dataset, and a November–December Snares Shelf CPUE model run also for the Sub-Antarctic dataset. 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 66% of the total spawning season catch on the WCSI in 2010–11. The unstandardised catch rate from all non-zero midwater tows in 2010–11 increased and was the highest in the series, with a median catch of 8.8 t per hour, and a median tow duration of 2.0 hours. Catch rates were similar (8.9 t per hour) for target hoki tows, with the same median tow duration of 2.0 hours. Catch rates in bottom trawls on the WCSI were lower than in midwater trawls, with a median catch rate of 1.0 t per hour for all non-zero hoki catches and 2.9 t per hour for target hoki tows. Median tow duration of bottom trawls decreased to 6.1 hours for all target species but increased to 4.1 hours for target hoki only tows in 2010–11. From 1999–2000 to 2003–04, standardised catch rates from all non-zero tows showed a similar decline to non-standardised tows. 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 95% of the spawning season catch of 10 368 t reported on TCEPR forms from Cook Strait in 2010–11. A further 4560 t of catch was reported on TCER forms (see Figure 2b). Non-standardised catch rates continued to be high in Cook Strait, with an increase in median catch rate to 24.9 t per hour in non-zero mid-water tows and a decrease in median tow duration to 0.4 hours (equivalent to a median catch of 12.3 t per tow). Overall the non-standardised catch rates showed a slight increase from 1989–90 to 2010–11, 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 2010–11 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 4.7 hour in 2010–11. The median non-standardised catch rate in bottom trawls on the Chatham Rise in 2010–11 of 1.2 t per hour was the same as that in 2009–10, and the highest catch rate since 1989–90. 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. Standardised catch rates generally decreased from 1991–92 to 2003–04, increased to 2008–09, decreased in 2009–10, and increased again in 2010–11 (Figure 6a). Similar trends were observed for core vessels targeting hoki and core vessels in January (Figure 6b).

Bottom trawl catches reported on TCEPRs accounted for 87% of the catch taken from the Sub-Antarctic in 2010–11 (see Figure 2b). Median tow duration decreased slightly to 5.0 hours in 2010–11 and non-standardised catch rates in bottom trawls were slightly higher than those in 2009–10 at 0.3 t per hour. Catch rates for hoki target bottom trawls were higher than those for all target trawls (1.2 t per hour in 2010–11), but are still lower than target catch rates in the other hoki fisheries. Standardised catch rates generally decreased from 1996–97 to 2003–04 and increased to 2009–10, with a slight decrease in 2010–11 (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 TCEPRs (see Figure 2b). Midwater tow catch rates in 2010–11 were 10.8 t per hour, and bottom tow catch rates were 3.0 t per hour. Spawning season catches from Puysegur were also mainly reported on TCEPRs (see Figure 2b), with midwater and bottom tow catch rates in 2010–11 both at 3.2 t per hour.

Standardised indices for WCSI, Chatham Rise, and Sub-Antarctic all showed similar trends: decreasing from 1991–92 to 2003–04 and increasing to 2008–09 (Figure 6). In 2009–10 and 2010–11 catch rates from the WCSI continued to increase, the Sub-Antarctic increased and then decreased, while those of the Chatham Rise decreased then increased (Figure 6).

2.1.4 Bycatch

Estimates of bycatch in the hoki fishery were determined from data collected by Ministry of Fisheries observers. For target hoki trawls, the observer data in 2010–11 represent about 40% of vessels, 8% of tows, and 11.3% 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 2010–11 were generally low (less than 2%) for all species. The observed bycatch in the WCSI fishery in 2010–11 showed increases in bycatch rates for hake (2.4%) and ling (2.0%). As in the past, there was very little bycatch in Cook Strait, with spiny dogfish having the largest observed bycatch rate (0.8%).

In the non-spawning areas, bycatch rates in 2010–11 were also low for most species. On the Chatham Rise, ling (2.6%), and silver warehou (4.7%) showed increases in bycatch rates from 2009–10, whereas hake (0.9%), javelinfish (7.6%) and rattails (6.4%) showed decreases. Of the main Sub-Antarctic bycatch species, bycatch rates decreased for ling (7.4%), javelinfish (2.1%), and rattails (1.9%), and increased for silver warehou (2.0%), white warehou (1.8%), southern blue whiting (1.4%), and spiny dogfish (3.5%).

2.2 Size and age composition of commercial catches

Data to estimate length frequencies in 2010–11 were available from the Ministry's Observer Programme (OP). No shed sampling of landed fish was carried out by NIWA in 2010–11. 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 for which hoki was caught in 2010–11 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 1028 tows, of which 284 came from the WCSI, 66 from Cook Strait, 374 from the Chatham Rise, 273 from the Sub-Antarctic, 19 from the ECSI, 6 from Puysegur, and 6 from ECNI. In Cook Strait, 20 observer samples were also collected by a NIWA scientist on the FV *Thomas Harrison* during a hoki industry acoustic survey (O'Driscoll 2012). 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. Length frequencies from Cook Strait are normally stratified by month, island of landing, and vessel size. However, in 2011 with no market samples taken, Cook Strait stratification was by month periods, and vessel size (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 NIWA samples on *Thomas Harrison*. All available otoliths (764) from Cook Strait and a sub-sample of 739 otoliths from the WCSI 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 2010–11, 1241 otoliths (including 602 males and 638 females) out of 2963 otoliths collected from 317 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 4.5 t of hoki select at random 2 otoliths from each tow.
4. For tows catching between 4.5 t and 8 t of hoki select at random 4 otoliths from each tow.
5. For tows catching more than 8 t of hoki select at random 6 otoliths from each tow.

On the Sub-Antarctic in 2010–11, 1275 otoliths (including 632 males and 643 females) out of 2294 otoliths collected from 235 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 3 otoliths from each tow.
3. For tows catching between 2 t and 6.5 t of hoki select at random 5 otoliths from each tow.
4. For tows catching between 6.5 t and 12 t of hoki select at random 8 otoliths from each tow.
5. For tows catching more than 12 t of hoki select at random 10 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 2011 catch from the WCSI fishery was of fish from 55 to 100 cm (Figure 8) from the 2003–08 year-classes (ages 3–8) (Figure 9). The main length mode for female hoki was from 70–100 cm (Figure 8), and was made up of hoki aged 4 (2007 year-class) and older. Female hoki from the 2008 and 2009 year-classes formed smaller modes centred at 60 and 47 cm respectively (Figures 8 and 9). The male modes for different year-classes were more distinct: the 2007 year-class was centred at 70 cm, the 2008 year-class at 61 cm and the 2009 year-class at 49 cm (Figures 8 and 9). A few small (30–35 cm) male and female hoki from the 2010 year-class were also caught.

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. The catch contained 43% females in 2010–11 (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 32% in 2010–11 (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, and decreased again in 2009–10 and 2010–11 to 17% (Figure 10b). Many of these small fish are spawning: 20% of the female fish less than 55 cm (i.e., mostly 2 year-olds from the 2009 year-class) were in spawning condition, compared to 40% 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 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 (Figure 11). In 2011 there were no data, from either market or OP sampling, from inside 25 n. miles.

The overall mean length of hoki from the WCSI during the 2011 spawning season showed no trend for the females and a slight increasing trend for the males (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 (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 2010–11, although vessels less than 60 m were not sampled (Figure 14), and there was no sampling from inside the 25 n. mile line.

Cook Strait

The length distribution of female hoki from Cook Strait in 2011 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 3–9 (see Figure 16). The modal age was 5 (2006 year-class) for males and 7 (2004 year-class) for females (see Figure 16). Fewer fish from the 2009 year-class (age 2) were caught in Cook Strait than in the other fisheries, and only 0.7% of the catch was fish less than 60 cm in 2011, although 2.7% of the catch was fish less than 65 cm (see Figure 10b).

In 2011, 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 (Figure 17, see Table 8). For vessels both larger and smaller than 40 m there were no samples taken in June or July 2011 (Figure 18). Therefore, the August and September length frequencies were also applied to catches in June and July for both vessel classes (Table 10).

Length frequencies by vessel class showed the size distribution of the catch was broadly similar across the two vessel size categories, although more smaller fish were caught by the larger vessels (Figure 19a). There were some differences in size distribution of the catch in some strata (Figure 19b) — the number of males measured for large vessels in 2011 was very low as larger vessels were targeting large females. This impacted on the overall mean length of hoki from Cook Strait which increased from 75 cm in 2010 to 79 cm in 2011. The sex ratio of the Cook Strait catch was skewed towards females from 2001–05, then reversed as the number of males increased from 2006–09 to 62%, and then decreased in 2010 and 2011 to 49% and 39% (see Figure 10a). There was no clear trend in the mean length of hoki over the season (Figure 20).

As on the WCSI, the mean length at age has increased over time in the Cook Strait fishery (Figure 21), although there are now very few males aged 8 and older.

The Cook Strait catch-at-age for 2011 was not used in the 2012 hoki stock assessment model, except as a sensitivity, as it was not considered representative of the commercial catch in 2011 due to poor temporal observer coverage and the rapidly changing sex ratio.

Puysegur

In 2010–11, only 6 samples were collected from Puysegur, with only one sample taken during the spawning season in July 2011. These were mainly fish from 45–100 cm (Figure 22). Little can be concluded from this single sample.

East coast South Island

Nineteen samples were collected from the ECSI during the 2011 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 91% of the commercial catch, 89% of length frequencies, and 86% of the available otoliths came from the hoki target fishery in 2010–11 (Figure 24). The remainder of otoliths were from tows targeting barracouta, alfonsino, hake, hapuka, silver warehou, and white warehou. The tree-based regression split the OP data from the Chatham Rise fishery into three strata based on depth (Table 11). The mean length of hoki on the Chatham Rise was less in shallower water.

The length distribution of hoki from the Chatham Rise in 2010–11 had 3 modes and was similar for males and females (Figure 25). The catch was dominated by small hoki of 30–80 cm from the 2006–09 year-classes (ages 2–5), with few larger, older fish caught (Figure 26). The modal age of both males and females was 3+ (2007 year-class). More females than males were caught in 2010–11, with males comprising 47% 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 9% of the catch aged 7 years or older (see Figure 10b), and only 33% of these being male (see Figure 10a). About 53% of the catch by number was less than 65 cm in 2010–11, and this percentage has been increasing each year since 2001–02 (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 2010–11 (Figure 27), although coverage was lower than ideal in some months, especially January and June–July. The western side of the Chatham Rise (statistical areas 020, 021, 022, and 023) was "over-sampled" and the mid Chatham Rise (statistical areas 401–404, and 407–410) was adequately covered (Figure 27).

Sub-Antarctic

About 86% of the commercial catch, 55% of length frequencies, and 80% of the available otoliths came from the hoki target fishery in 2010–11 (Figure 28). The remainder of otoliths were from target tows for hake, ling, scampi, 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, time, and depth (Table 12). 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 2010–11 consisted mainly of 35–105 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 2001–09 year-classes. The modal age of females was 3 (2007 year-class), and the modal age for males was ages 3 and 4 (2007 and 2006 year-classes). 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% in 2010–11 (see Figure 10b). About 55% of the fish caught in the Sub-Antarctic in 2010–11 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 April, some sampling from mid-November to May, and little coverage from July to September (see Table 7). Coverage was good on the Snares Shelf and to the east of the Auckland Islands, but poor in other areas. Length frequencies by target species showed that small hoki were more likely to be caught in fisheries targeting hoki, squid or silver warehou (Figure 32).

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 Chatham Rise and Sub-Antarctic in 2010–11 (Figure 33). 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 2010–11 are compared in Figure 34. The catch in all areas was dominated by fish from 45 to 90 cm (mainly 2003–09 year-classes, aged 2–7 years). The percentage of small fish in the catch from the Chatham Rise was higher in 2010–11 than in 2009–10 (see Figure 10b), with 53% of hoki on the Chatham Rise less than 65 cm. 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, the Sub-Antarctic, and on the WCSI.

3. HOKI RESEARCH

3.1 Resource surveys

3.1.1 Trawl surveys

Chatham Rise

The twenty-first annual trawl survey of the Chatham Rise was completed between 2 and 28 January 2012, with 100 stations used for biomass estimation. The total biomass of all hoki in 2012 decreased by 6.8% to 87 500 t (Table 13). There was a 27% increase in the biomass estimate for recruited hoki (3 years and older) from 40 700 t in 2011 to 55 900 t in 2012. The biomass estimate for age 2+ (2009 year-class) at 29 100 t was average, and the estimate for age 1+ (2010 year-class) at 2 600 t was very low (Table 13).

Hoki size and age frequencies from the 2012 Chatham Rise survey were dominated by 1+ (32–48 cm), 2+ (49–62 cm), and 3+ (63–71 cm) hoki, with only a few larger fish (Figures 35 and 36).

The 2012 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 contributed only 2.5% of the total hoki biomass.

Sub-Antarctic

The fourteenth survey in the *Tangaroa* summer trawl time series was carried out from 24 November to 24 December 2011, with 80 successful core stations. Previous surveys in the summer series were in November–December 1991–93, and 2000–09. 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 2011 survey was 46 100 t (Table 14), 29% lower than the 2009 survey. The estimated biomass in 2011 was at about the same level as seen in 2007 and 2008, and less than half of the biomass seen in the early 1990s.

Hoki length frequencies in 2011 ranged from 50–110 cm (Figure 37). The mode at 48–59 cm corresponds to hoki from the 2009 year-class (Figure 38) and these small fish were mainly caught at Puysegur and on the Stewart-Snares shelf. Compared to the 2009 survey, there was there were few 1+ (2010 year-class) or 2+ (2009 year-class) hoki caught in 2011. The main adult mode had lengths from 60 to 100 cm and consisted of fish from the 2002–08 year-classes at ages 3–9. Some larger older female and male hoki were also caught (Figure 38).

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 stock assessment, 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 2011)

3.1.2 Acoustic surveys

Cook Strait

The 2011 acoustic survey of spawning hoki abundance in Cook Strait was carried out by industry vessels *Thomas Harrison* and *Independent 1* from 18 July to 27 August. Four snapshots were completed from *Thomas Harrison* and two snapshots were carried out from *Independent 1*. Estimates of hoki abundance calculated using standard methods ranged from 172 000 t (c.v. 23%) on 18–19 July to 478 000 t (c.v. 53%) on 20–21 August (Table 15). However, there was considerable uncertainty associated with the estimated size distribution of the commercial catch from Cook Strait in 2011 because of poor observer sampling (see Section 2.2.1). Following the recommendations of the Hoki Fishery Assessment Working Group, two alternative series of acoustic indices were calculated for Cook Strait: one series was based on annual acoustic target strength (TS) values using the commercial length frequency from the year of the survey (values in Table 15); and the other series was calculated using the same TS value for all surveys in the time-series. Both time series of acoustic indices of hoki abundance in Cook Strait are given in Table 16.

The abundance index for 2011, calculated using the length frequency from the 2011 commercial fishery, was 300 000 t, which was 5% lower than the equivalent index from the 2009 industry survey, but higher than estimates from 2003 to 2008, and above average for the overall time-series (Table 16). The abundance index for 2011, calculated using a constant TS value, was 269 000 t which was 19% lower than the equivalent index from 2009 and near average for the time series (Table 16). The overall survey weightings (c.v.s) were the same for both alternative series. The c.v. of the 2011 estimate (35%) was higher than that estimated for the most recent research survey in 2008 (c.v. 30%) because of a 18-day gap in sampling during the (theoretical) peak season from 24 July to 10 August (see Table 15). However, the c.v. of the 2011 survey was at the lower end of the range estimated for previous surveys in the time series (30–91%) and lower than that estimated from the industry surveys in 2007 and 2009.

4. CONCLUSIONS

The total reported hoki catch in 2010–11 was 118 719 t, about 1300 t below the TACC of 120 000 t, and 11 500 t higher than the catch in 2009–10. Catches increased in the western spawning area (WCSI), decreased in the eastern spawning area (Cook Strait), remained at similar levels for the non-spawning areas (Chatham Rise and Sub-Antarctic), and increased slightly for other areas (Puysegur, ECSI, and ECNI). With the increase in the western catch allocation to 60 000 t, the catch on the WCSI increased by nearly 12 000 t to 48 300 t, and, for the first time in five years, this was the largest hoki fishery. The Chatham Rise was the second largest fishery, with 38 400 t taken, and the Sub-Antarctic catch remained similar at 12 600 t in 2010–11. The catch from Cook Strait at 14 900 t was down about 3000 t, and the 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 2010–11 was fish from 45 to 90 cm (mainly 2003–09 year-classes, aged 2–7 years). The percentage of small fish in the catch in 2010–11 was higher than in 2009–10 on the Chatham Rise area. Widespread occurrence of young fish may indicate relatively good recent recruitment, or may be because there are fewer older fish remaining in the population. The largest average size of fish in 2010–11 was from the WCSI, Sub-Antarctic and Cook Strait.

Relative indices from the Chatham Rise trawl survey in 2012 decreased by 7%. The biomass estimate for recruited hoki increased, but estimates for upcoming year-classes were average (2009 year-class at age 2+) and low (2010 year-class at age 1+). The estimated biomass from the Sub-Antarctic 2011 trawl survey was 29% lower than the 2009 survey, and at about the same level as seen in 2007 and 2008, with low estimates for 1+ and 2+ hoki. The acoustic estimate of spawning hoki biomass in Cook Strait was 19% lower than the equivalent index from 2009 and near average for the time series.

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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 MFish 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 2010–11. 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).

	Estimated	Reported catch (MHR)		
Year	catch	Exclude HOKET	Include HOKET	TACC
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	118 719	118 719	120 000

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 of Fisheries 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 2010–11. 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 and ECSI	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	2 870	45 252	1 977	23 766	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	242 420
2000–01	102 221	6 799	36 298	2 411	30 077	49 847	2 035	147	26	229 858
2001–02	92 711	5 319	23 976	2 971	30 182	39 151	1 147	39	5	195 501
2002–03	73 856	5 932	36 713	7 382	20 216	39 092	929	532	8	184 660
2003–04	45 111	1 153	41 034	2 140	11 640	33 650	880	126	49	135 784
2004–05	33 111	5 548	24 833	3 244	6 245	30 673	522	37	152	104 364
2005–06	38 988	1 431	21 803	665	6 744	34 058	686	8	4	104 385
2006–07	33 328	399	20 113	1 006	7 670	37 813	667	8	4	101 010
2007–08	20 928	308	18 470	2 323	8 708	37 920	640	19	1	89 319
2008–09	20 548	233	17 535	1 054	9 807	39 011	588	25	3	88 805
2009–10	36 349	272	17 880	669	12 275	39 138	618	7	-	107 209
2010–11	48 338	1 175	14 926	1 624	12 646	38 419	1 587	2	3	118 719

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.

Variable	All target species R^2	Variable	Target hoki R^2
WCSI spawning, core vessels			
Year	4.9	Year	4.9
Day of year	20.4	Day of year	16.6
Vessel	27.0	Vessel	24.2
Target species	32.2	Mid time	27.3
Mid time	34.7		
Cook Strait spawning, core MW vessels			
		Fishing year	2.1
		Day of fishing year	19.9
		Vessel	23.3
Chatham Rise and ECSI Non-spawning, core BT vessels			
Fishing year	7.9	Fishing year	8.8
Target species	19.2	Vessel	13.0
Vessel	22.9	Mid time of tow	16.4
Mid time of tow	25.7	Duration of tow	19.2
Duration of tow	28.2	Month	20.6
Month	29.4		
Chatham Rise and ECSI Non-spawning, core BT vessels, January			
Fishing year	10.2		
Target species	22.0		
Vessel	26.1		
Duration of tow	28.7		
Mid time of tow	31.8		
Statistical area	33.5		
Sub-Antarctic non-spawning, core BT vessels			
Fishing year	3.9	Fishing year	3.4
Target species	12.7	Month	8.9
Month	17.5	Start time of tow	12.9
Start time of tow	21.2	Vessel	15.9
Vessel	23.7	Statistical area	18.3
Statistical area	25.7	Duration of tow	19.9
Duration of tow	27.2		
Sub-Antarctic non-spawning, core BT vessels, Snares Shelf, Nov–Dec			
Fishing year	11.4		
Longitude	29.2		
Vessel	33.2		
Start time of tow	36.3		
Target species	39.2		
Duration of tow	40.9		
Statistical area	42.1		

Table 5: Observer coverage 2010–11 by area, BT, BPT, MW, MPT 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)		
Fishing year	All	Observed	Percent observed	All	Observed	Percent observed	All	Observed	Percent observed
Chatham Rise	53	13	24.5	5 585	374	6.7	38 414	3 510	9.1
Cook Strait	25	5	20.0	992	66	6.7	11 638	1 335	11.5
ECNI	50	2	4.0	2 695	6	0.2	1 569	1	0.0
ECSI	10	2	20.0	182	19	10.4	1 618	408	25.2
Macquarry	2	-	-	16	-	-	3	-	-
Puysegur	19	2	10.5	202	6	3.0	1 175	7	0.6
Sub-Antarctic	36	19	52.8	2 932	273	9.3	12 646	2 207	17.5
WCNI	12	-	-	44	-	-	2	-	-
WCSI	42	11	26.2	3 524	284	8.1	48 246	5 940	12.3
All areas	116	31	26.7	17 677	1029	5.8	118 719	13 410	11.3

(b) Target hoki tows

	Number of vessels			Number of tows			Catch (t)		
Fishing year	All	Observed	Percent observed	All	Observed	Percent observed	All	Observed	Percent observed
Chatham Rise	26	12	46.2	4 128	333	8.1	35 064	3 050	8.7
Cook Strait	20	5	25.0	891	66	7.4	11 609	1 335	11.5
ECNI	17	1	5.9	400	1	0.2	1 155	0	0.0
ECSI	9	2	22.2	144	19	13.2	1 600	408	25.5
Macquarry	-	-	-	-	-	-	-	-	-
Puysegur	3	-	-	76	-	-	1 051	-	-
Sub-Antarctic	17	9	52.9	1 298	150	11.6	10 872	1 933	17.8
WCNI	2	-	-	2	-	-	0	-	-
WCSI	32	10	31.2	2784	256	9.2	44 703	5 531	12.4
All areas	63	25	39.7	10 312	825	8.0	109 226	12 258	11.2

Table 6: Bycatch rates on vessels with Observer Programme observers in the hoki fishery for tows targeting hoki from 1990–91 to 2010–11. 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 1994–95 and 1996–97 for which there are no observer data). Bycatch rates not calculated where observed hoki catch is less than 100 t.

(a) WCSI

					Catch in t (% of hoki catch)
	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	16 475	514 (3.1)	265 (1.6)	303 (1.8)	82 (0.5)
2001–02	16 668	1 460 (8.8)	513 (3.1)	124 (0.7)	119 (0.7)
2002–03	10 192	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 (1.2)	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	11 620	87 (0.7)	167 (1.4)	65 (0.6)	79 (0.7)
2010–11	9556	231 (2.4)	189 (2.0)	99 (1.0)	61 (0.6)

(b) Cook Strait

					Catch in t (% of hoki catch)
	HOK	**HAK**	**LIN**	**SWA**	**SPD**
1992–93	107	-	-	-	1 (0.6)
1993–94	495	-	6 (1.3)	-	1 (0.2)
1994–95	-	-	-	-	-
1995–96	734	-	2 (0.3)	-	13 (1.8)
1996–97	-	-	-	-	-
1997–98	3 461	-	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 (0.0)	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 (1.5)
2004–05	2 207	-	5 (0.2)	2 (0.1)	38 (1.7)
2005–06	1 080	-	2 (0.2)	-	15 (1.4)
2006–07	2 298	-	12 (0.5)	2 (0.1)	85 (3.7)
2007–08	3 079	-	7 (0.2)	1 (0.0)	51 (1.6)
2008–09	2 290	-	3 (0.1)	-	27 (1.2)
2009–10	3 892	1	9 (0.2)	1 (0.0)	32 (0.8)
2010–11	1 637	-	-	-	13 (0.8)

Table 6: continued.

(c) Puysegur

	Catch in t (% of hoki catch)				
	HOK	**HAK**	**LIN**	**SWA**	**SPD**
1990–91	986	3 (0.3)	25 (2.5)	25 (2.5)	1 (0.1)
1991–92	1 028	27 (2.6)	431 (41.9)	431 (41.9)	4 (0.4)
1992–93	530	3 (0.6)	80 (15.0)	80 (15.0)	-
1993–94	959	-	8 (0.8)	8 (0.8)	6 (0.6)
1994–95	226	- (0.1)	8 (3.7)	8 (3.7)	-
1995–96	719	2 (0.2)	33 (4.6)	33 (4.6)	2 (0.3)
1996–97	455	- (0.1)	6 (1.3)	6 (1.3)	3 (0.8)
1997–98	226	4 (1.9)	25 (10.9)	25 (10.9)	9 (4.0)
1998–99	370	- (0.1)	25 (6.8)	25 (6.8)	7 (1.9)
1999–00	823	6 (0.7)	30 (3.6)	30 (3.6)	16 (1.9)
2000–01	561	- (0.1)	20 (3.5)	20 (3.5)	1 (0.2)
2001–02	678	2 (0.3)	52 (7.6)	52 (7.6)	2 (0.3)
2002–03	549	- (0.1)	32 (5.8)	32 (5.8)	2 (0.3)
2003–04	1 237	1 (0.1)	20 (1.6)	20 (1.6)	11 (0.9)
2004–05	478	3 (0.5)	105 (22.0)	105 (22.0)	1 (0.2)
2005–06	10	- (0.2)	4 (38.5)	4 (38.5)	0 (0.5)
2006–07	31	- (0.5)	- (0.7)	- (0.7)	-
2007–08	986	3 (0.3)	25 (2.5)	25 (2.5)	1 (0.1)
2008–09	1 028	27 (2.6)	431 (41.9)	431 (41.9)	4 (0.4)
2009–10	530	3 (0.6)	80 (15.0)	80 (15.0)	-
2010–11	1	-	-	-	-

(d) Sub-Antarctic

		Catch in t (% of hoki catch)							
	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 (0.0)	3 (0.1)
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 (0.4)	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)	-	0 (0.0)
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 (1.1)	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 (2.1)	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 (0.2)	10 (2.5)
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 (7.0)
2007–08	3 105	101 (3.3)	1004 (32.3)	13 (0.4)	30 (1.0)	176 (5.7)	28 (0.9)	61 (2.0)	76 (2.5)
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	2 884	32 (1.1)	214 (7.4)	57 (2.0)	102 (3.5)	60 (2.1)	54 (1.9)	40 (1.4)	51 (1.8)

Table 6: continued.

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

		Catch in t (% of hoki catch)						
	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 (0.1)
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	8 945	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 (1.6)
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	4 818	52 (1.1)	179 (3.7)	132 (2.7)	105 (2.2)	530 (11.0)	338 (7.0)	91 (1.9)
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	4 621	42 (0.9)	121 (2.6)	218 (4.7)	40 (0.9)	351 (7.6)	296 (6.4)	22 (0.5)

(f) ECSI, June–September.

	Catch in t (% of hoki catch)							
	HOK	**HAK**	**LIN**	**SWA**	**SPD**	**JAV**	**RAT**	WWA
2000–01	5	- (0.5)	- (1.7)	-	-	-	-	-
2001–02	97	- (0.3)	1 (0.8)	-	-	-	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 (0.3)	4 (0.5)	1 (0.1)	1 (0.1)	4 (0.4)	6 (0.6)	2 (0.2)
2004–05	280	- (0.2)	1 (0.5)	-	-	1 (0.4)	2 (0.7)	-
2005–06	505	5 (1.1)	- (0.1)	35 (6.9)	1 (0.2)	1 (0.2)	3 (0.6)	-
2006–07	-	-	-	-	-	-	-	-
2007–08	72	2 (2.1)	1 (1.2)	2 (2.8)	-	2 (2.8)	9 (12.5)	2 (2.8)
2008–09	311	- (0.1)	- (0.1)	-	-	-	1 (0.3)	-
2009–10	41	- (1.1)	1 (1.3)	-	-	1 (2.4)	18 (43.9)	2 (4.9)
2010–11	413	2 (0.4)	1 (0.1)	-	-	-	4 (1.0)	2 (0.5)

Table 7: Number of 2010–11 hoki length frequencies and otoliths by observer trips, target species, and monthly timing.

(a) WCSI observer samples

Trip	Month	Target species	Number of Length frequencies	Number of Otoliths
1	Jun	HOK	23	68
2	Jun	HAK	15	-
3	Jun	HAK(4), HOK(11)	15	38
4	Jul	HOK	15	-
5	Jul	HOK	28	80
6	Aug	HAK(1), HOK(21)	22	63
7	Aug	HOK	8	-
8	Aug	HOK	59	181
9	Aug	HAK(6), HOK(7)	13	42
10	Aug	HOK	9	30
11	Aug	HAK	1	-
12	Aug	HOK	11	40
13	Aug-Sep	HAK(1), HOK(63)	64	197
Total		HAK(28), HOK(256)	284	739

(b) Cook Strait observer samples

Trip	Month	Target species	Length frequencies	Number of Otoliths
1	Aug	HOK	17	164
2	Aug/Sep	HOK	21	213
3	Aug	HOK	6	59
4	Aug/Sep	HOK	9	98
5	Aug/Sep	HOK	13	130
TH*	Aug	HOK	20	100
Total			86	764

* Length frequencies and otoliths collected on an acoustics trip in Cook Strait on *Thomas Harrison* by a NIWA scientist.

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

			Number of length frequencies		Number of otoliths
Trip	Month	Target species	Chatham Rise	ECSI spawning	
1	Oct	HOK	42	-	177
2	Nov	HOK/SWA	18	-	76
3	Nov/Dec	HOK/SWA	16	-	67
4	Dec	BAR/HOK/SWA	18	-	60
5	Dec	HOK/SWA	18	-	67
6	Dec	HOK/SWA	2	-	6
7	Feb	HOK	1	-	4
8	Feb/Mar	HOK/SWA	85	-	367
9	Feb/Mar	HOK/SWA	65	-	291
10	Mar	BYS	1	-	-
11	Apr/May	HOK	75	-	-
12	May	HOK	1	-	
13	May/Jun	HAK/HOK/HPB/SWA	11	-	63
14	Aug/Sep	HOK	11	16	35
15	Sep	HOK/SWA	3	-	14
16	Sep	HOK	1	-	-
17	Sep	HOK	-	3	-
18	Sep	HOK/SWA/WWA	6	-	11
Total			374	19	1 241

Table 7: continued.

(d) Sub-Antarctic observer data

Trip	Month	Target species	Number of Length frequencies	Number of Otoliths
1	Oct	WWA	5	23
2	Oct	HOK	11	76
3	Oct	HOK	27	259
4	Oct/Nov	HOK/LIN	64	225
5	Oct/Nov	HOK/SWA	2	10
6	Nov/Dec	HOK/LIN/SWA	13	113
7	Dec/Jan	HOK/SQU	5	23
8	Dec	HOK	4	12
9	Dec/Jan	HAK	7	8
10	Jan/Feb	SQU	8	26
11	Jan/Feb	SQU	3	5
12	Jan/Feb	LIN/SQU/SWA	3	12
13	Feb	SCI	14	-
14	Feb	SQU	2	-
15	Feb/Mar	SQU	2	3
16	Feb/Mar	HOK	5	-
17	Feb/Mar	SQU	10	-
18	Mar	SQU	4	-
19	Mar	HAK/HOK/SQU/SWA	7	12
20	Mar	SQU	1	-
21	Mar	SQU	1	-
22	Apr/May	HOK	51	370
23	Apr	SQU	1	-
24	Apr	SQU	2	-
25	Apr	SQU/SWA	3	17
26	May	SQU	1	5
27	May/Jun	HAK/SQU/SWA	9	44
28	Jun	SQU/SWA	2	-
29	Jun/Jul	LIN/SQU	5	28
30	Sep	HOK	1	4
Total			273	1 275

Table 8: Number of Cook Strait observed tows by month and vessel size category for the 2011 sampling season.

		Month				Total
Data set	Stratum	Jun	Jul	Aug	Sep	
Observer tows	Nelson/Picton vessel < 30 m	-	-	31	14	45
	Nelson/Picton vessel 30–40 m	-	-	-	-	-
	Nelson/Picton vessel > 40 m	-	-	4	17	21
Observer tows by NIWA scientist	Nelson/Picton vessel > 40 m	-	-	20	-	20

Table 9: Percentage of female hoki by observer stages on the WCSI for female fish less than or equal to 55 cm (n = 830) and female fish greater than 55 cm (n = 12 858) for the 2011 spawning season.

	Females ≤ 55 cm	Females > 55 cm
Immature and resting	37.6	5.3
Ripening	40.8	42.8
Ripe	17.3	34.6
Running ripe	2.5	6.6
Spent	1.7	10.6

Table 10: Cook Strait 2011 stratification for the length frequencies. As there were no observer length frequencies in June or July, August and September length frequencies were scaled up to the total vessel size catch for the season.

Stratum	Vessel size	Month	Catch (t)	Scaled up to total vessel size catch (t)	Number of Observer samples
1	< 40 m	Aug	2 893	4 332	31
2	< 40 m	Sep	1 459	2 185	14
3	≥ 40 m	Aug	968	2 935	24
4	≥ 40 m	Sep	721	2 186	17

Table 11: Strata for the Chatham Rise fishery in 2010–11 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.

	Splitting variable	Mean length	Hoki catch (t)		No. of tows sampled		No. of otoliths	No. of fish Measured
Stratum	Depth of net	(cm)	TCEPR	OP	TCEPR	OP		
1	< 470 m	58.8	5 762	586	1 408	61	171	7 027
2	470–543.8 m	65.3	19 276	1 991	2 201	208	637	21 811
3	≥ 543.8 m	69.0	13 334	933	1 835	105	297	10 812

Table 12: Strata for the Sub-Antarctic fishery in 2010–11 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.

	Splitting variables		Mean length	Hoki catch (t)		No. of tows sampled		No. of otoliths	No. of fish Measured
Stratum	Latitude	Dates or depth of net	(cm)	TCEPR	OP	TCEPR	OP		
1	north of 49° S	< 355.8 m	54.7	506	33	338	23	16	605
2	north of 49° S	≥ 355.8 m	68.5	7 491	1 703	1 184	133	709	12 204
3	south of 49° S	26 Oct 2010 – 30 Sep 2011	74.6	3 971	352	1 293	93	280	5 839
4	south of 49° S	1 – 25 Oct 2010	85.1	674	119	111	17	100	1 478

Table 13: Relative biomass estimates of hoki on the Chatham Rise from *Tangaroa* trawl surveys, January 1992–2012. The c.v. is the coefficient of variation as % (in parentheses).

	1+ 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)

Table 14: Relative biomass estimates of hoki in core 300–800 m strata from Sub-Antarctic *Tangaroa* trawl surveys. c.v. is the coefficient of variation as % (in parentheses).

Series	Survey	Total hoki biomass ('000 t)	c.v
Summer	1991	80.3	(7)
	1992	87.4	(6)
	1993	99.7	(9)
	2000	55.7	(13)
	2001	38.1	(16)
	2002	39.9	(14)
	2003	14.3	(13)
	2004	17.6	(11)
	2005	20.4	(13)
	2006	14.8	(11)
	2007	46.0	(16)
	2008	47.5	(14)
	2009	65.0	(16)
	2011	46.1	(15)
Autumn	1992	67.8	(8)
	1993	53.5	(10)
	1996	89.0	(9)
	1998	67.7	(11)

Table 15: Acoustic biomass estimates by snapshot and stratum for 2011 Cook Strait. c.v. is the coefficient of variation. Stratum names: 1, Narrows Basin; 2, Cook Strait Canyon; 3, Nicholson Canyon; 5A, Cook Strait Canyon extension; 5B, deepwater outside Nicholson and Wairarapa Canyons; 6, Terawhiti Sill.

								Stratum	Biomass	
Snapshot	Vessel	Dates	1	2	3	5A	5B	6	(‘000 t)	c.v.
1	*Independent 1*	18–19 Jul	32	85	7	16	25*	7	172	23
2	*Independent 1*	20–23 Jul	30	209	8	36	25*	4	312	32
3	*Thomas Harrison*	11–12 Aug	29	282	4	22	18	5	359	44
4	*Thomas Harrison*	20–21 Aug	36	350	4	28	27	34	478	53
5	*Thomas Harrison*	23–24 Aug	45	119	4	12	19	3	202	24
6	*Thomas Harrison*	26–27 Aug	45	183	2	12	36	1	279	24
Mean			36	205	5	21	25	9	300	18

* Stratum 5B was not surveyed in snapshots 1 and 2, so the mean value for this stratum from the other four snapshots was assumed.

Table 16: Acoustic indices of hoki abundance for Cook Strait 1988–2011. Biomass values with annual TS use acoustic target strength derived from commercial length frequency data in each survey year. Values with constant TS use an average ratio of hoki TS to fish weight (calculated from the mean of annual values).

		Biomass (‘000 t)		
Year	No of snapshots	Annual TS	Constant TS	c.v.
1991	4	180	191	0.41
1993	4	583	613	0.52
1994	3	592	597	0.91
1995	4	427	411	0.61
1996	5	202	196	0.57
1997	6	295	302	0.40
1998	5	170	170	0.44
1999	6	243	245	0.36
2001	11	220	217	0.30
2002	9	320	307	0.35
2003	9	225	222	0.34
2005	9	132	124	0.32
2006	7	126	128	0.34
2007*	4	216	218	0.46
2008	7	167	179	0.30
2009*	5	315	334	0.39
2011*	6	300	269	0.35

* Surveys from industry vessels

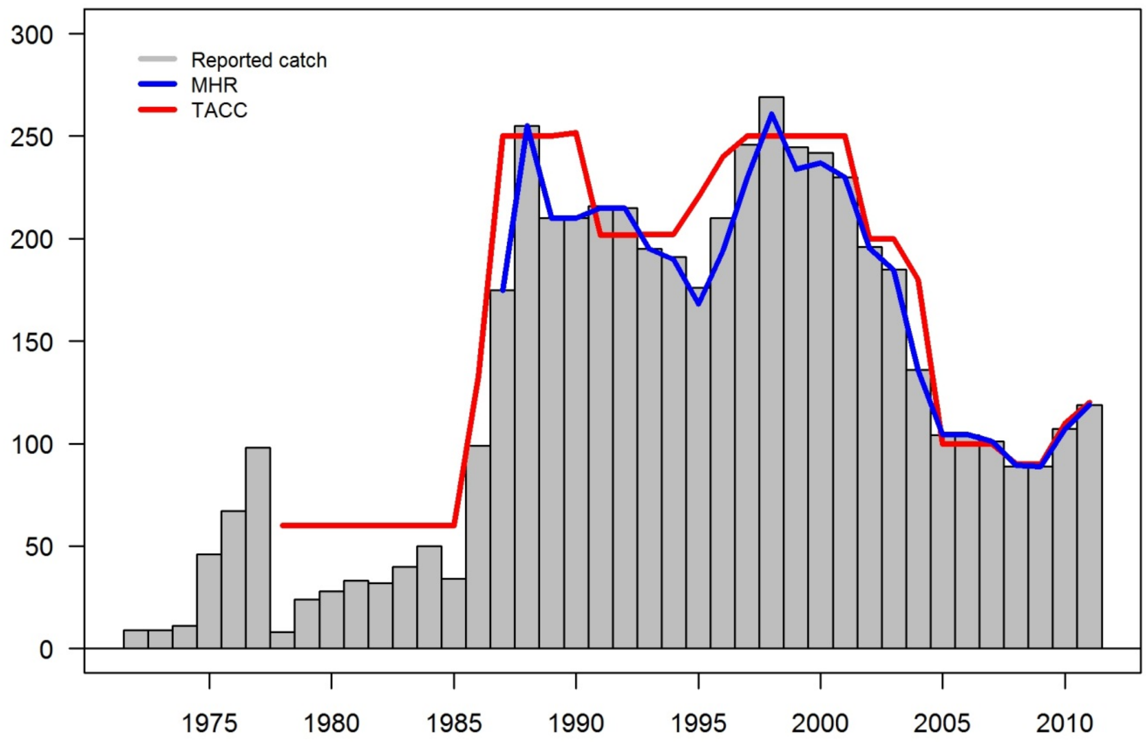
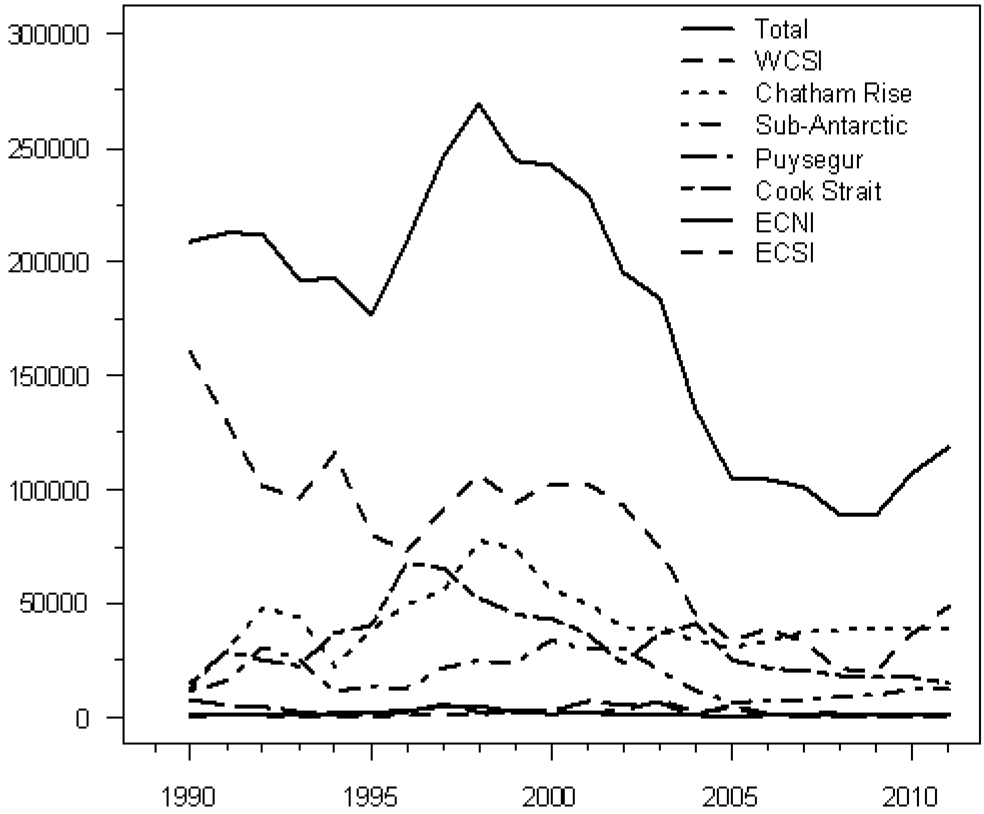


Figure 1: Total New Zealand hoki catch estimated from reported landings for calendar years 1972 to 1983 and fishing years 1983–84 (1984) to 2010–11.



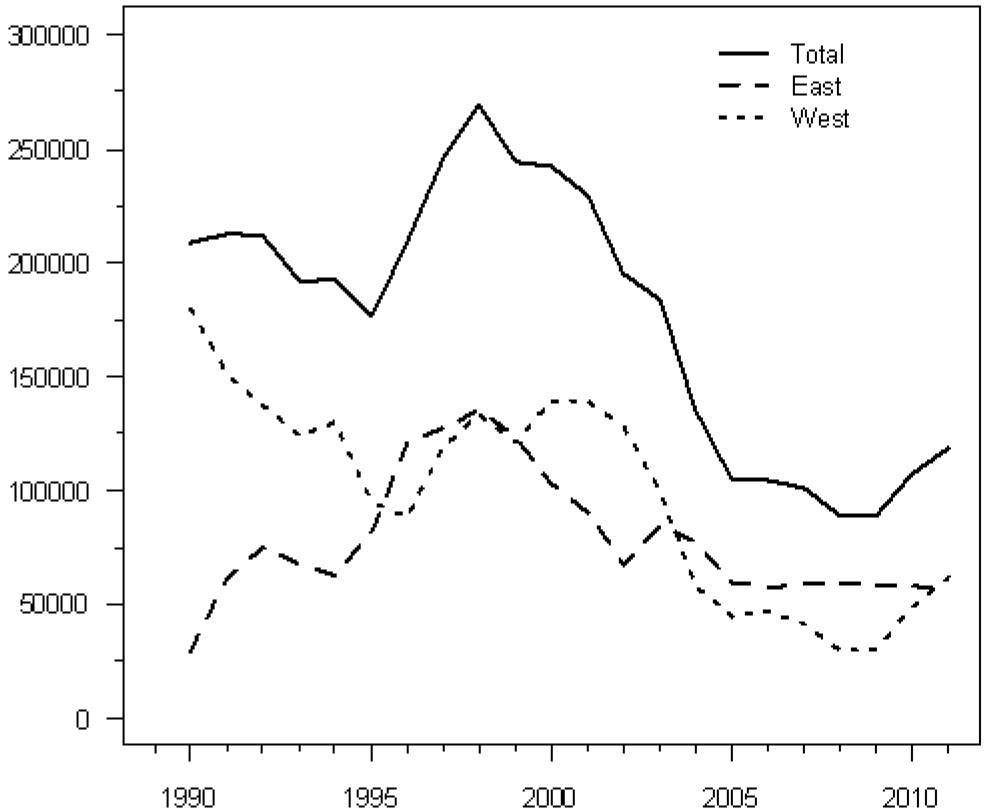


Figure 2a: Estimated total catch (t) of hoki by 'stock' area (upper panel) and fishing area (lower panel) from 1988–89 (89) to 2009–10 (10). "Eastern" areas include Chatham Rise, east coast South Island (ECSI), Cook Strait, and east coast North Island (ECNI). "Western" areas include west coast South Island (WCSI), Sub-Antarctic, and Puysegur.

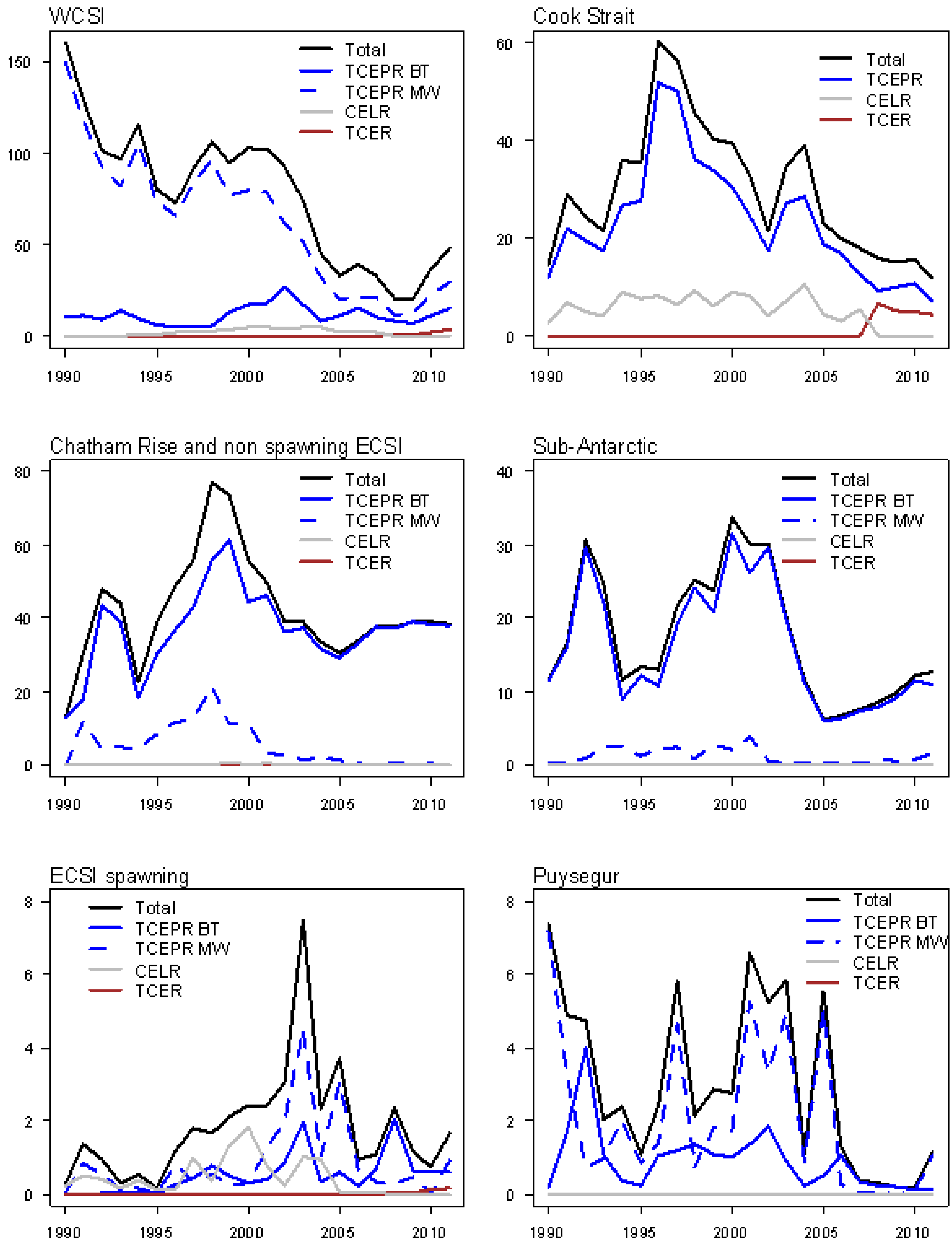
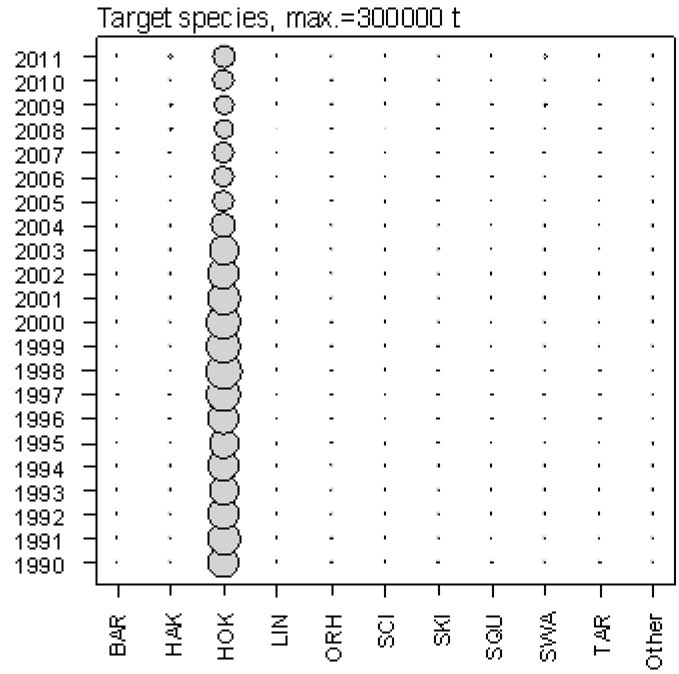


Figure 2b: Total catches and catches by form type by hoki area and fishing year. All areas (except Cook Strait) also show TCEPR data split by MW (midwater trawl) and BT (Bottom trawl). Sub-Antarctic and Puysegur have very little CELR or TCER data. There are no TCER or CELR catches for Sub-Antarctic.

(a)



(b)

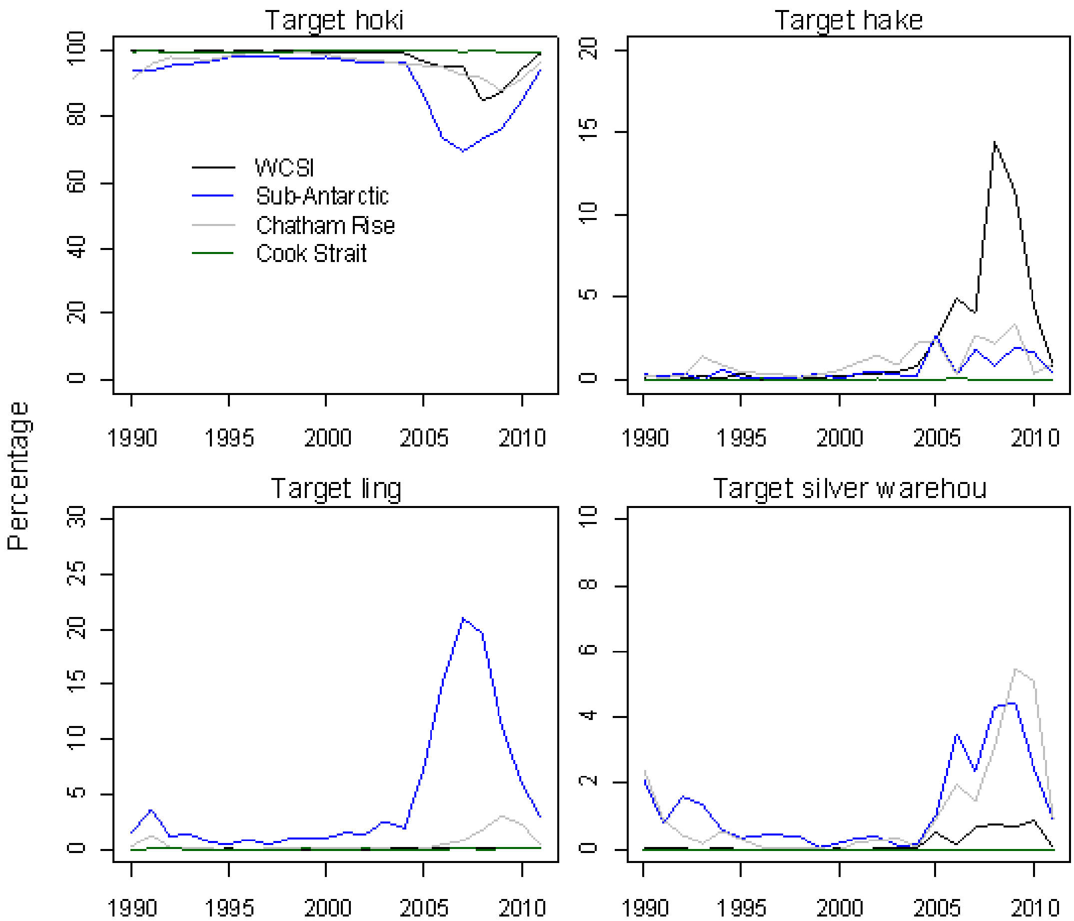
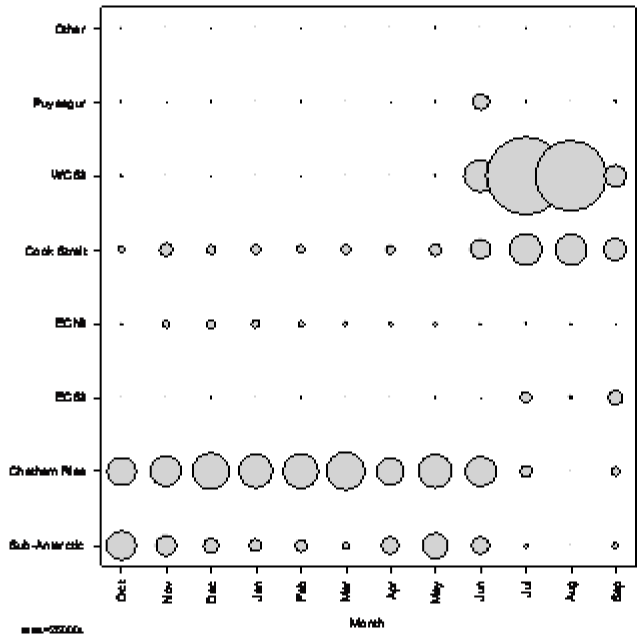


Figure 3: (a) Distribution hoki catch by target species, and (b) percentage of hoki catch by hoki, hake, ling, and silver warehou target tows for the 1989–90 to 2010–11 fishing years.

(a)



(b)

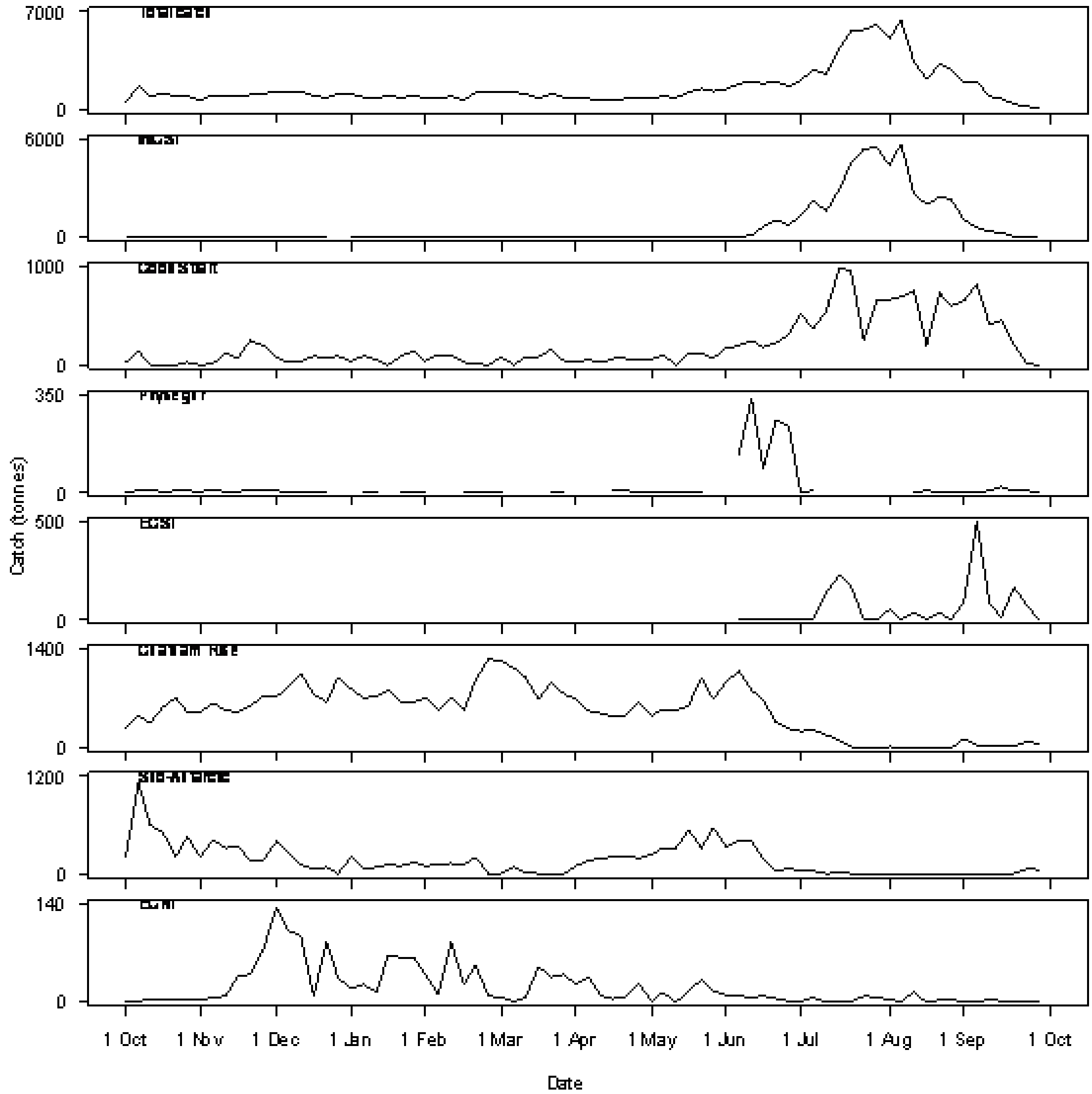


Figure 4: (a) Hoki catch by month and area (maximum circle size is 25 000 t) and (b) distribution of hoki catch (in 5 day bins) by area in the 2010–11 fishing year.

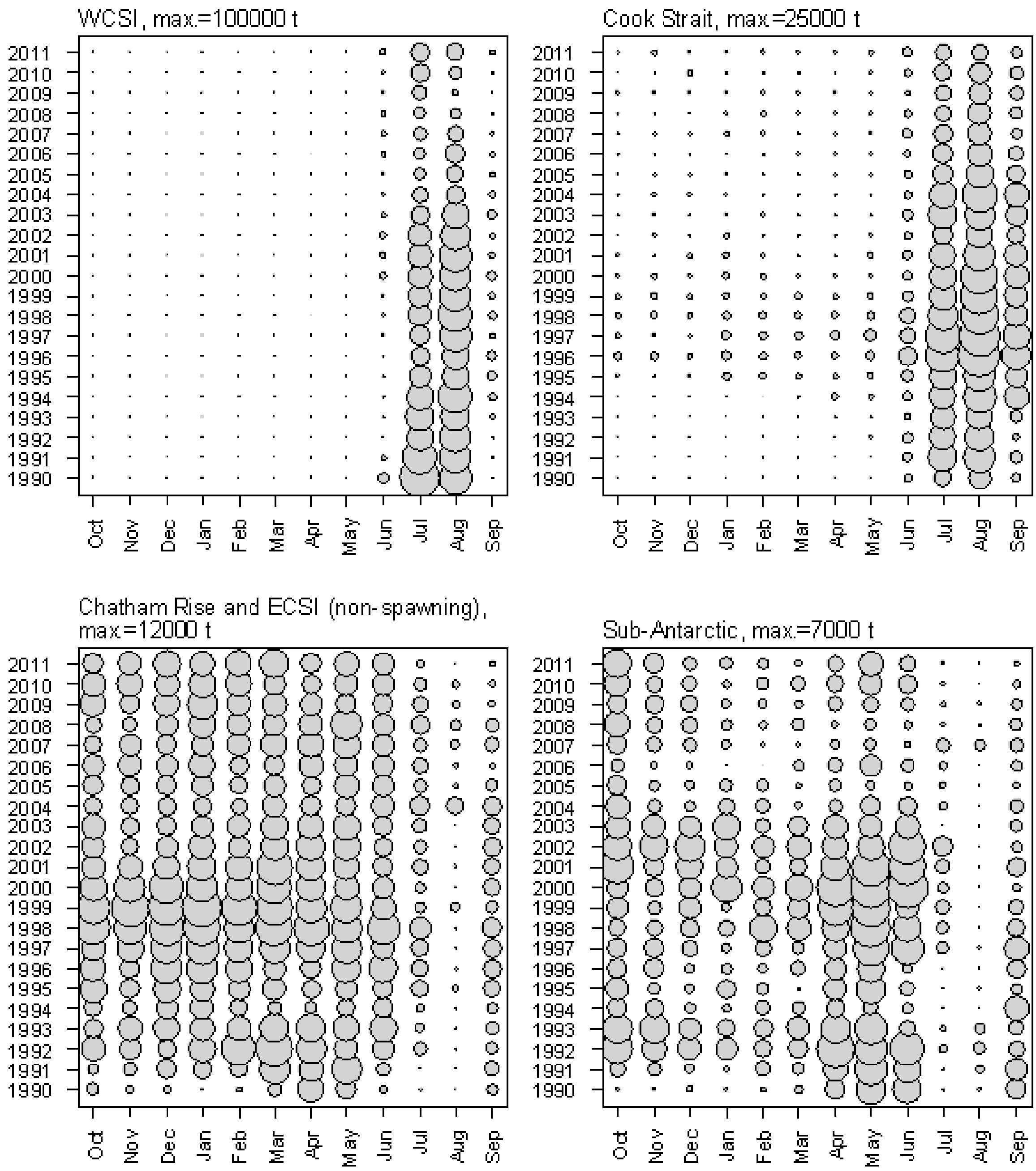


Figure 5: Distribution of hoki catch by month and area for the 1989–90 to 2010–11 fishing years.

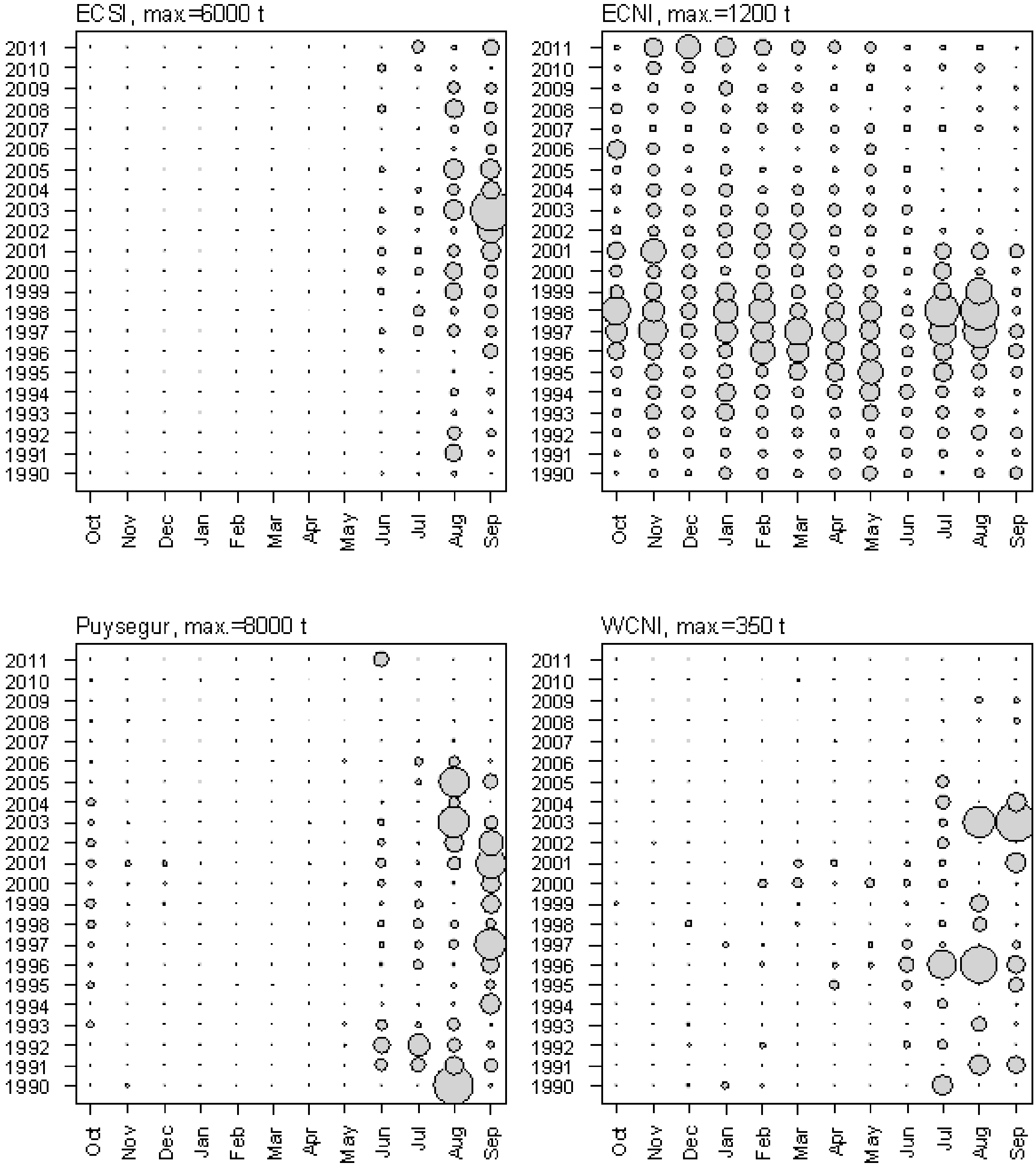
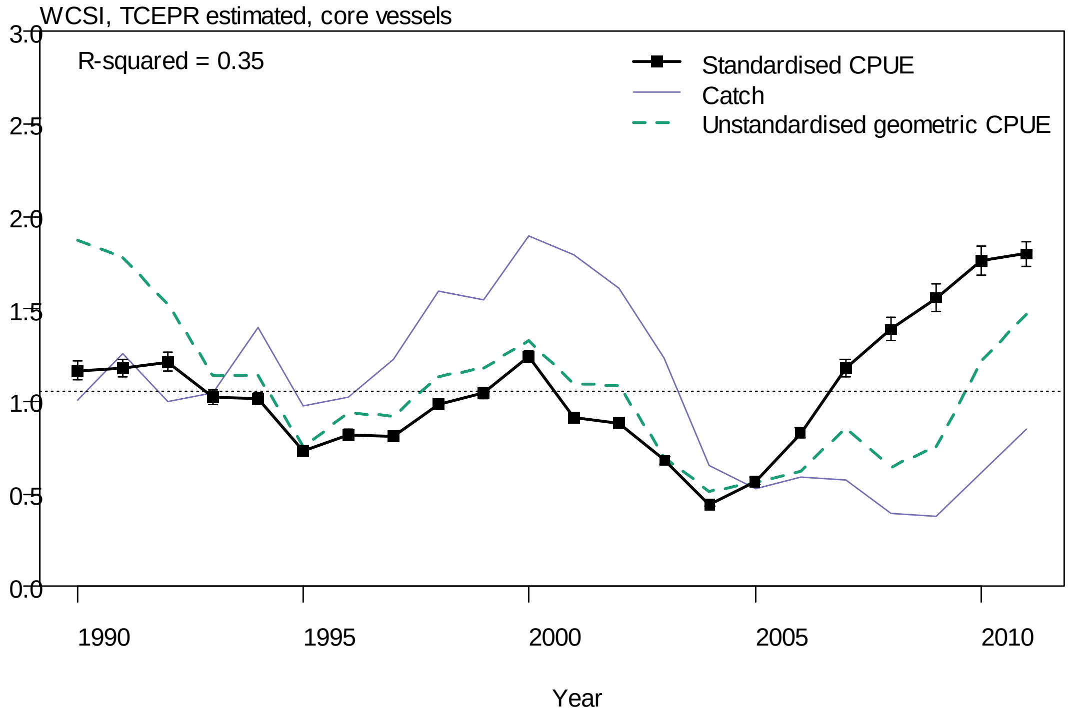


Figure 5: Continued.



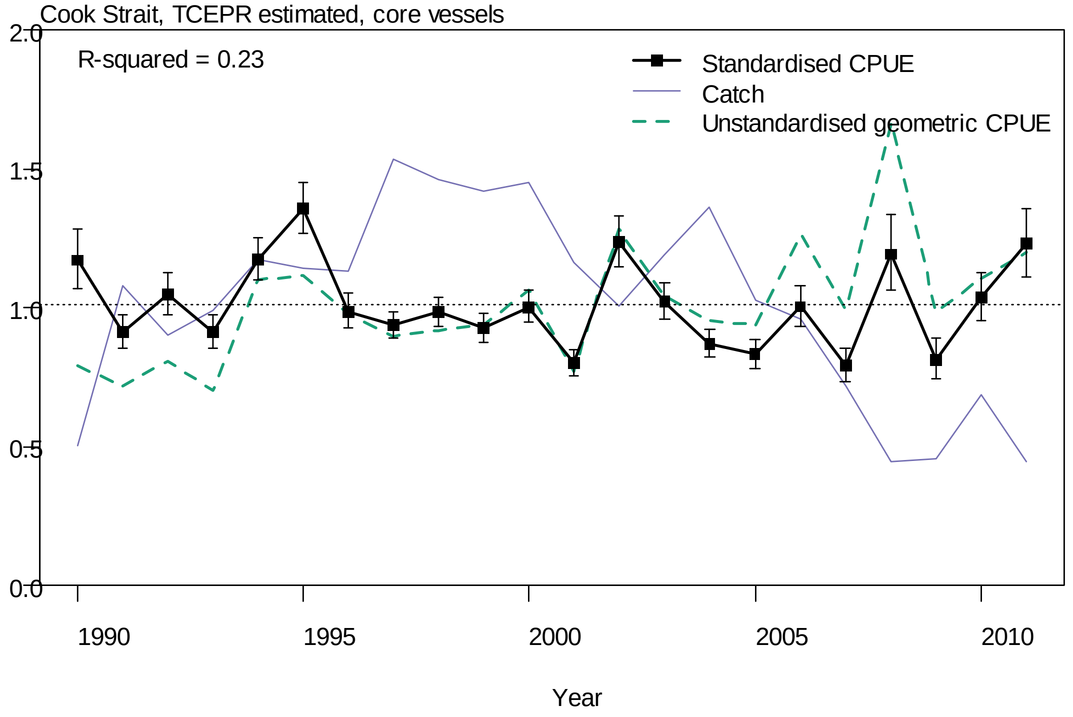
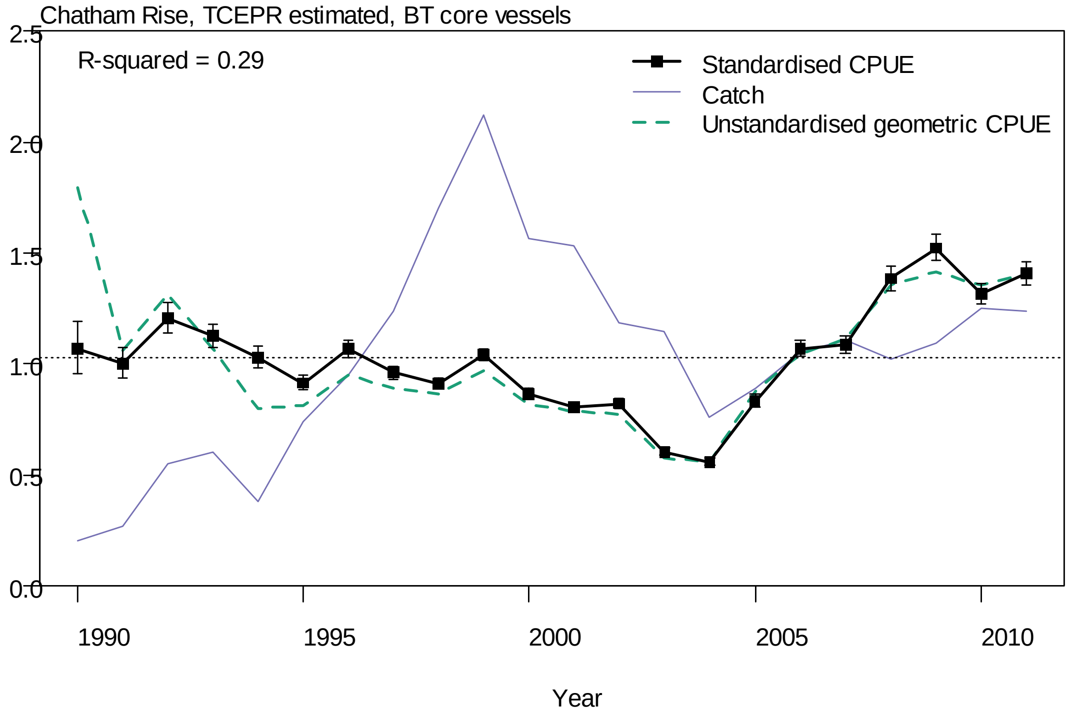


Figure 6a: Model catch, unstandardised, geometric and standardised CPUE indices by area for core data hoki tows for 1990–2011. Datasets for Chatham Rise and ECSI, and Sub-Antarctic included only bottom tows, and Cook Strait included only MW tows.



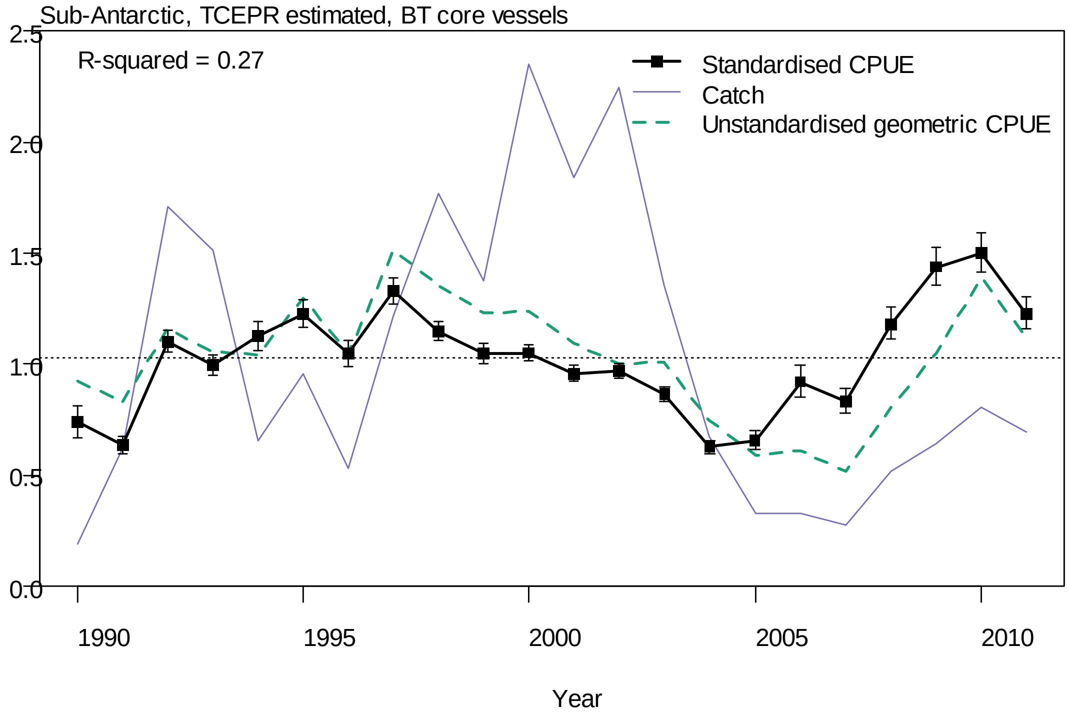


Figure 6a: continued.

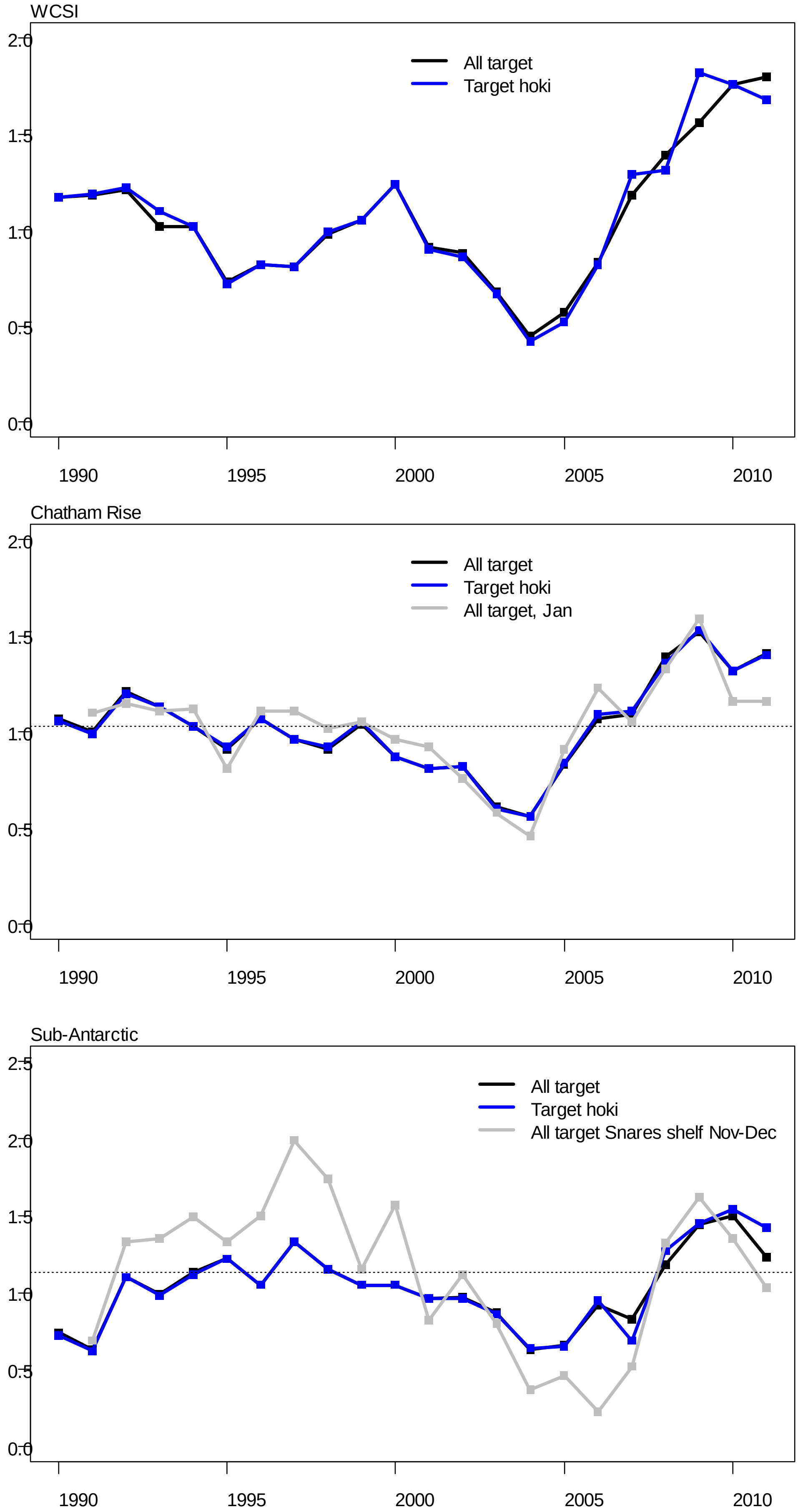
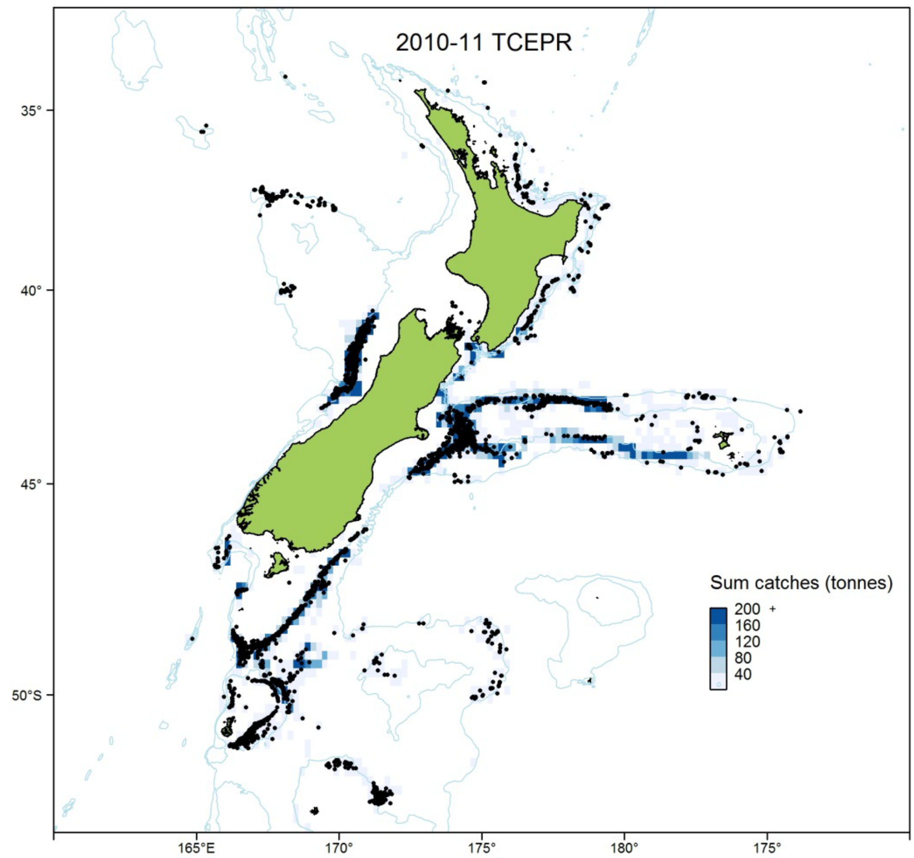


Figure 6b: Comparison of relative standardised indices from model runs for each area.



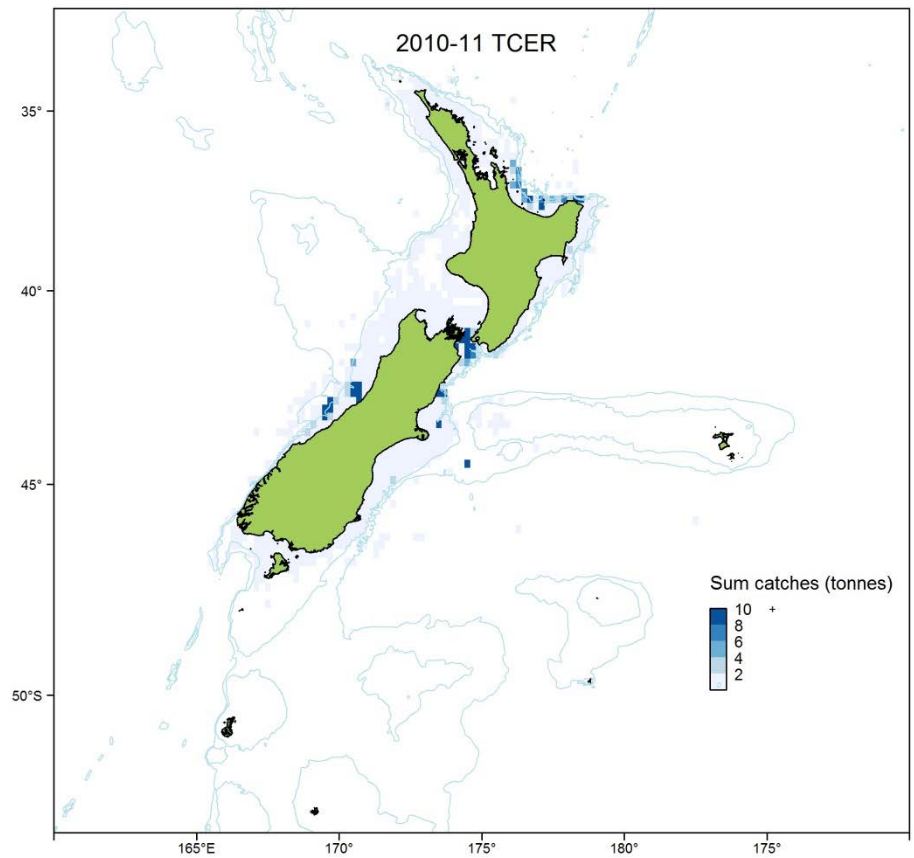


Figure 7: Density plots of all commercial TCEPR and TCER trawls where hoki was caught in the 2010–11 fishing year. TCEPR plot also shows observed positions as black dots.

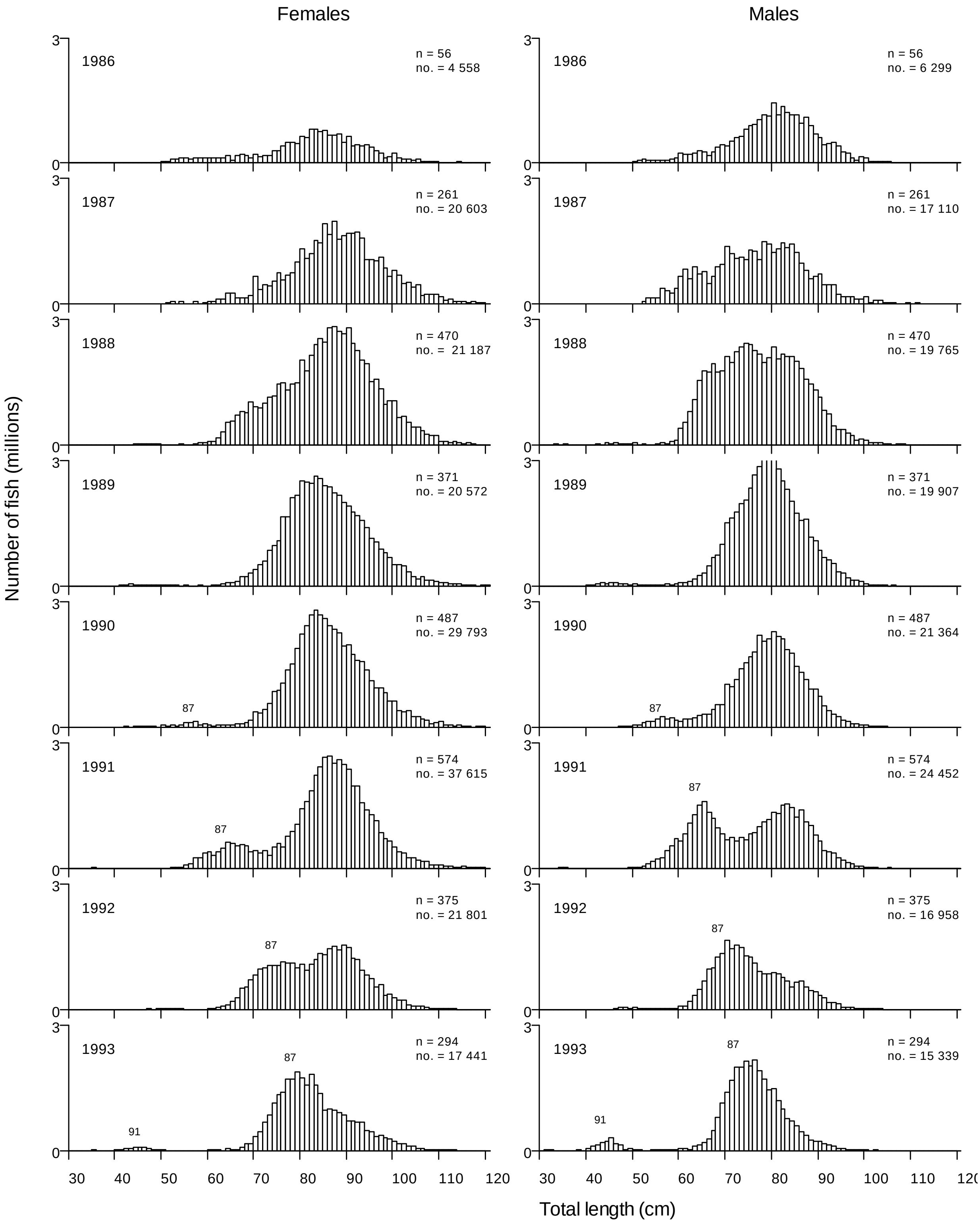


Figure 8: Length frequency of hoki in commercial catches from the west coast South Island spawning fishery from 1989 to 1993 sampled at sea by the Observer Programme. n, number of tows sampled; no., number of fish sampled. Numbers above the histograms mark estimated year-class modes, e.g., 91 = 1991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

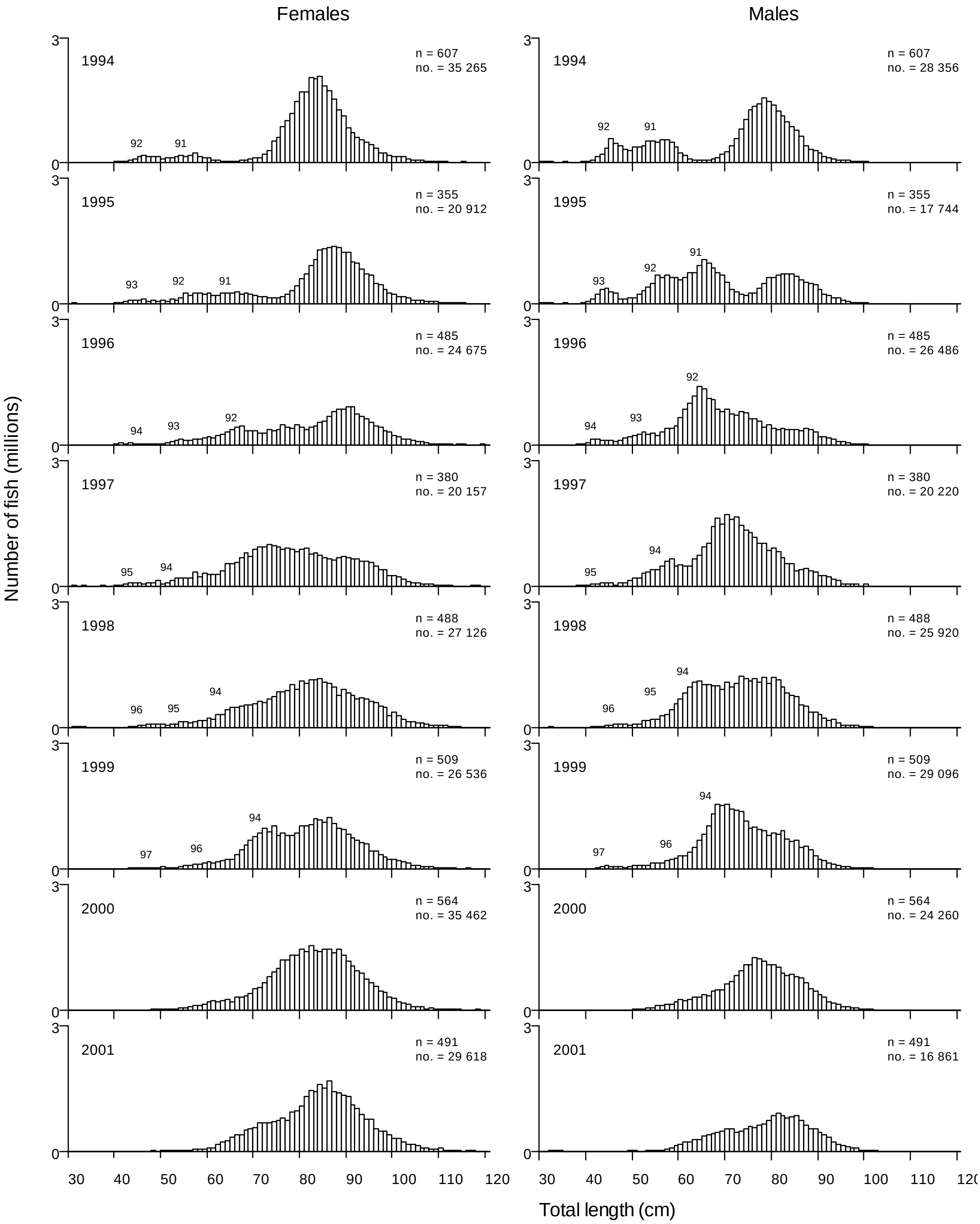


Figure 8 continued: Length frequency of hoki in commercial catches from the west coast South Island spawning fishery from 1996 to 2001 sampled at sea by the Observer Programme. n, number of tows sampled; no., number of fish sampled; N, number of landings sampled. Numbers above the histograms mark estimated year-class modes, e.g., 91 = 1991 year-class.

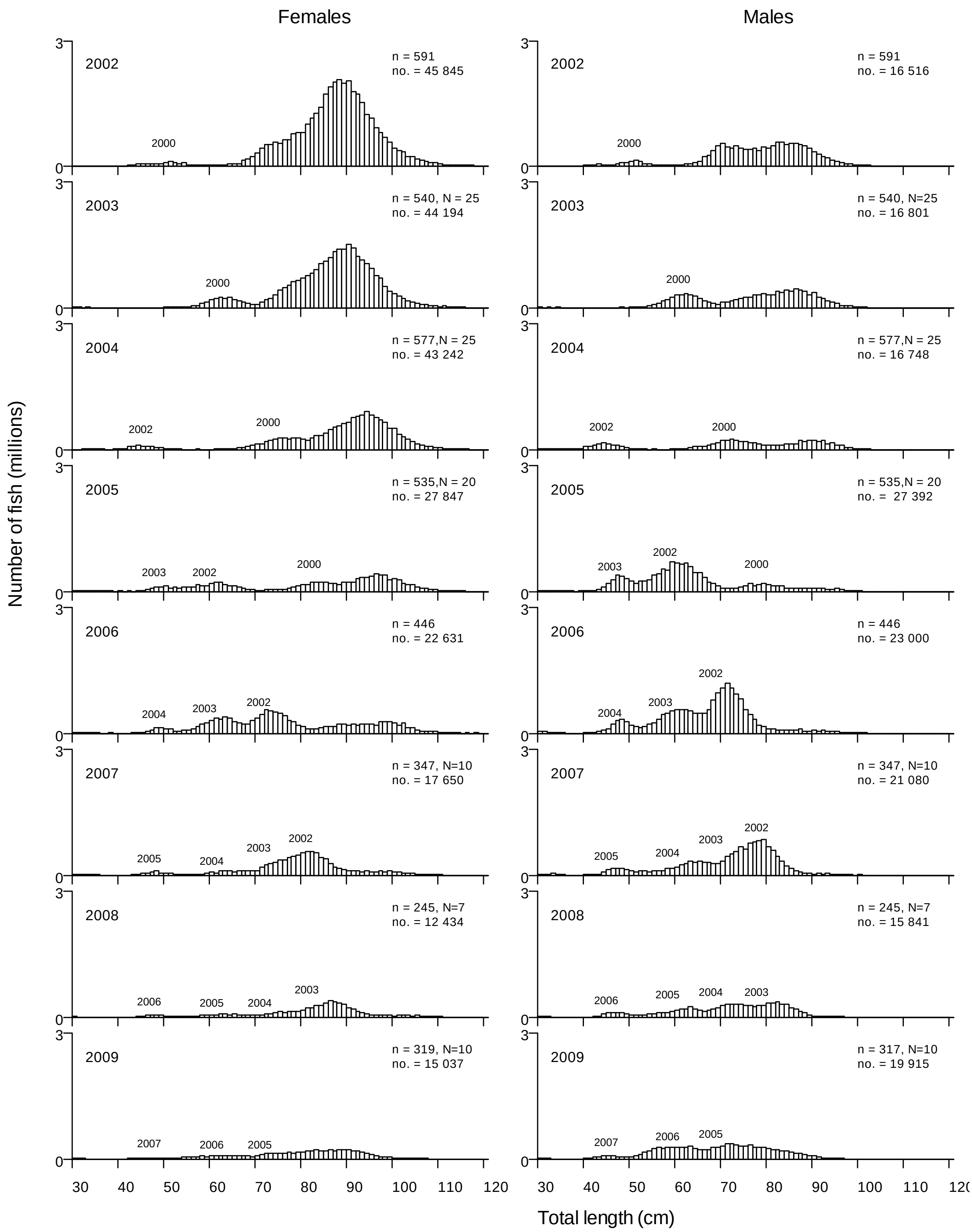


Figure 8 continued: Length frequency of hoki in commercial catches from the west coast South Island spawning fishery from 2002 to 2009. In 2003–05 and 2007–09, Observer Programme data are combined with samples of landings from inside the 25 n. mile line sampled by NIWA. n, number of tows sampled; no.,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

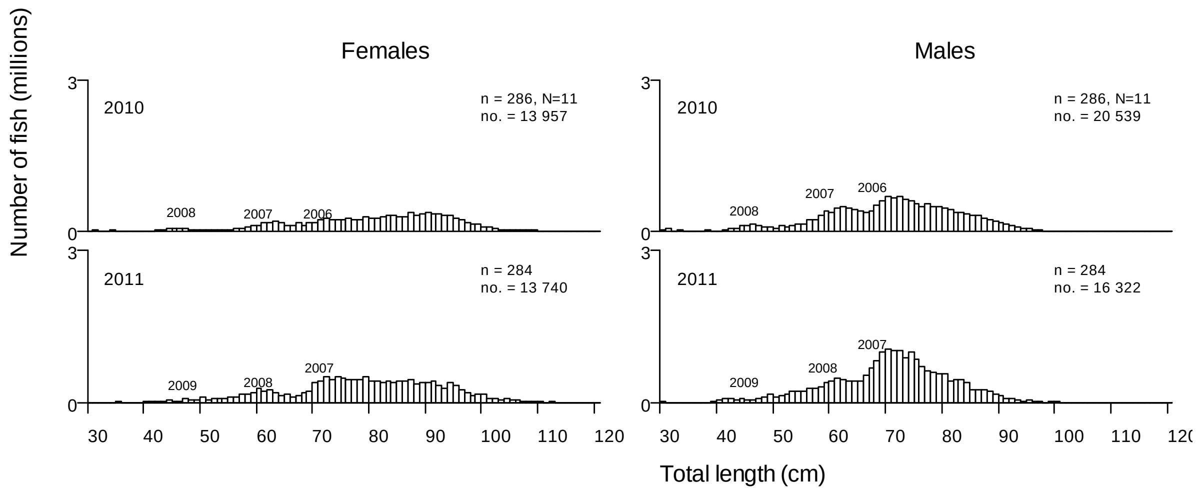


Figure 8 continued: Length frequency of hoki in commercial catches from the west coast South Island spawning fishery from 2010 to 2011. In 2010, Observer Programme data are combined with samples of landings from inside the 25 n. mile line sampled by NIWA, and in 2011 there is only Observer data outside 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.

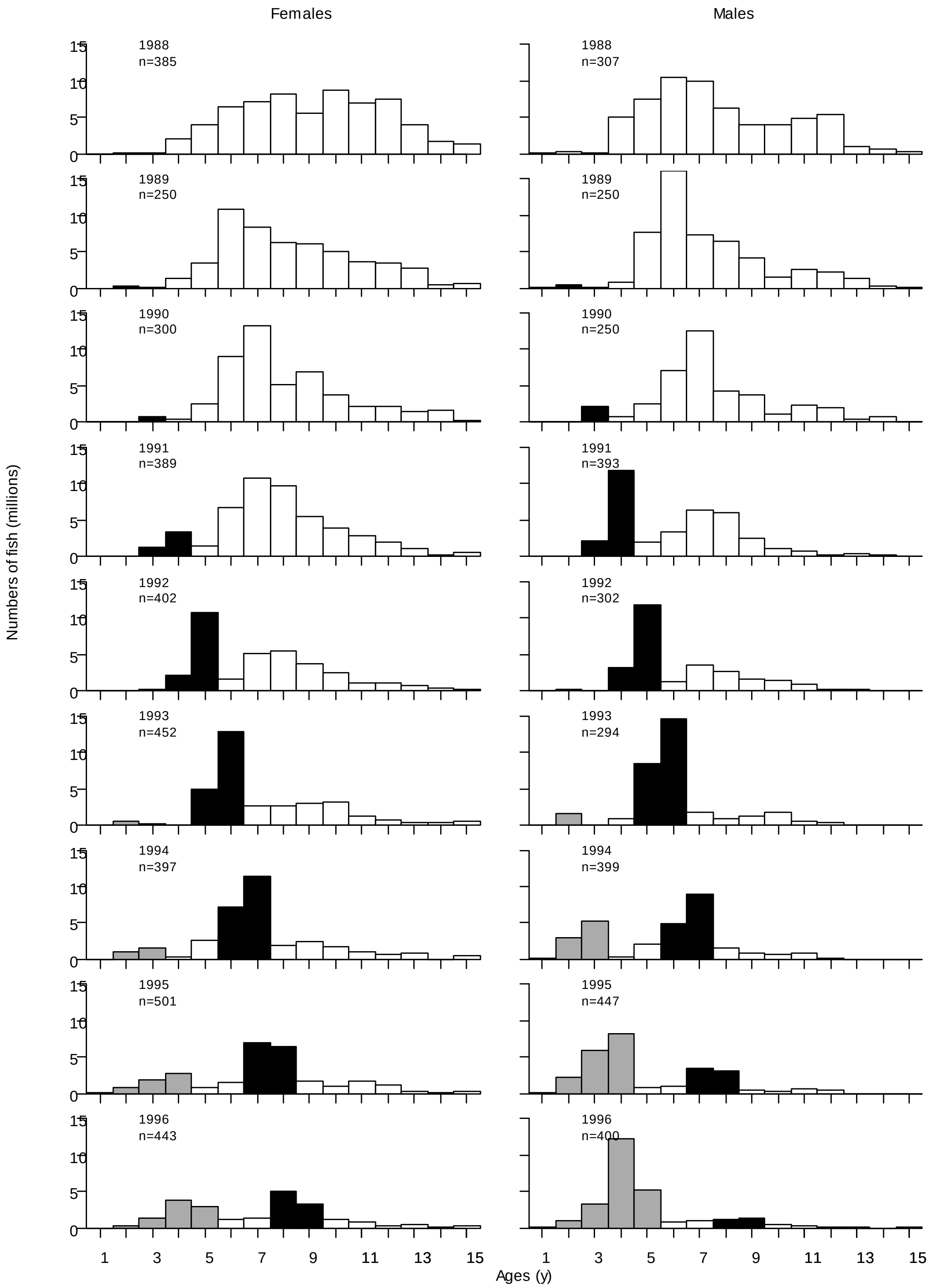


Figure 9: Catch at age of hoki in commercial catches from the west coast South Island spawning fishery from 1988 to 2011. n, number of fish aged. Black bars for the years 1990 to 2000 show 1987 and 1988 year-classes, grey bars show 1991–94 year-classes, and light grey bars in the 2004–2011 seasons represent the 2002 and 2003 year-classes.

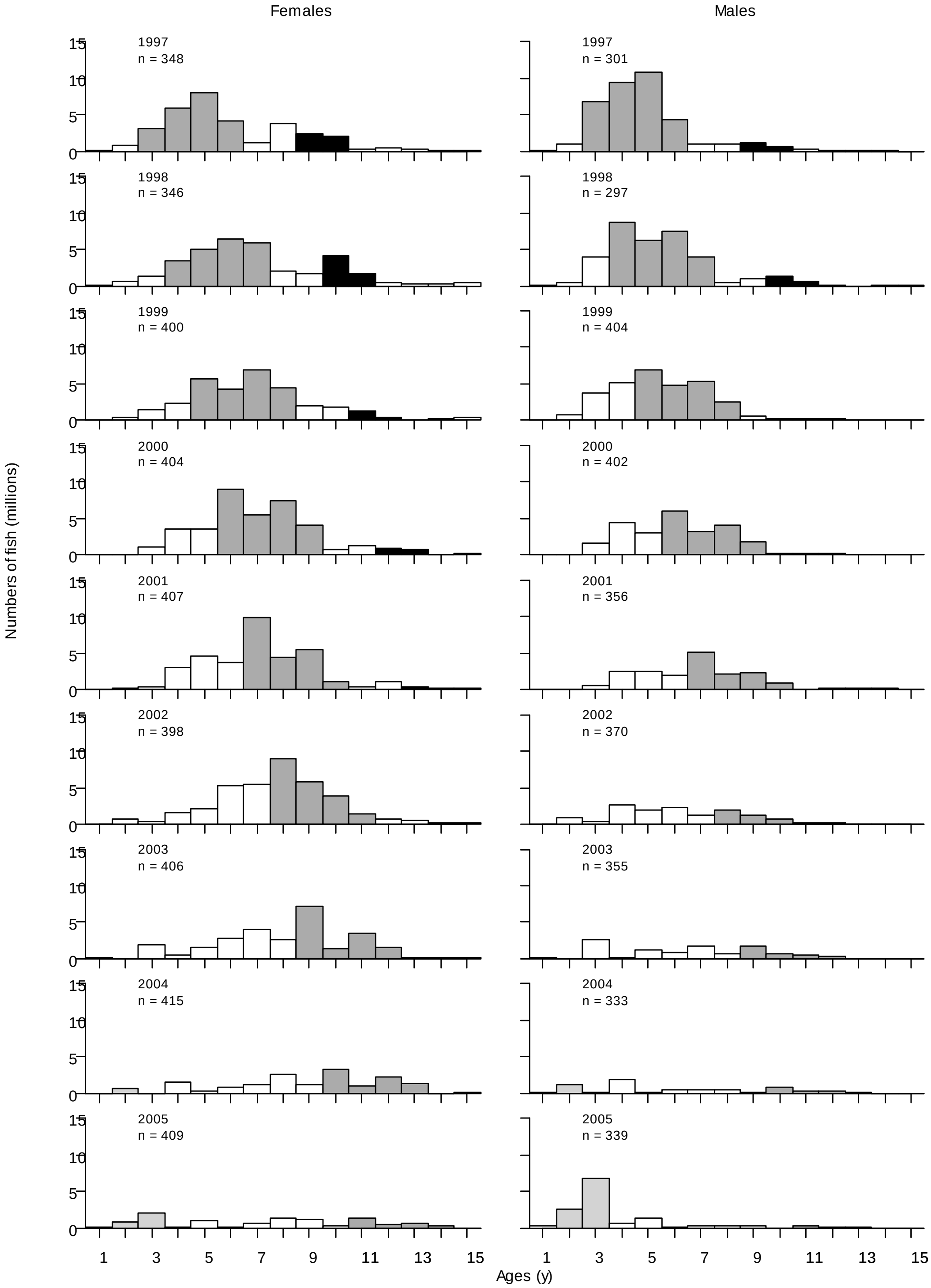


Figure 9: continued.

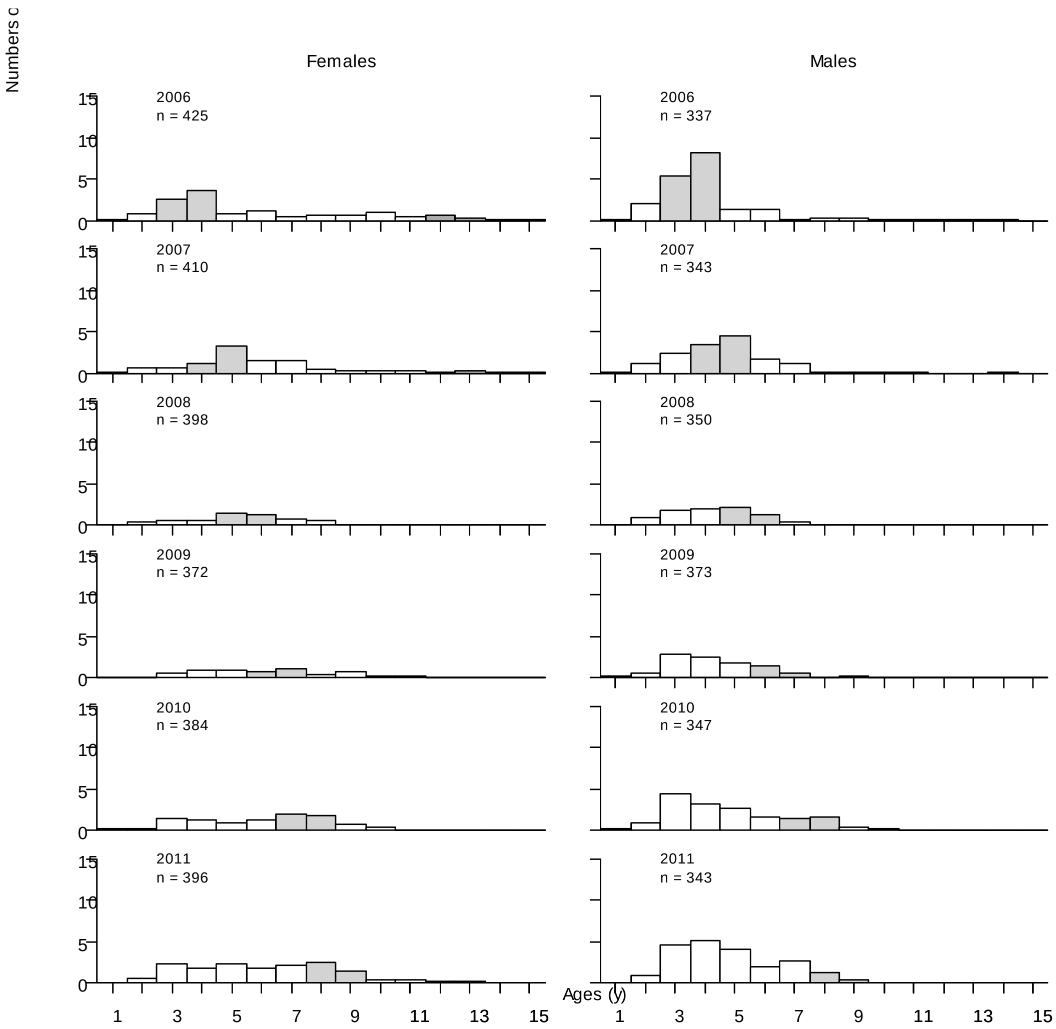


Figure 9: continued.

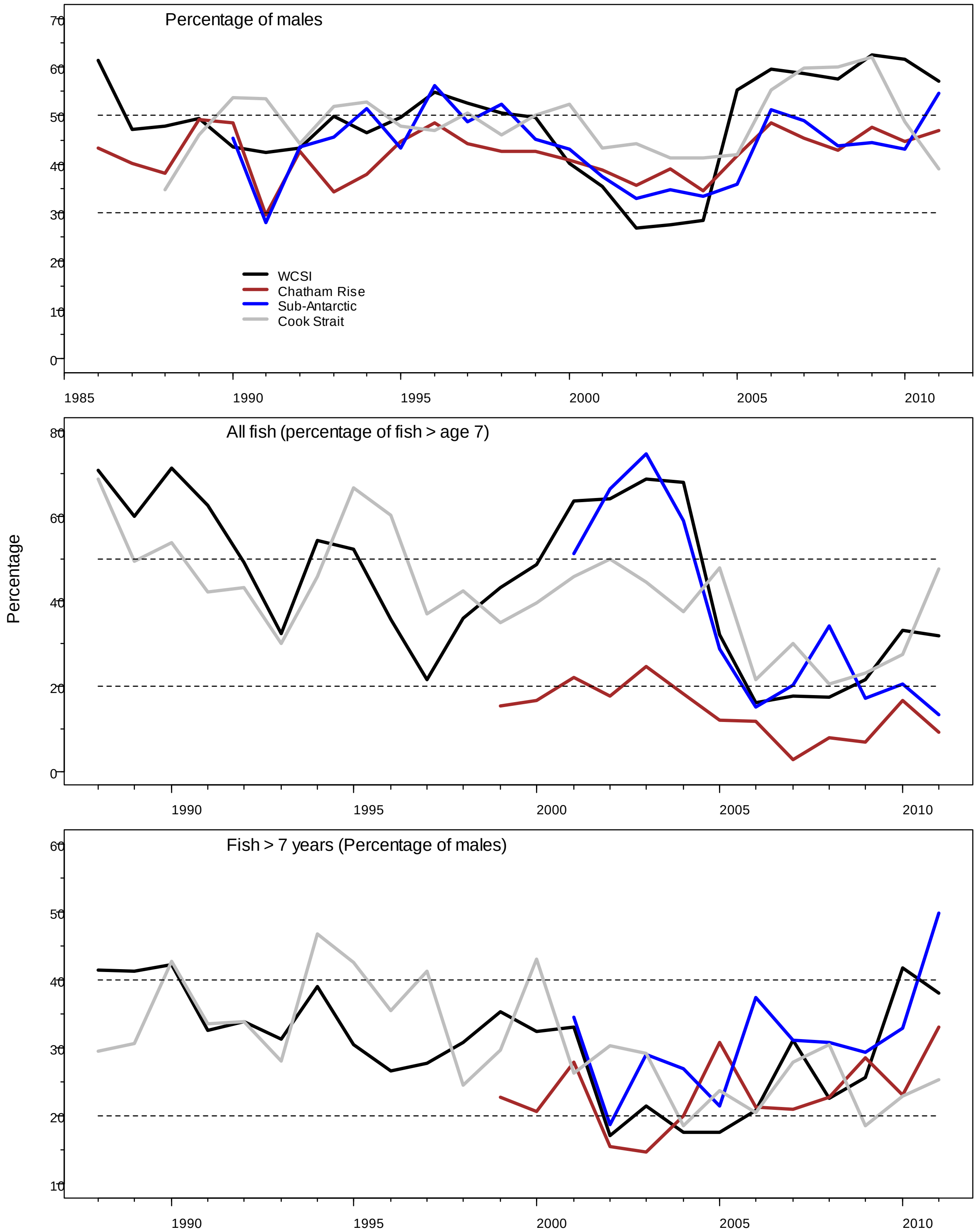


Figure 10a: Percentage of males in the catch, percentage of male and female fish aged 7 and older in the catch, and percentage of male fish aged 7 and older in the catch, by area and fishing year.

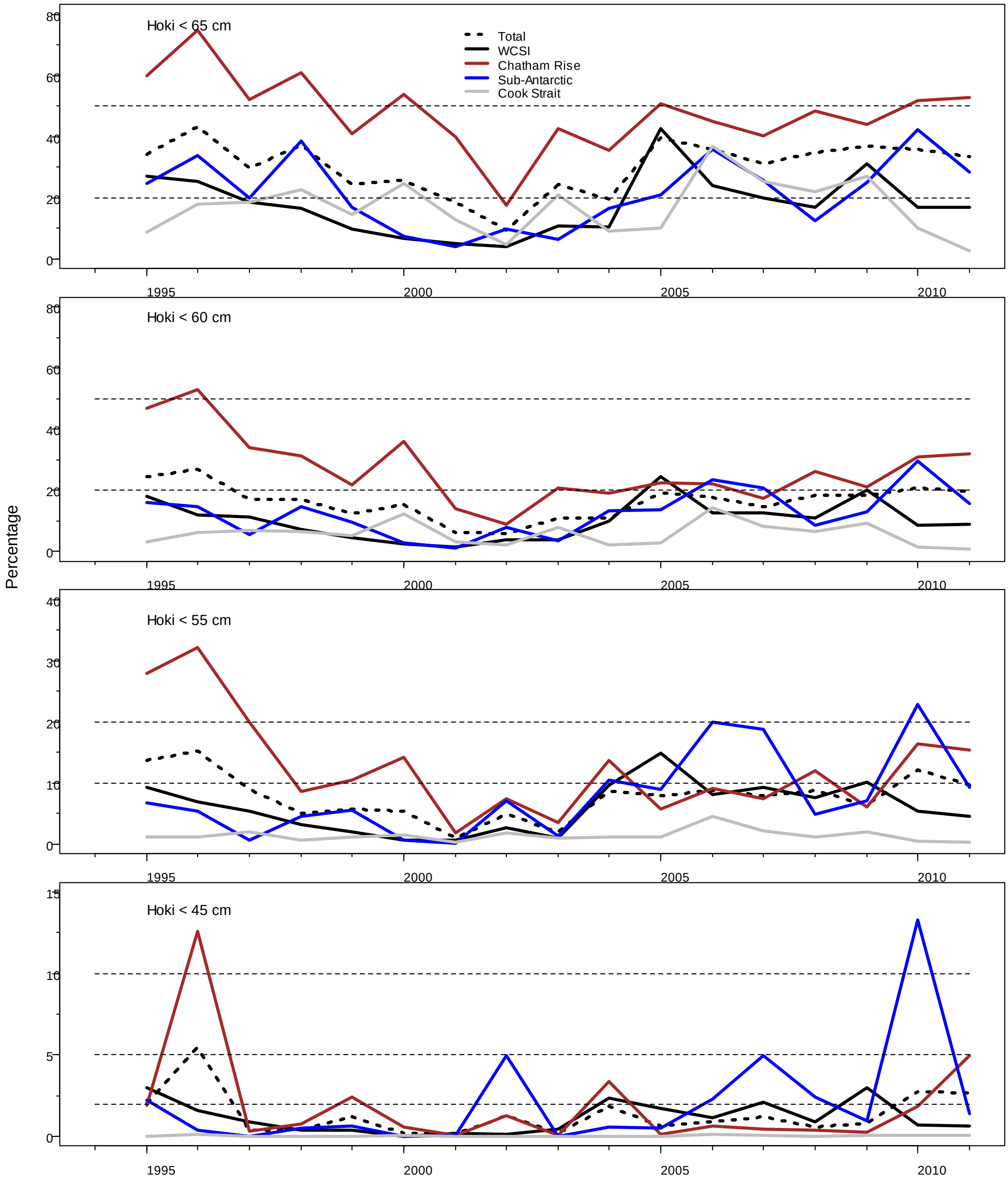


Figure 10b: Percentage of small fish in the catch by area and fishing year.

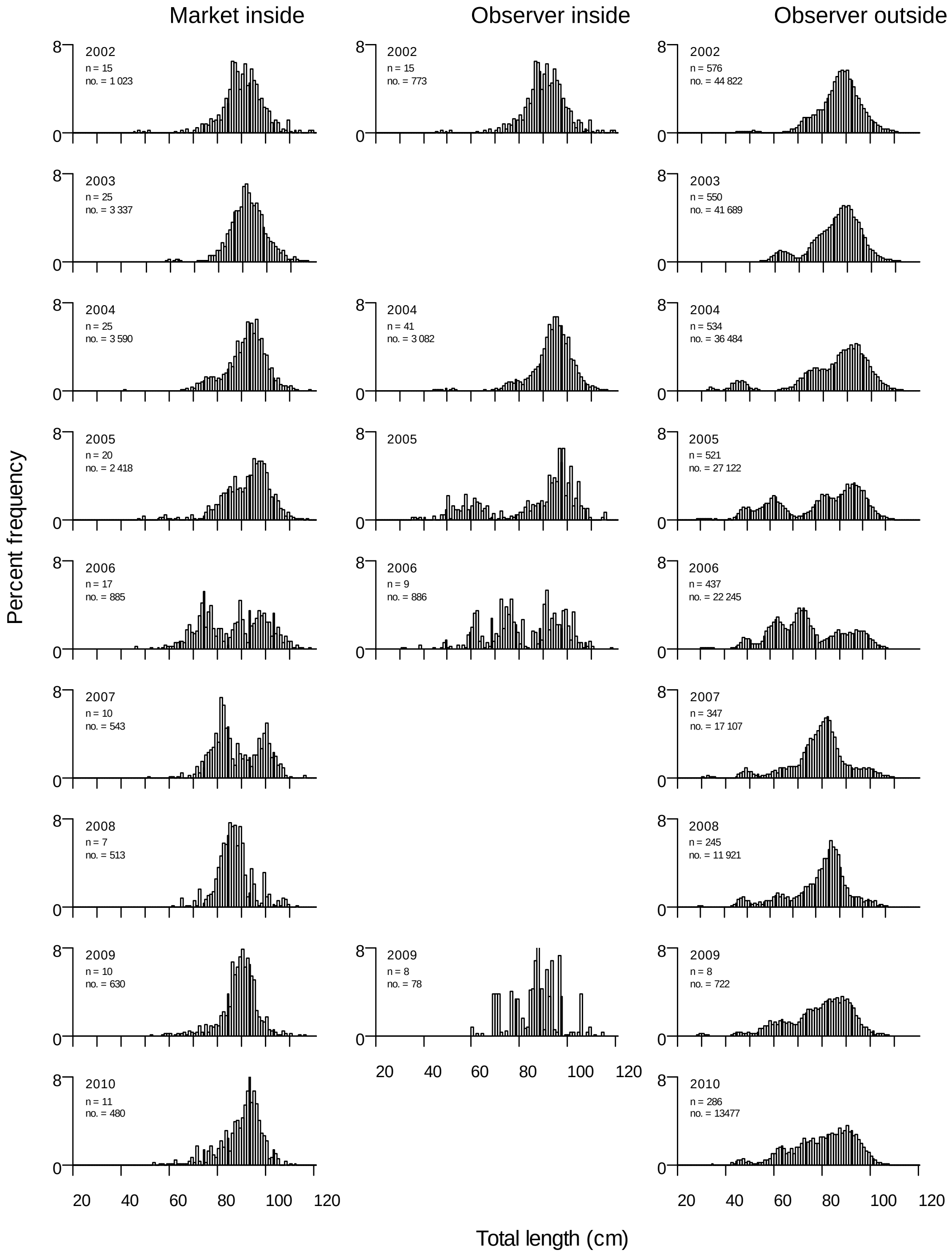


Figure 11a: Female length frequencies from inside the 25 n. mile line sampled by NIWA (market) and OP, and outside the 25 n. mile line sampled at sea by the Observer Programme (OP) in 2002–10. n, number of landings or tows sampled; no., number of fish sampled.

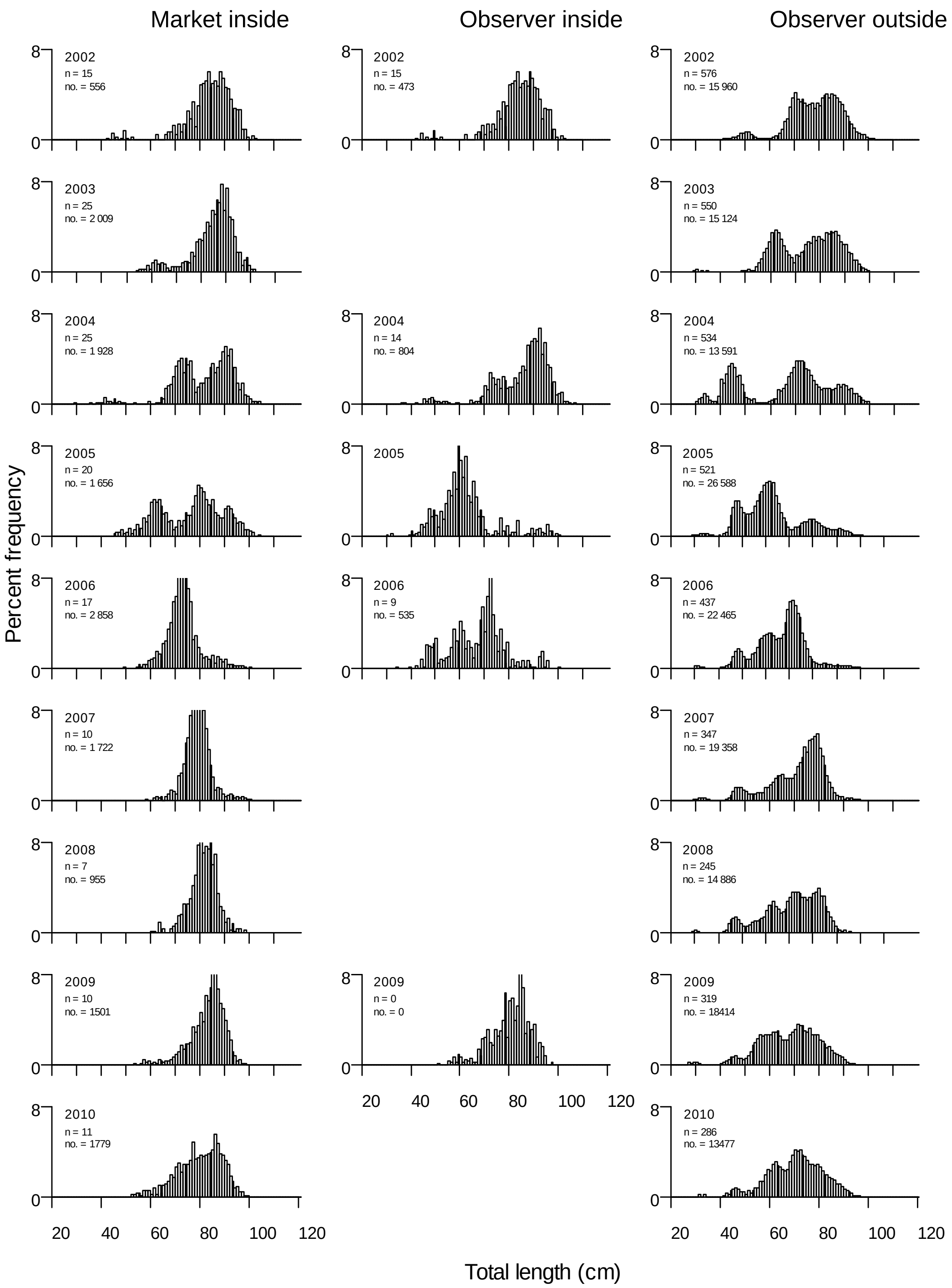


Figure 11b: Male length frequencies from inside the 25 n. mile line sampled by NIWA (market) and OP, and outside the 25 n. mile line sampled at sea by the Observer Programme (OP) in 2002–10. n, number of landings or tows sampled; no., number of fish sampled.

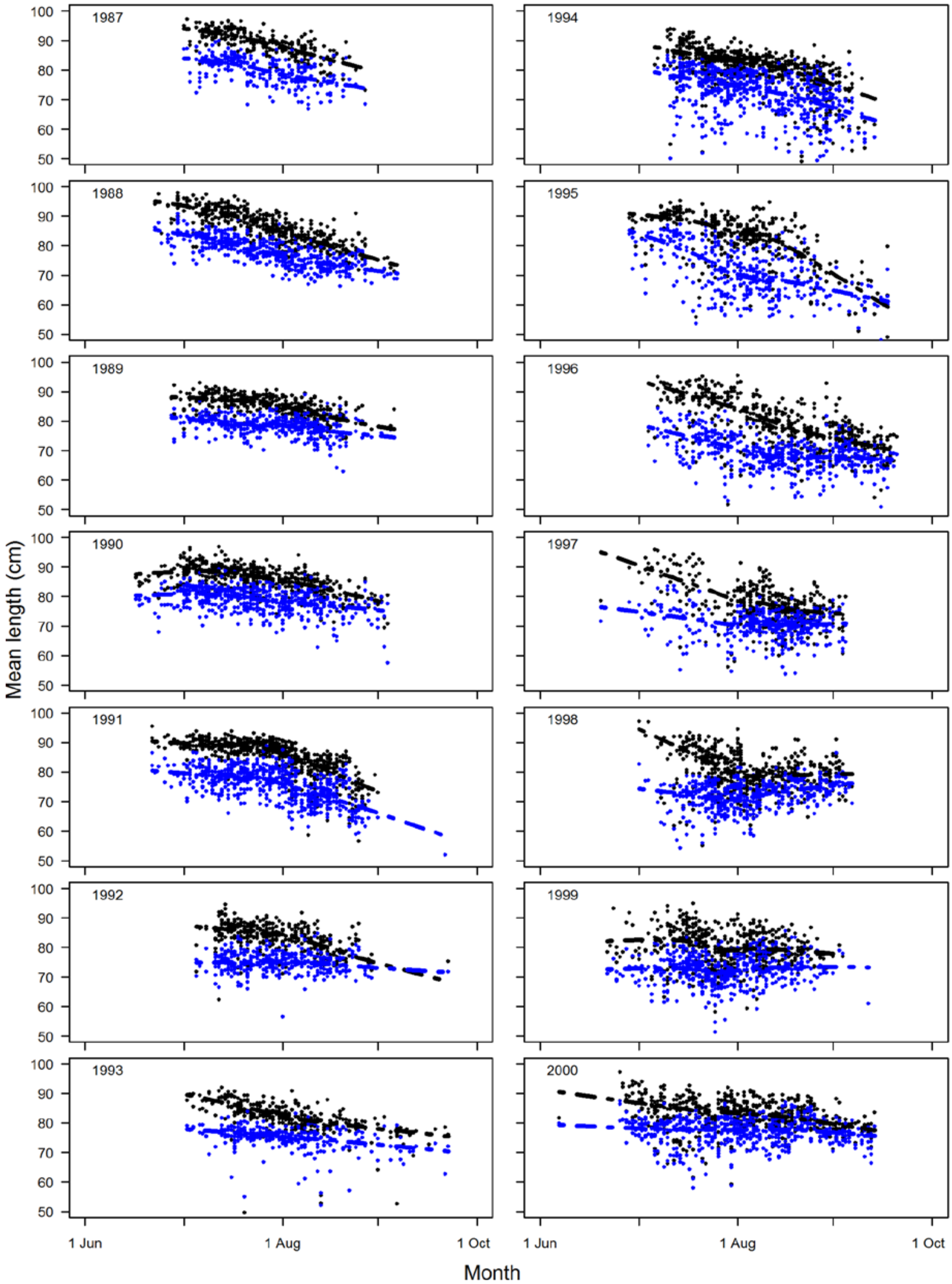


Figure 12: Mean length of female (black) and male (blue) hoki taken in commercial catches from the west coast South Island spawning fishery 1987–2000 sampled at sea by the Observer Programme. Lines are a loess fit.

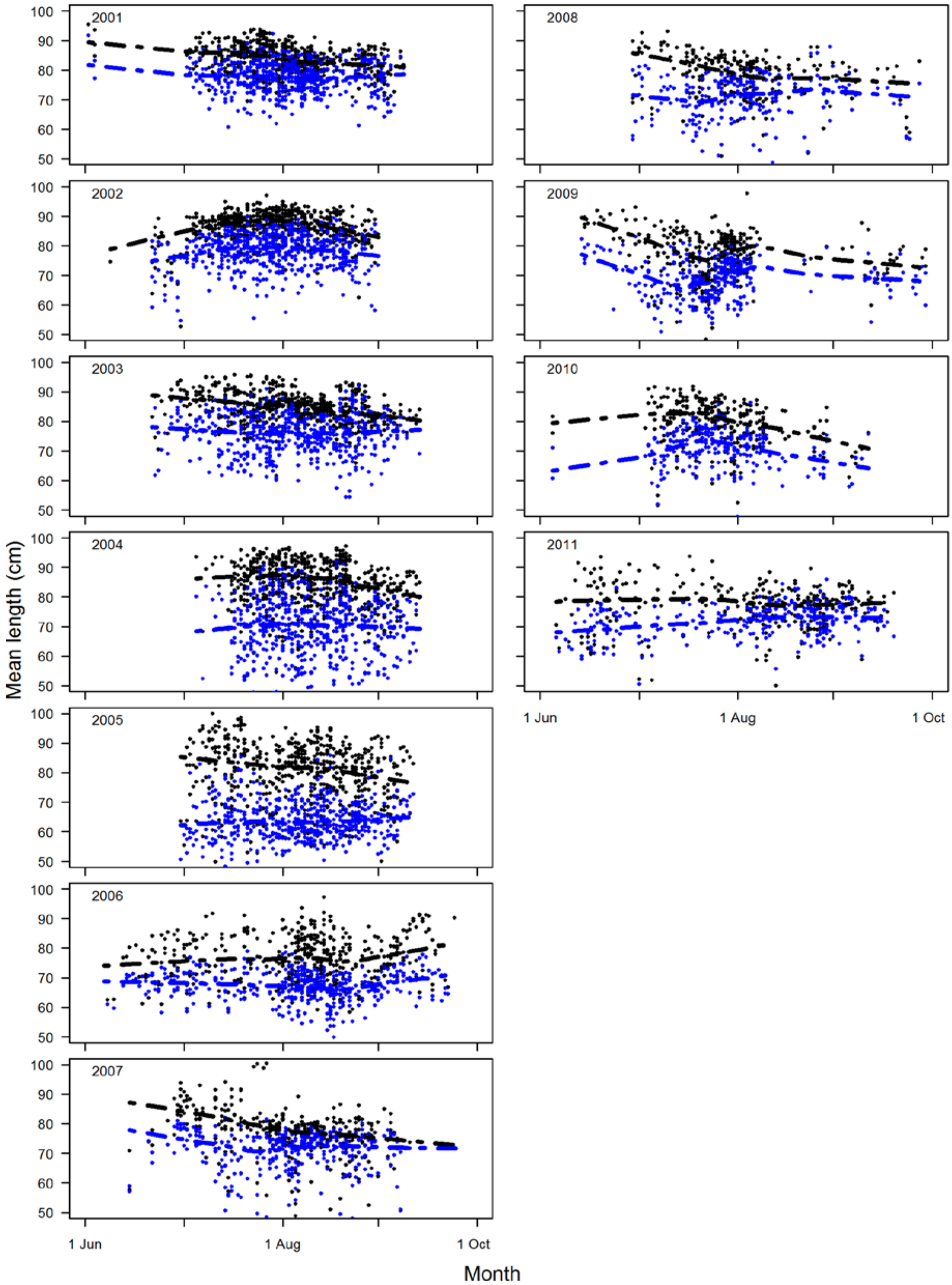


Figure 12 continued: Mean length of female (black) and male (blue) hoki taken in commercial catches from the west coast South Island spawning fishery 2001–2011 sampled at sea by the Observer Programme. Lines are a loess fit.

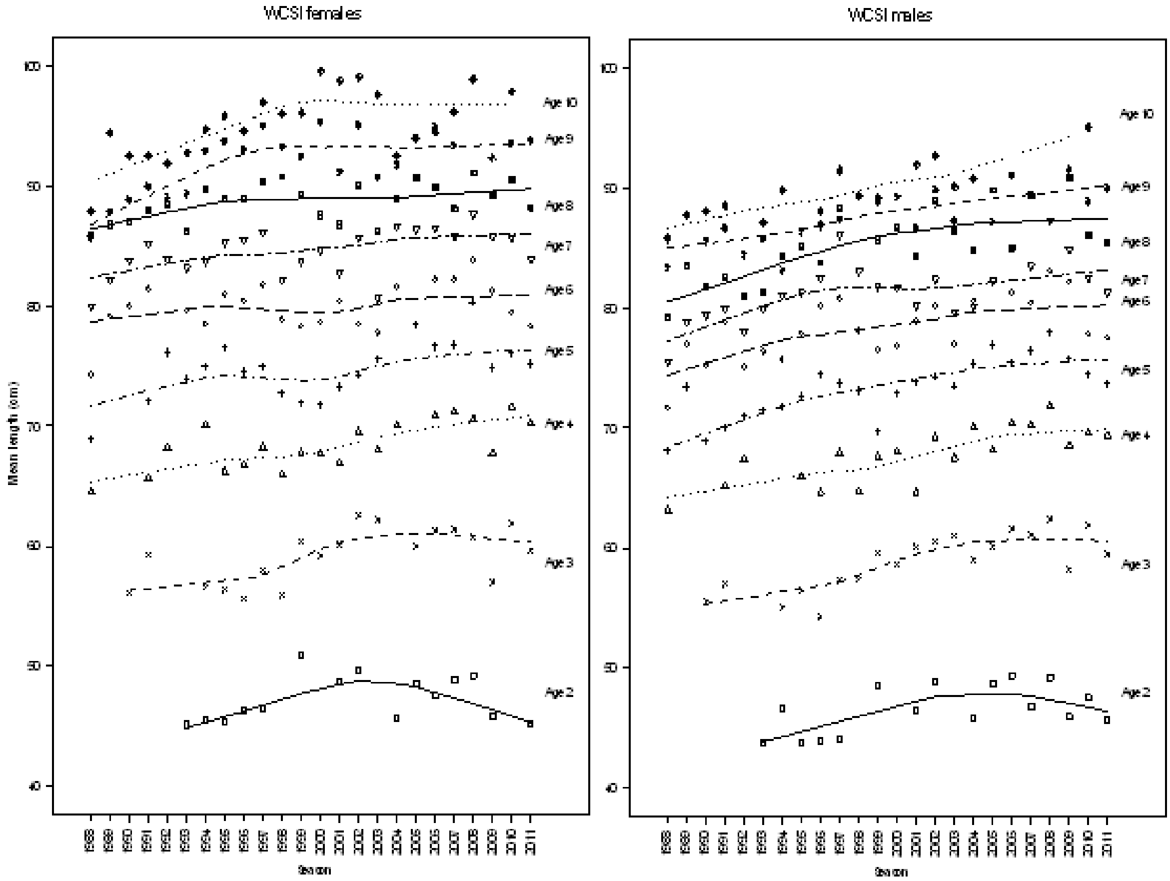


Figure 13: Mean length at age of female and male hoki taken in commercial catches from the west coast South Island spawning fishery 1988–2011 sampled at sea by the Observer Programme. Lines are a loess fit. Points with fewer than ten records are excluded.

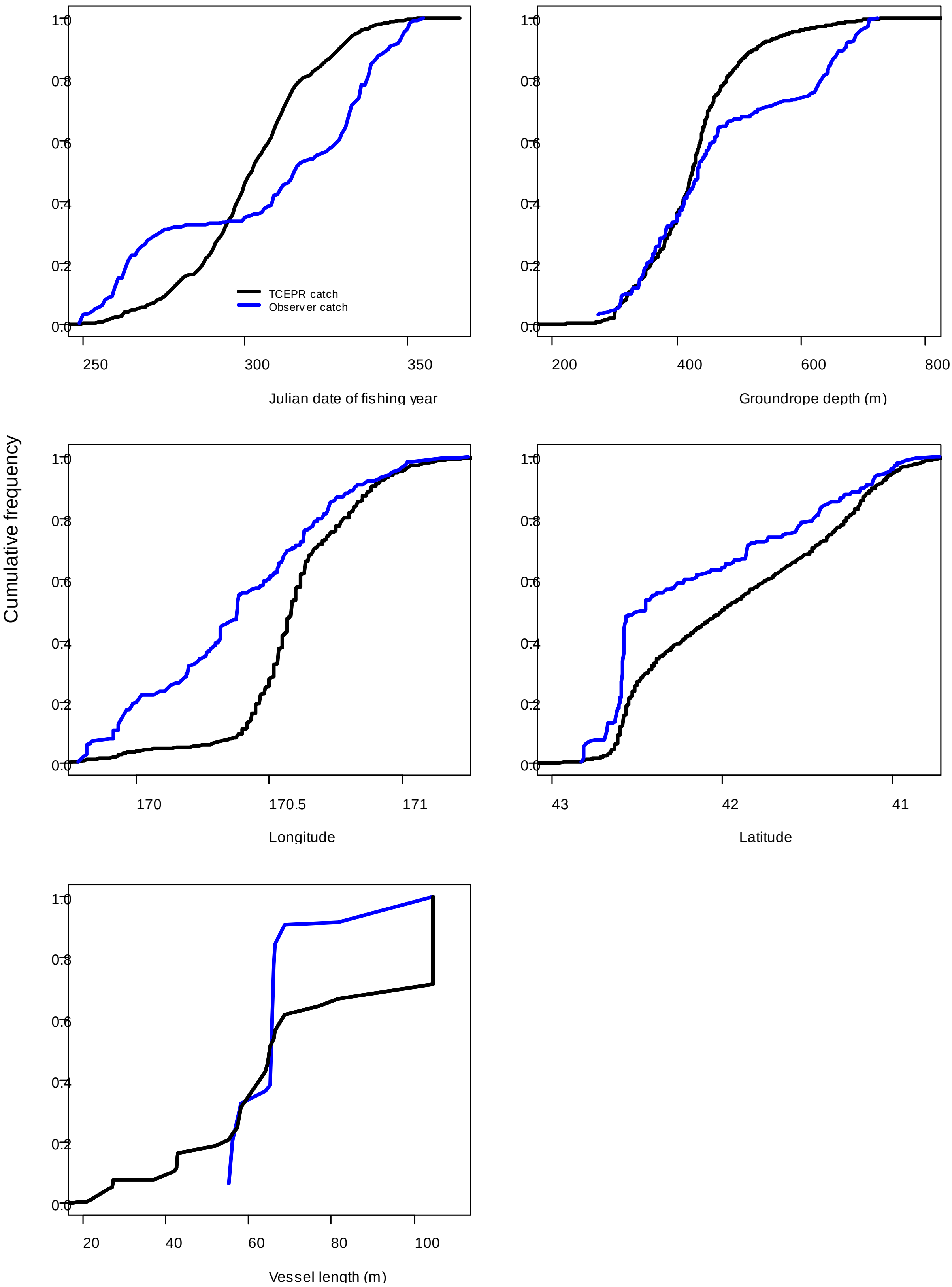


Figure 14: Comparison of WCSI 2010–11 Observer Programme (OP) observer catch coverage with TCEPR catches by day of year, depth, latitude, longitude, and vessel length. If sampling is representative of the fishery, then blue lines (observed catches) should overlay the black line (TCEPR catch).

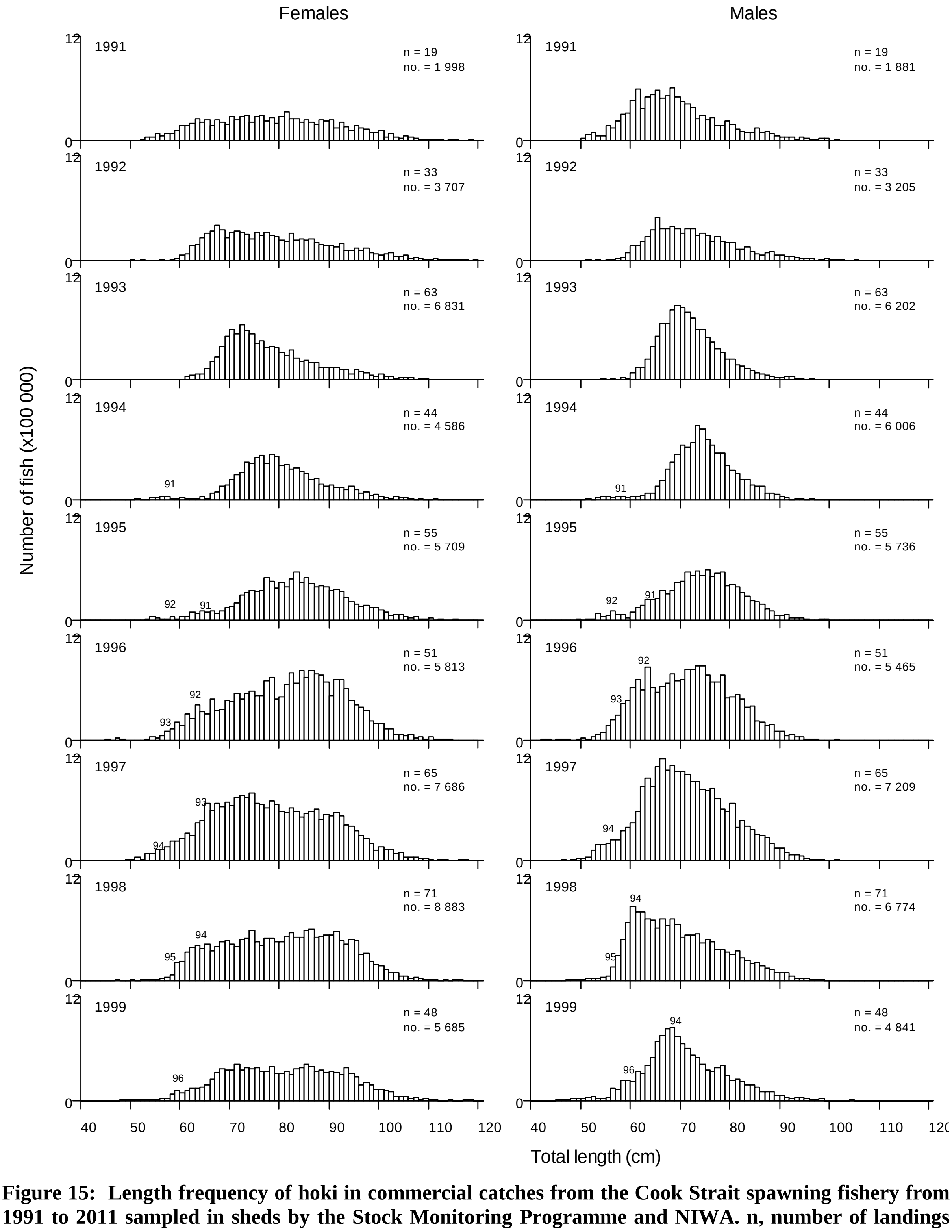


Figure 15: Length frequency of hoki in commercial catches from the Cook Strait spawning fishery from 1991 to 2011 sampled in sheds by the Stock Monitoring Programme and NIWA. n, number of landings sampled; no., number of fish sampled. Numbers above the histograms mark year-class modes, e.g., 91 = 1991 year-class.

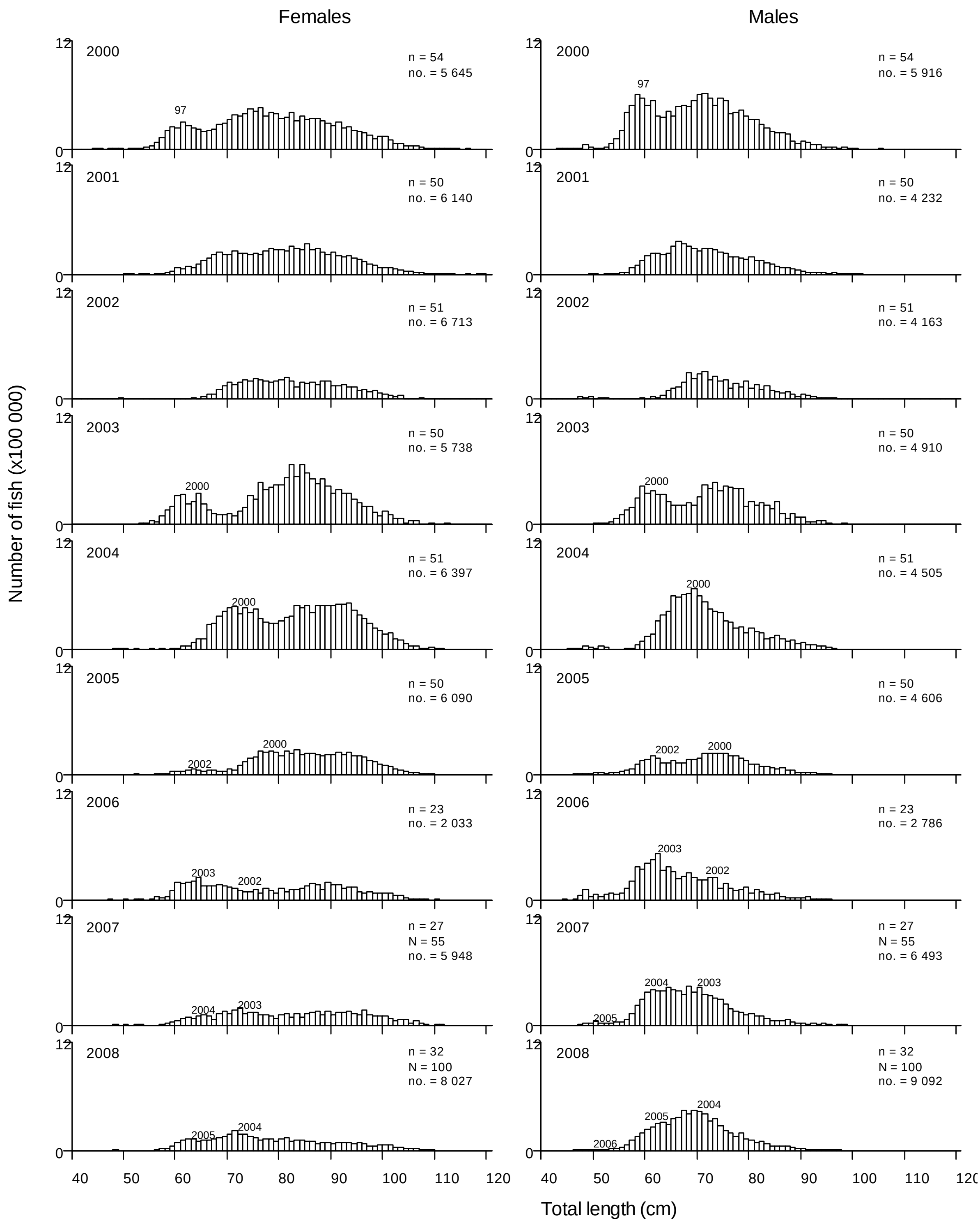


Figure 15 continued: 2006 data excludes Nelson vessels at least 40 m which sorted their catch at sea. 2007 and 2008 data includes shed samples (vessels less than 40 m) and observer samples vessels at least 40 m). n, number of landings sampled; N, number of observed tows; no., number of fish sampled.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

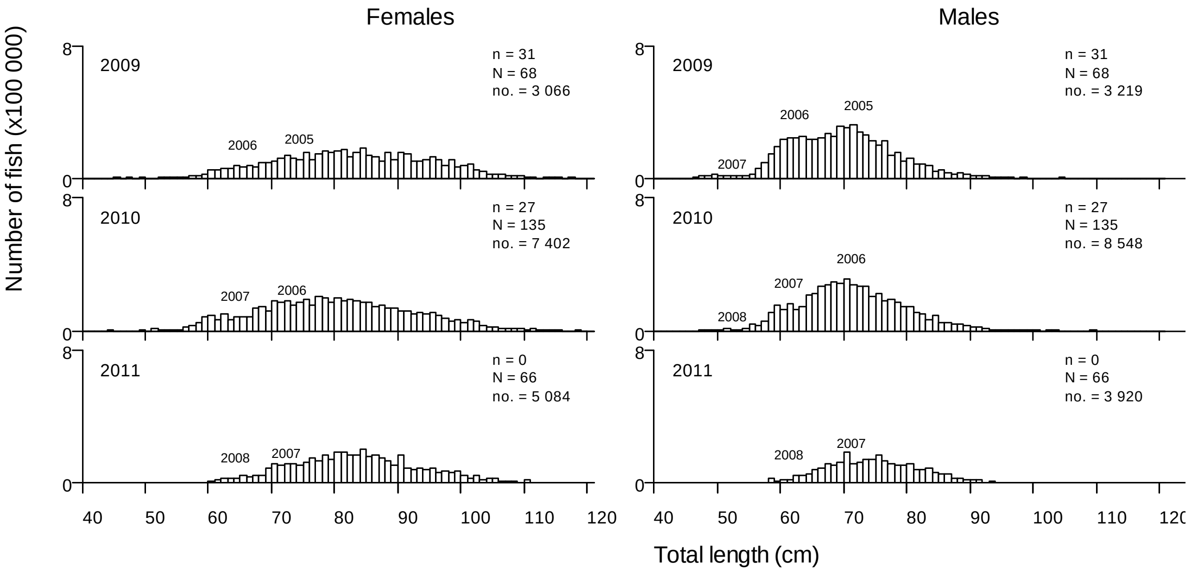


Figure 15 continued: 2009 data includes shed samples (vessels less than 40 m) and observer samples vessels at least 40 m), and 2010 data includes shed samples (vessels less than 40 m) and shed and observer samples (vessels at least 40 m) n, number of landings sampled. 2011 data only includes observer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

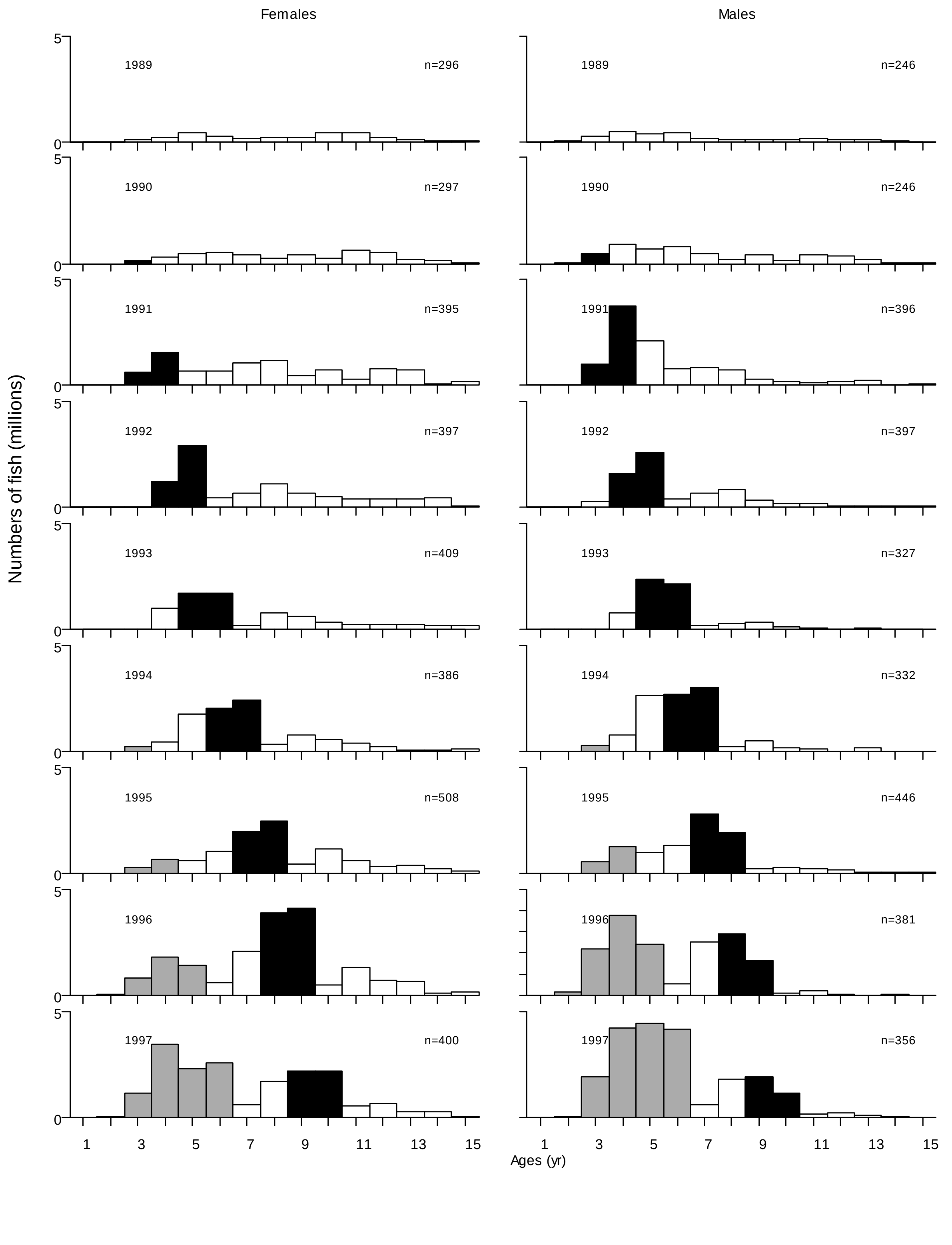


Figure 16: Catch at age of hoki in commercial catches from the Cook Strait spawning fishery from 1988 to 2010 sampled in sheds by the Stock Monitoring Programme and NIWA. 2006 data excludes Nelson shed samples from vessels at least 40 m which sorted their catch at sea. 2007– 2009 data includes shed samples (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 data only includes observer samples for both vessels less than 40 m and at least 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.

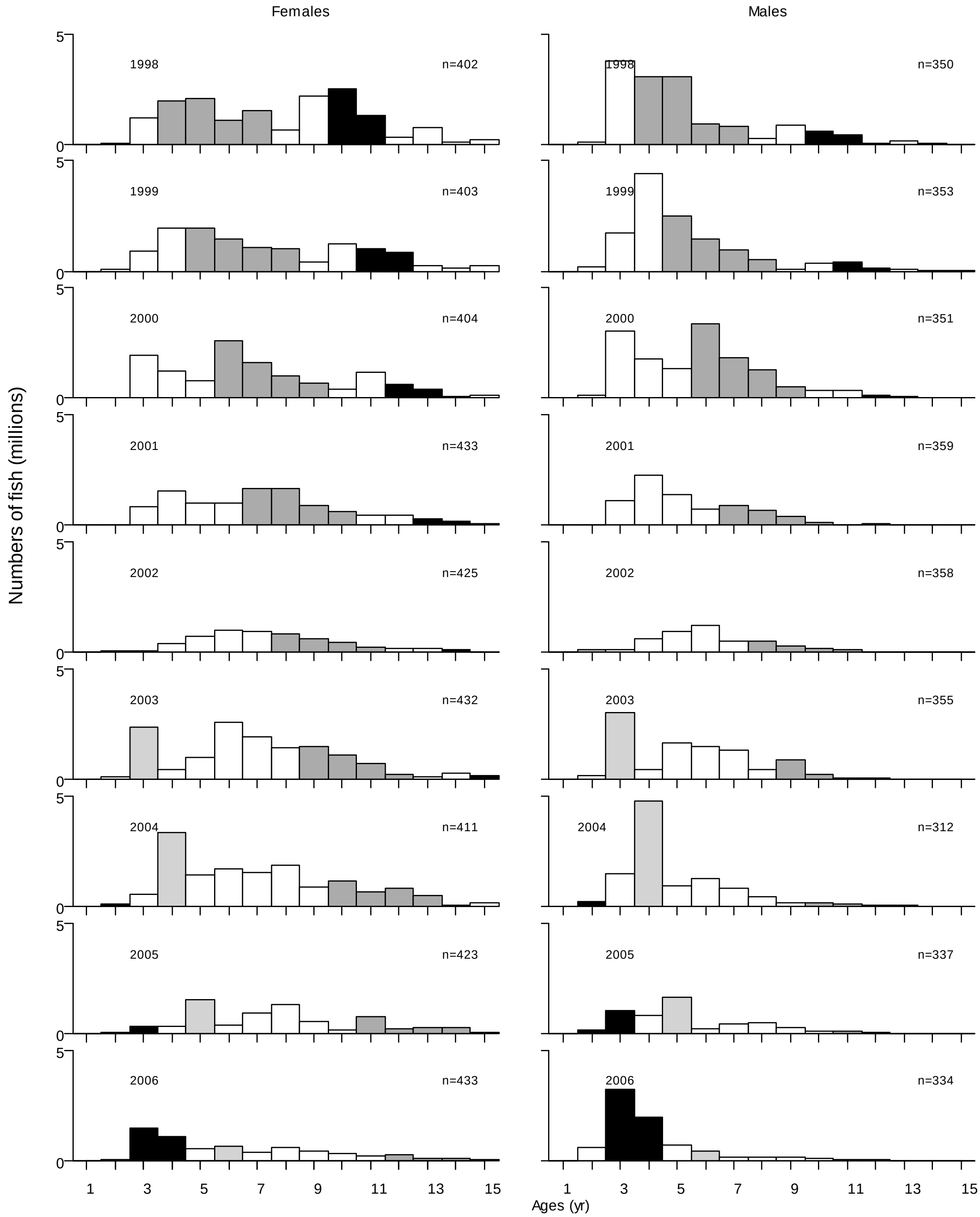


Figure 16: Continued.

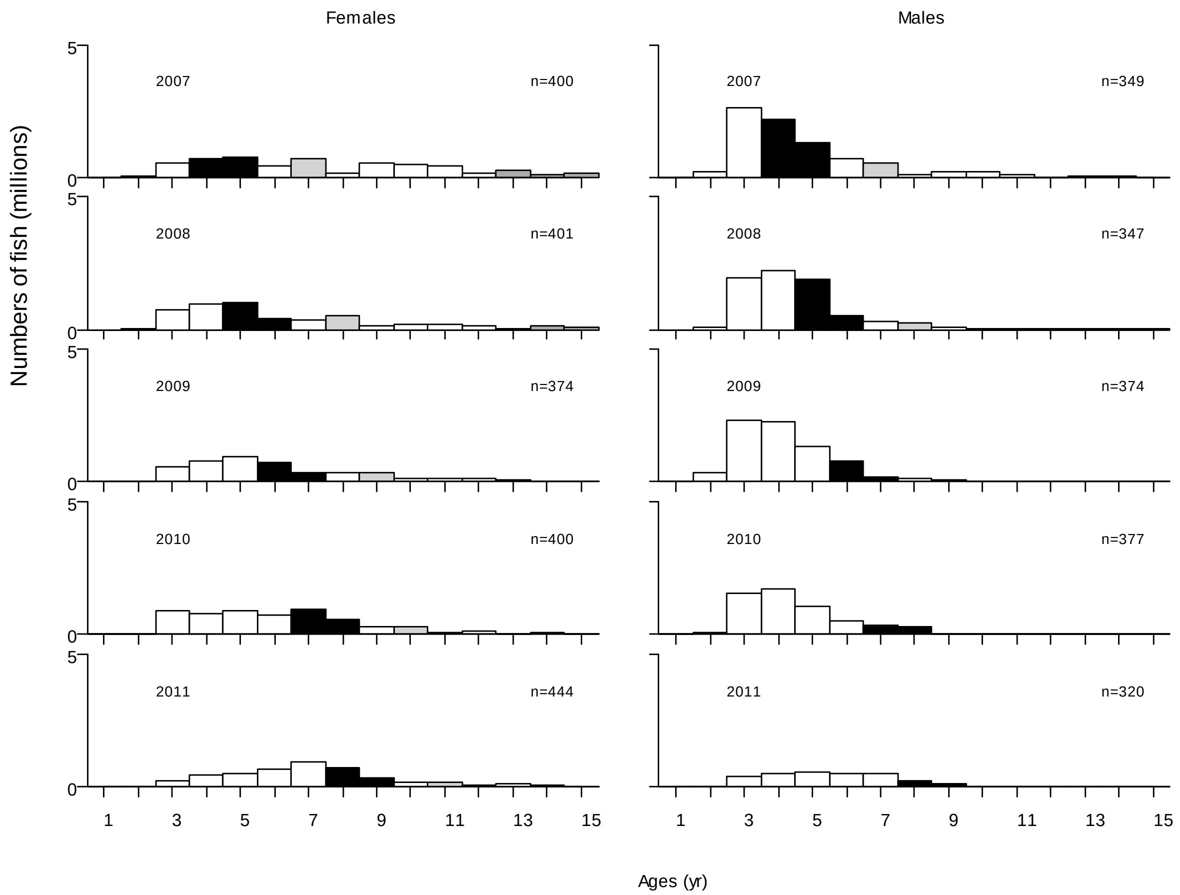


Figure 16: Continued.

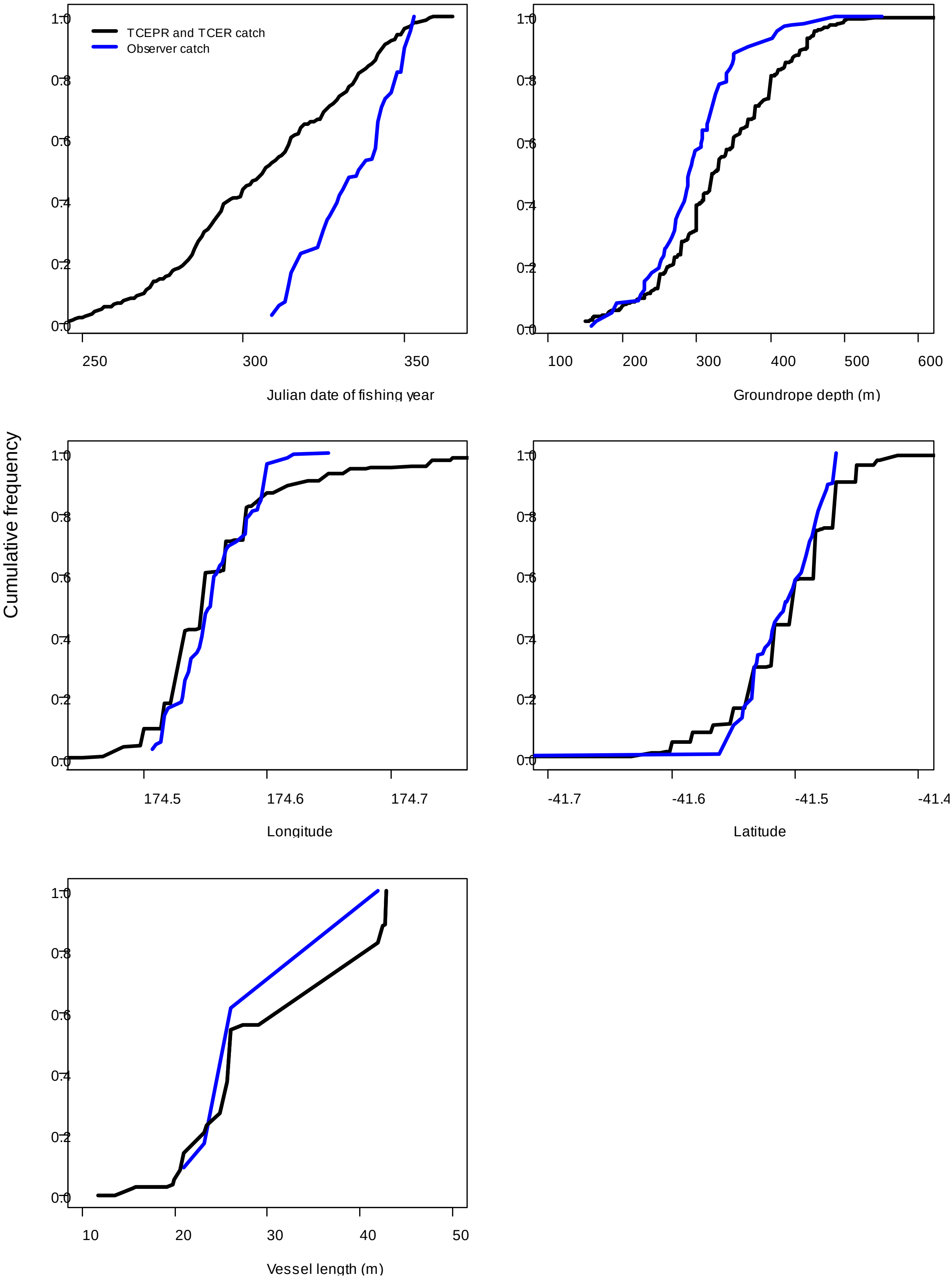


Figure 17: Comparison of Cook Strait 2010–11 Observer Programme (OP) observer catch coverage for TCEPR and TCER catches by day of year, depth, latitude, longitude, and vessel length. If sampling is representative of the fishery, then blue lines (sampled catches) should overlay black lines (catches).

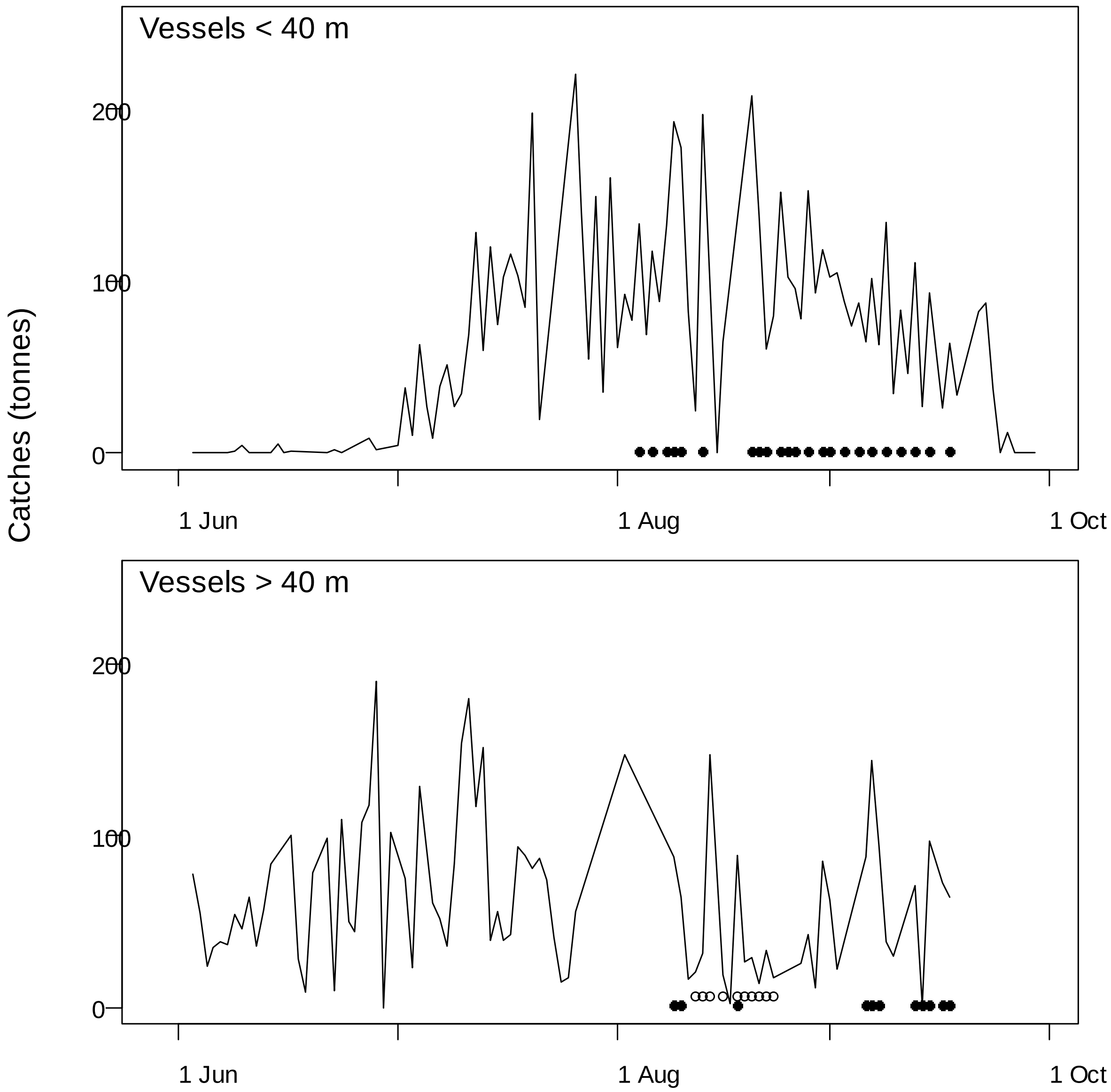


Figure 18: Cook Strait 2010–11 catch by day for vessels less than 40 m and at least 40 m during the spawning season, showing timing of Observer Programme (OP) samples (closed circles), and samples taken by a NIWA scientist during a hoki industry acoustic trip (open circles).

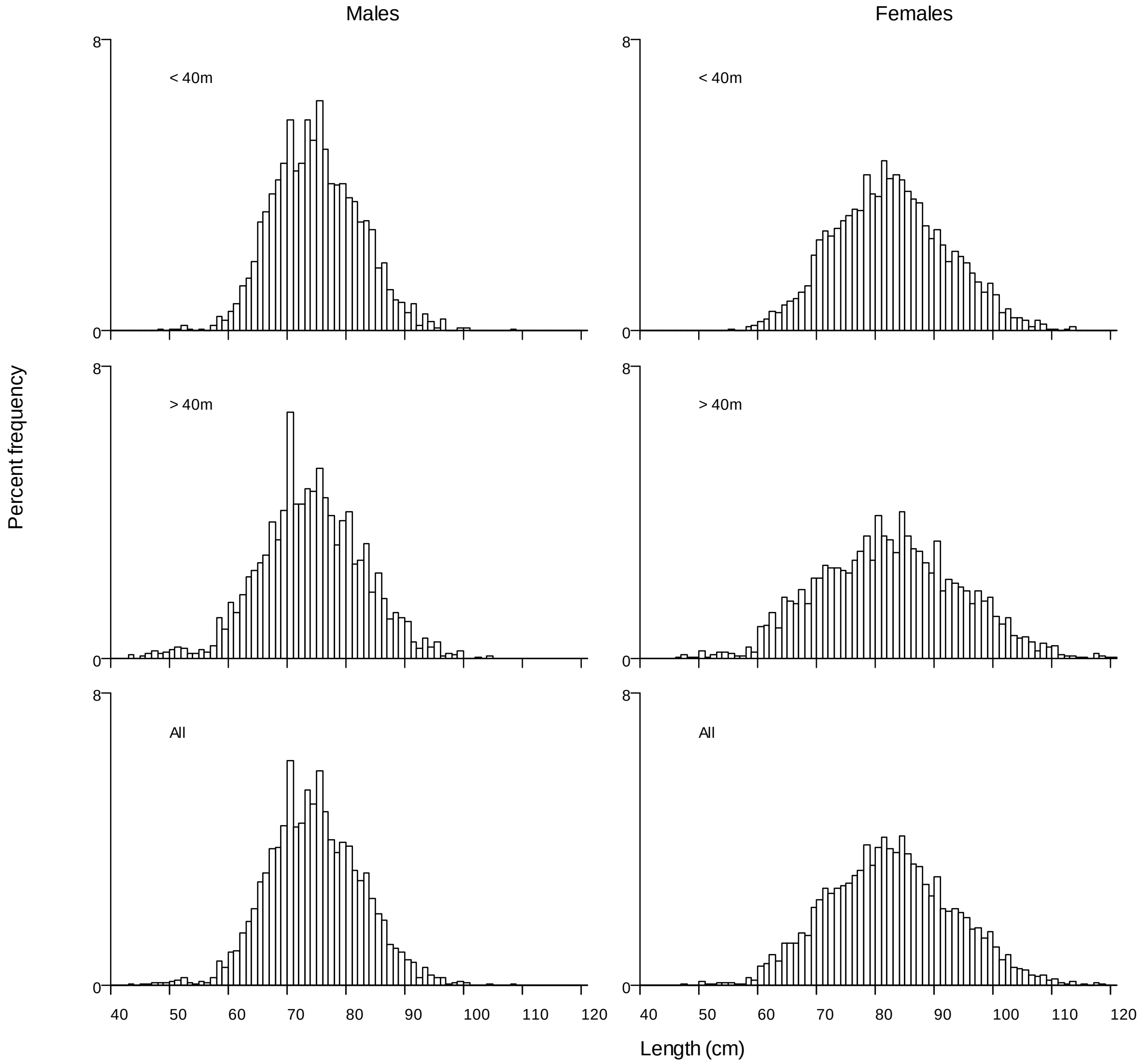


Figure 19a: Comparison of length frequency of hoki in Cook Strait commercial catches from 2010–11. Vessels are sampled by the Observer Programme.

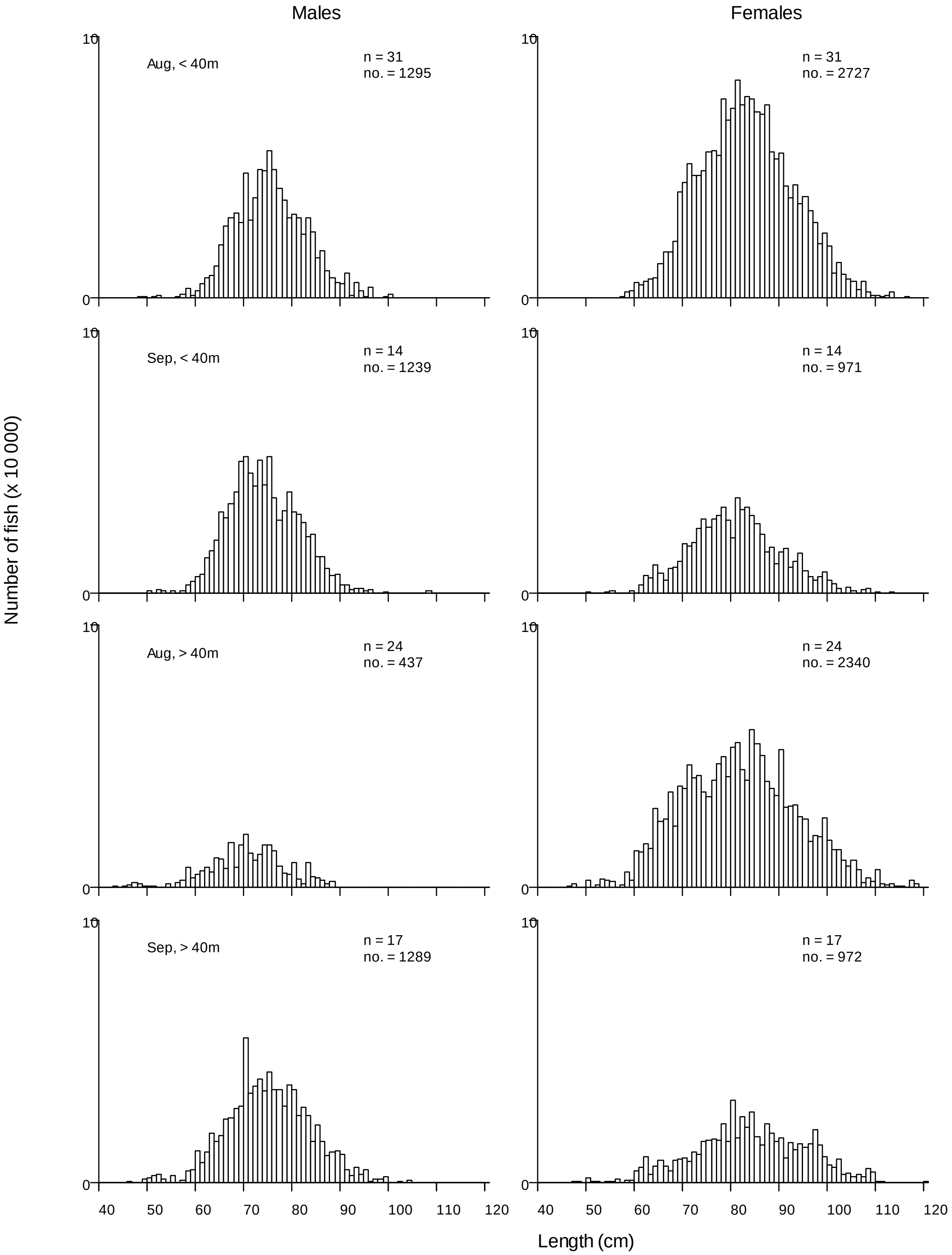


Figure 19b: Comparison of Observer Programme length frequencies of hoki taken in commercial catches from Cook Strait during 2011 by time strata for vessels less than 40m and vessels at least 40m. n, number of tows sampled; no., number of fish sampled.

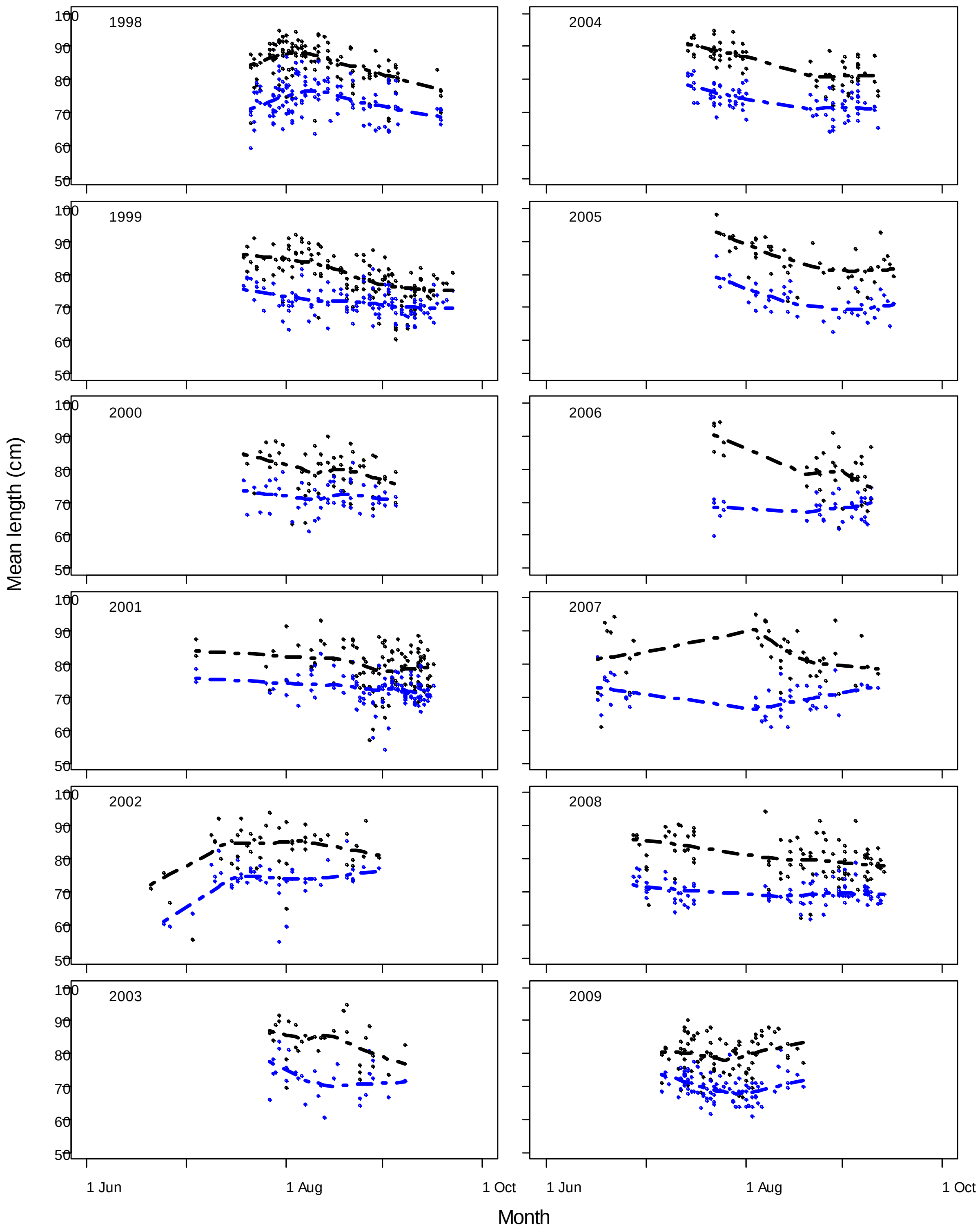


Figure 20: Mean length of female (black) and male (blue) hoki taken in commercial catches from the Cook Strait spawning fishery 1989–2011 from landings sampled by the Observer Programme (OP). Lines are a loess fit.

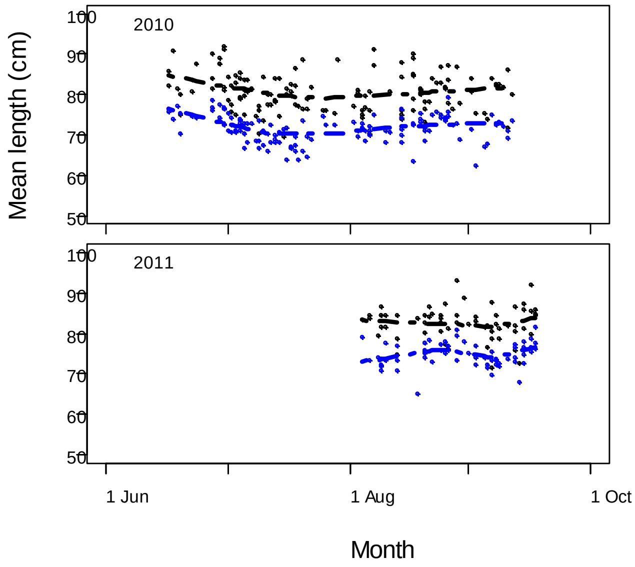


Figure 20: continued.

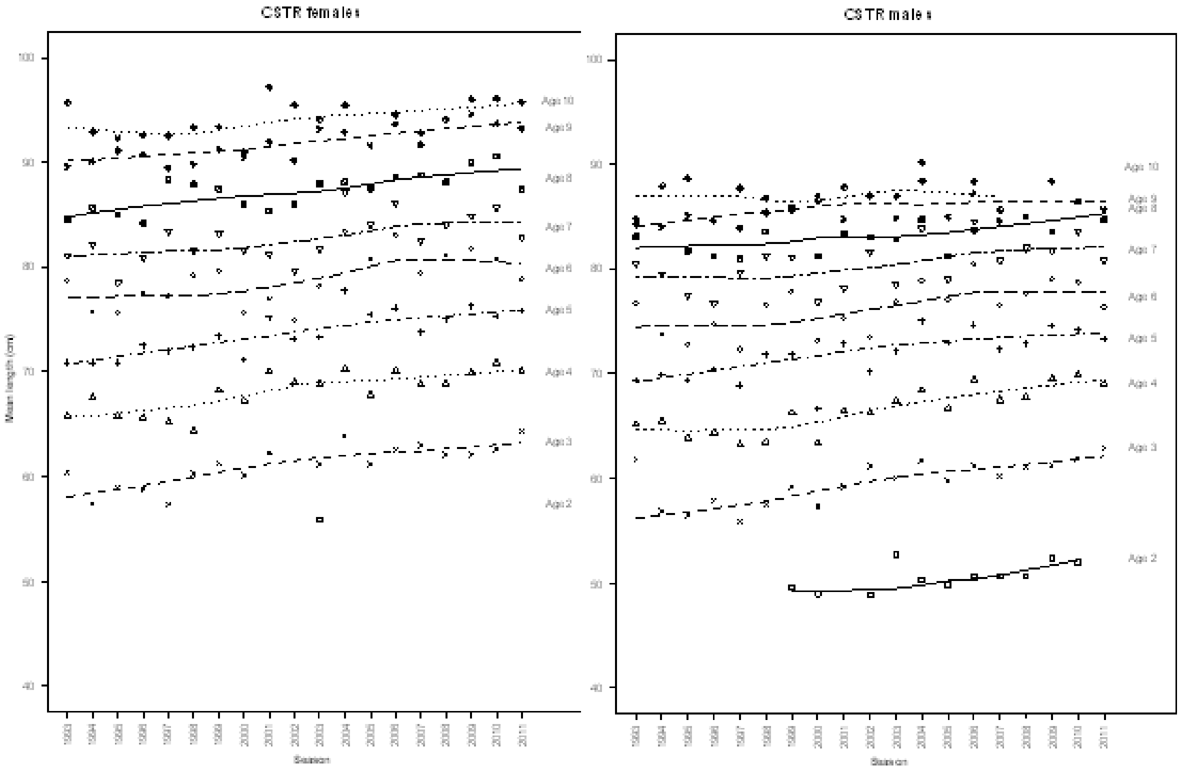


Figure 21: Mean length at age of female and male hoki taken in commercial catches from the Cook Strait spawning fishery 1988–2011 sampled at sea by the Observer Programme. Lines are a loess fit. Points with fewer than ten records are excluded.

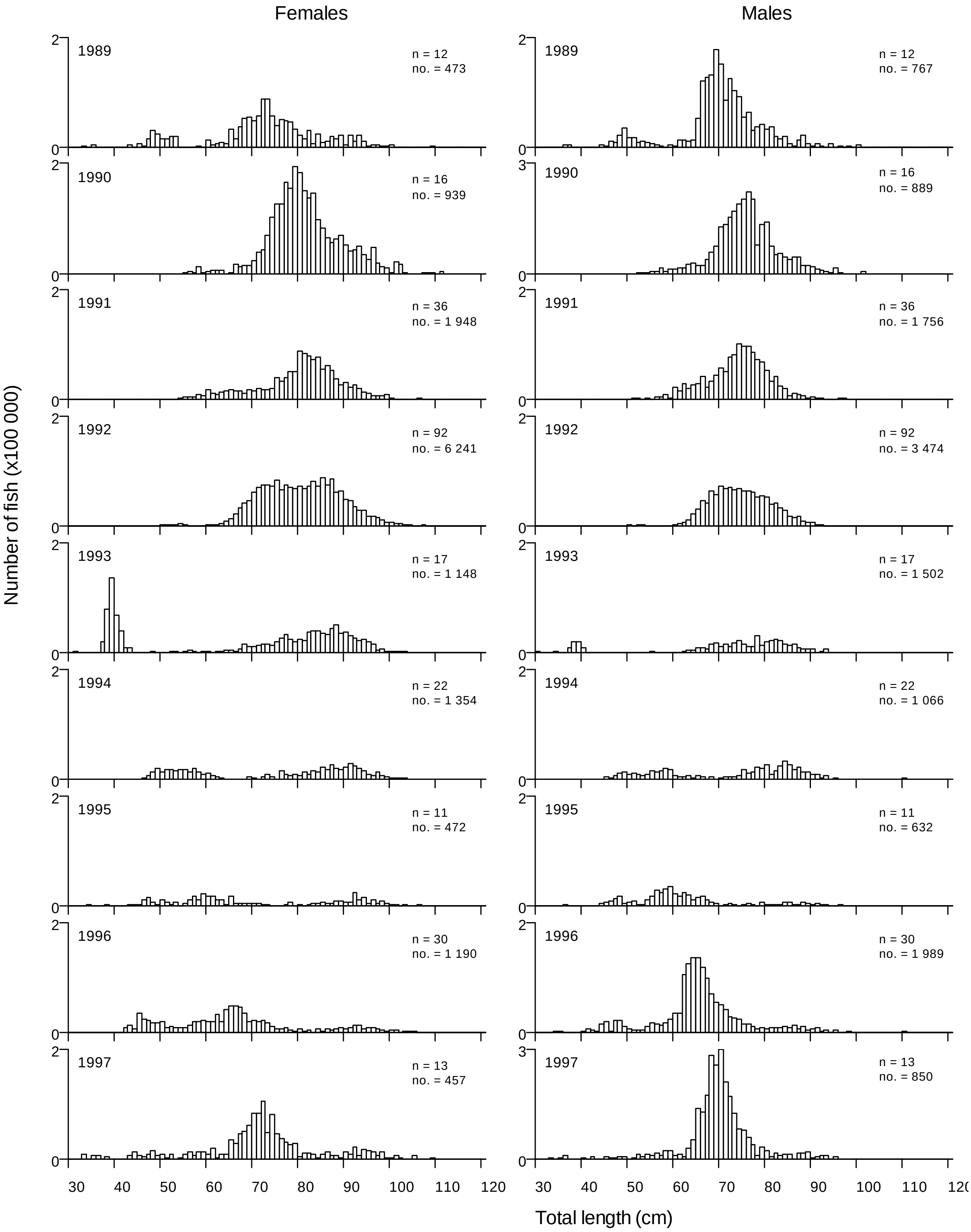


Figure 22: Length frequency of hoki in commercial catches from the Puysegur spawning fishery from 1989 to 1997, and 1999 to 2011 sampled at sea by the Observer Programme. n, number of tows sampled; no., number of fish sampled.

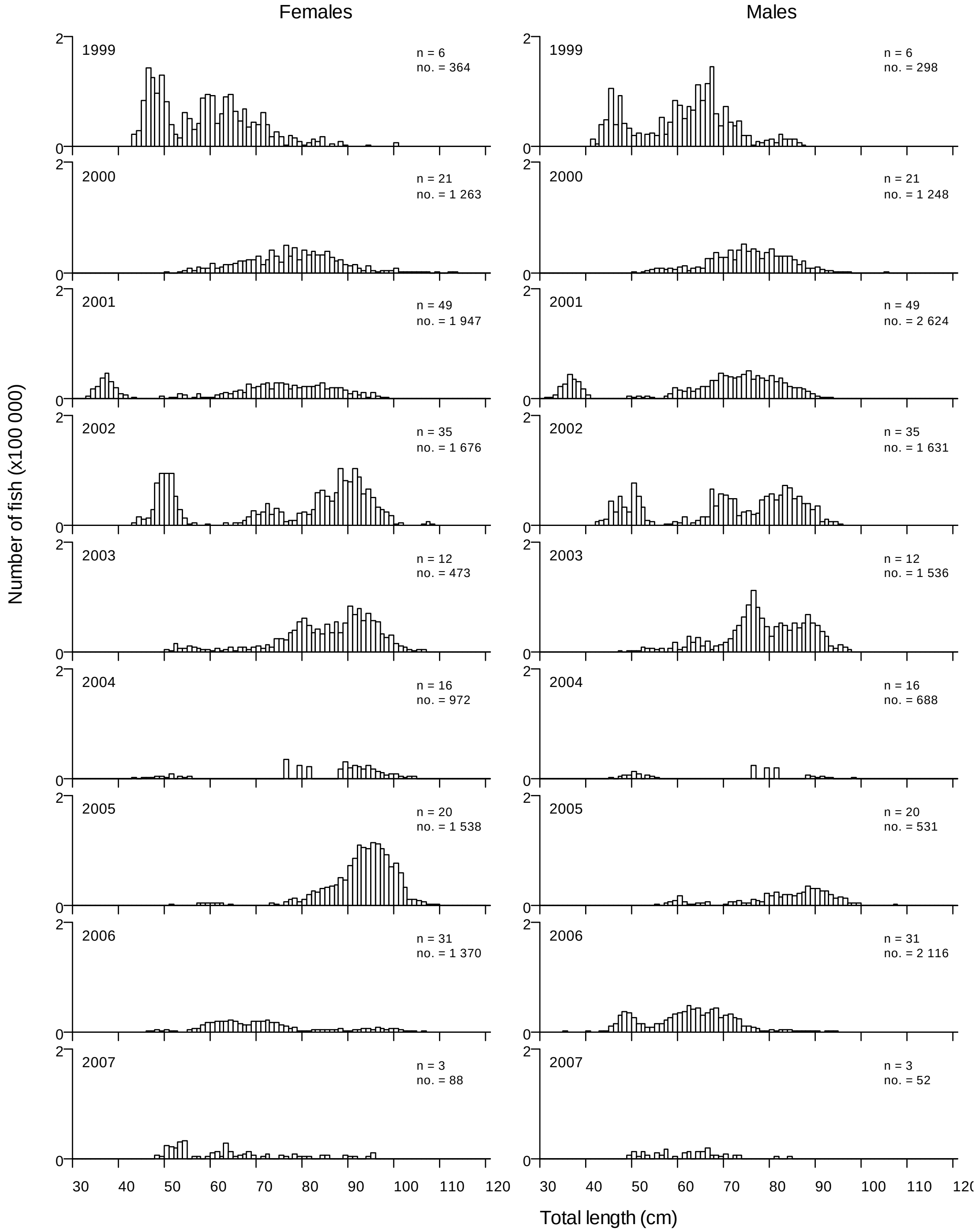


Figure 22: continued.

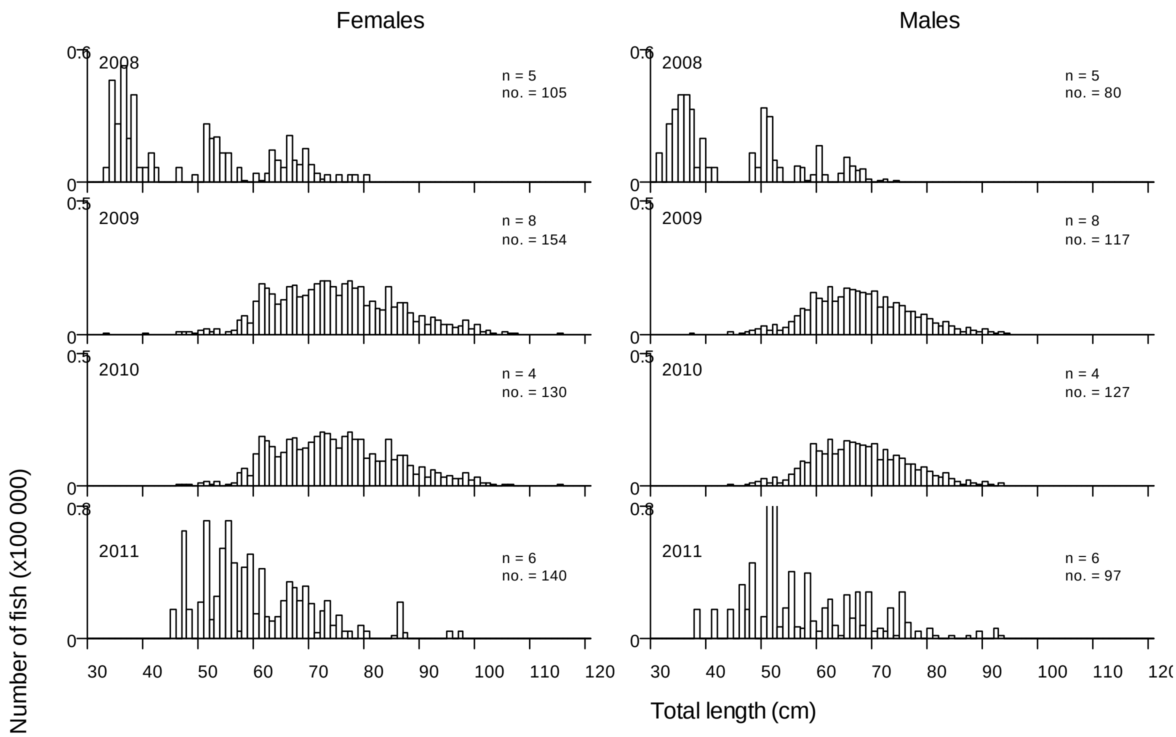


Figure 22: continued.

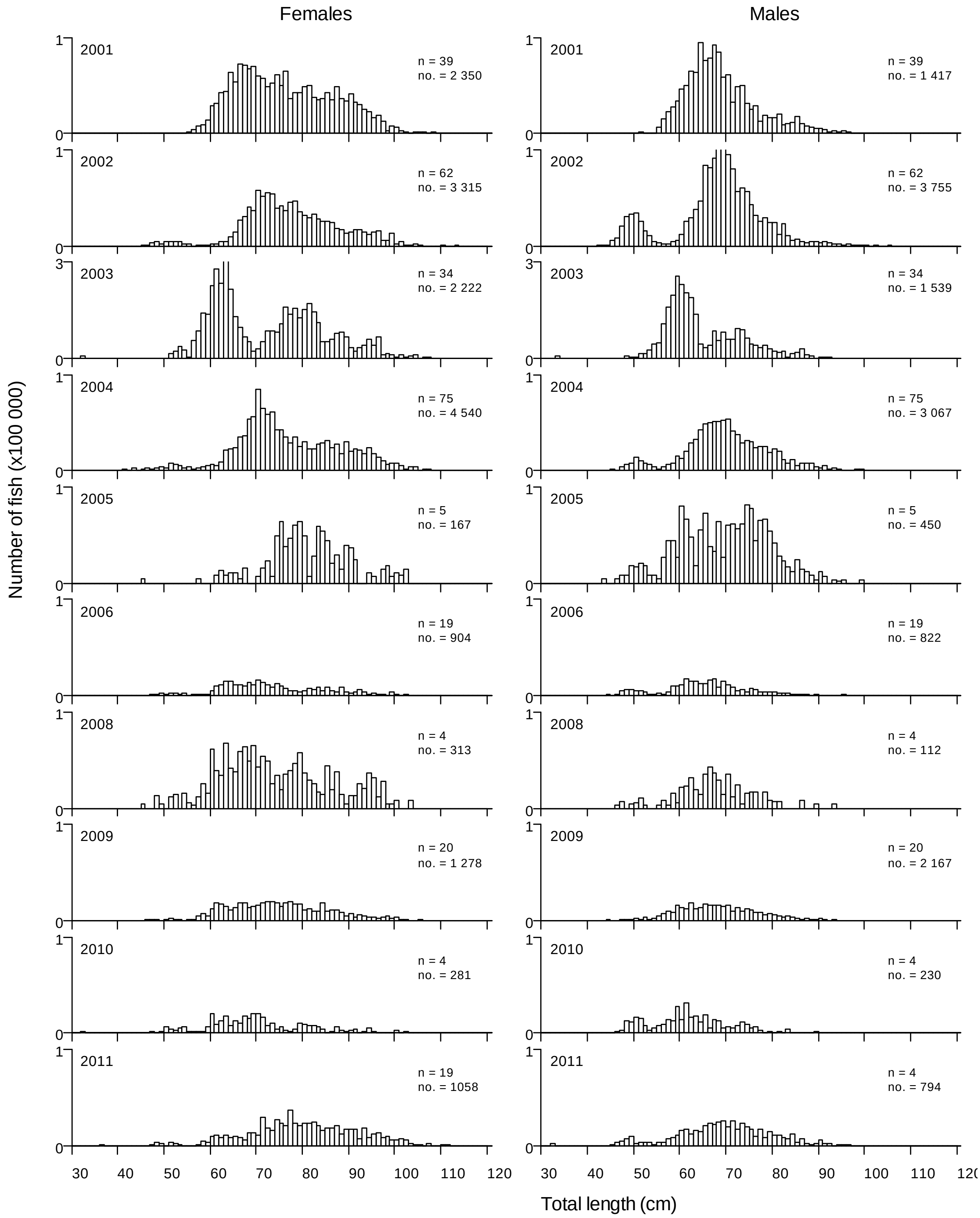


Figure 23: Length frequency of hoki taken in commercial catches from the ECSI spawning fishery from 2001 to 2011 sampled by the Scientific Observer Programme (2001–2006, 2008–2011) and combined with Hoki Management Company data (2001 to 2005). There were no samples in 2007. n is the number of tows sampled, no is the number of fish sampled.

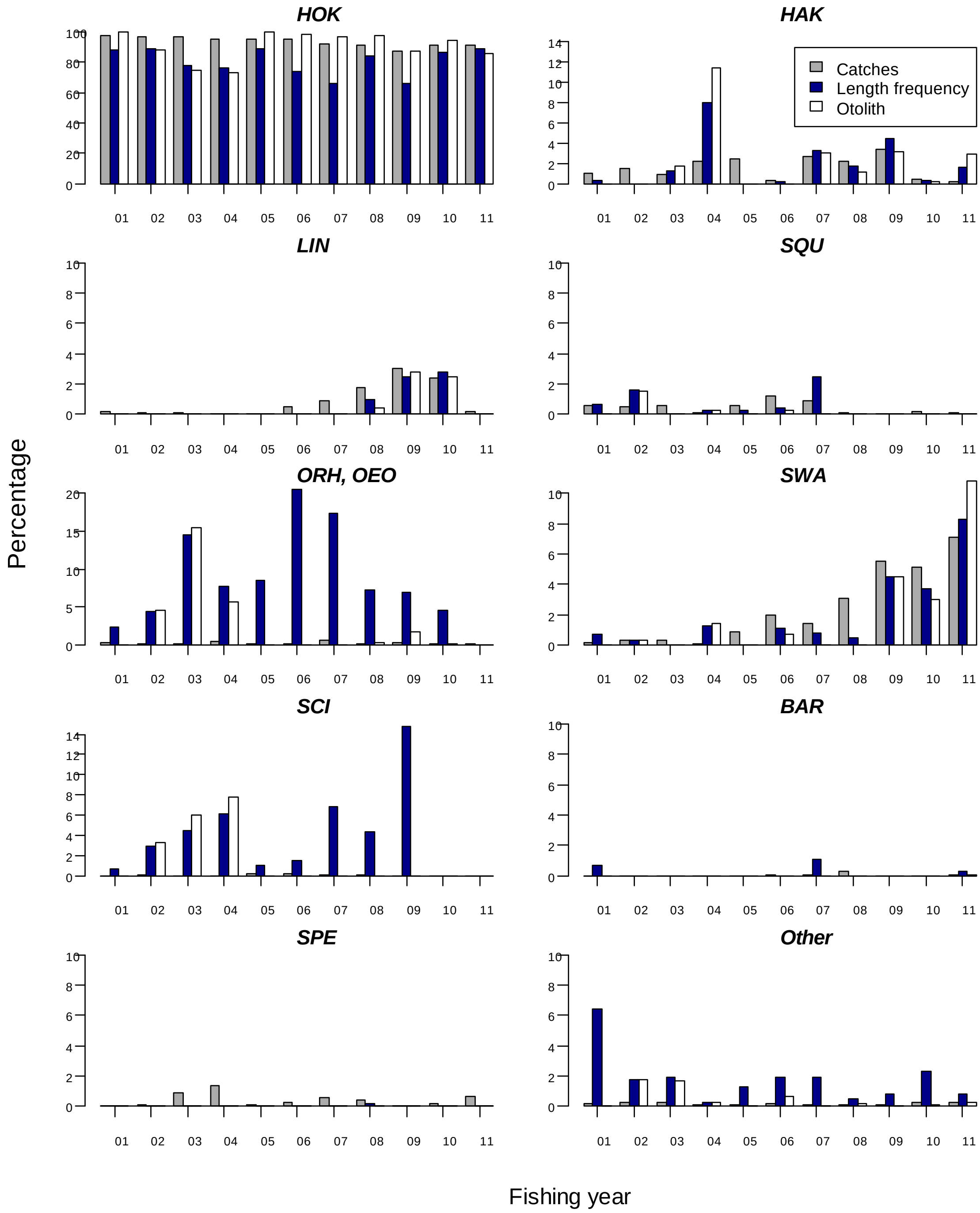


Figure 24: Percentage of hoki TCEPR, CELR and TCER catch, hoki length frequencies and hoki otoliths collected by the Observer Programme by target species for the Chatham Rise fishery from 2000–01 to 2010–11. Three-letter codes denote target species: HOK, hoki; ORH, orange roughy; OEO, oreos; SQU, squid; SWA, silver warehou; HAK, hake; SCI, scampi; LIN, ling; BAR, barracouta; SPE, sea perch; Other, all other target species combined.

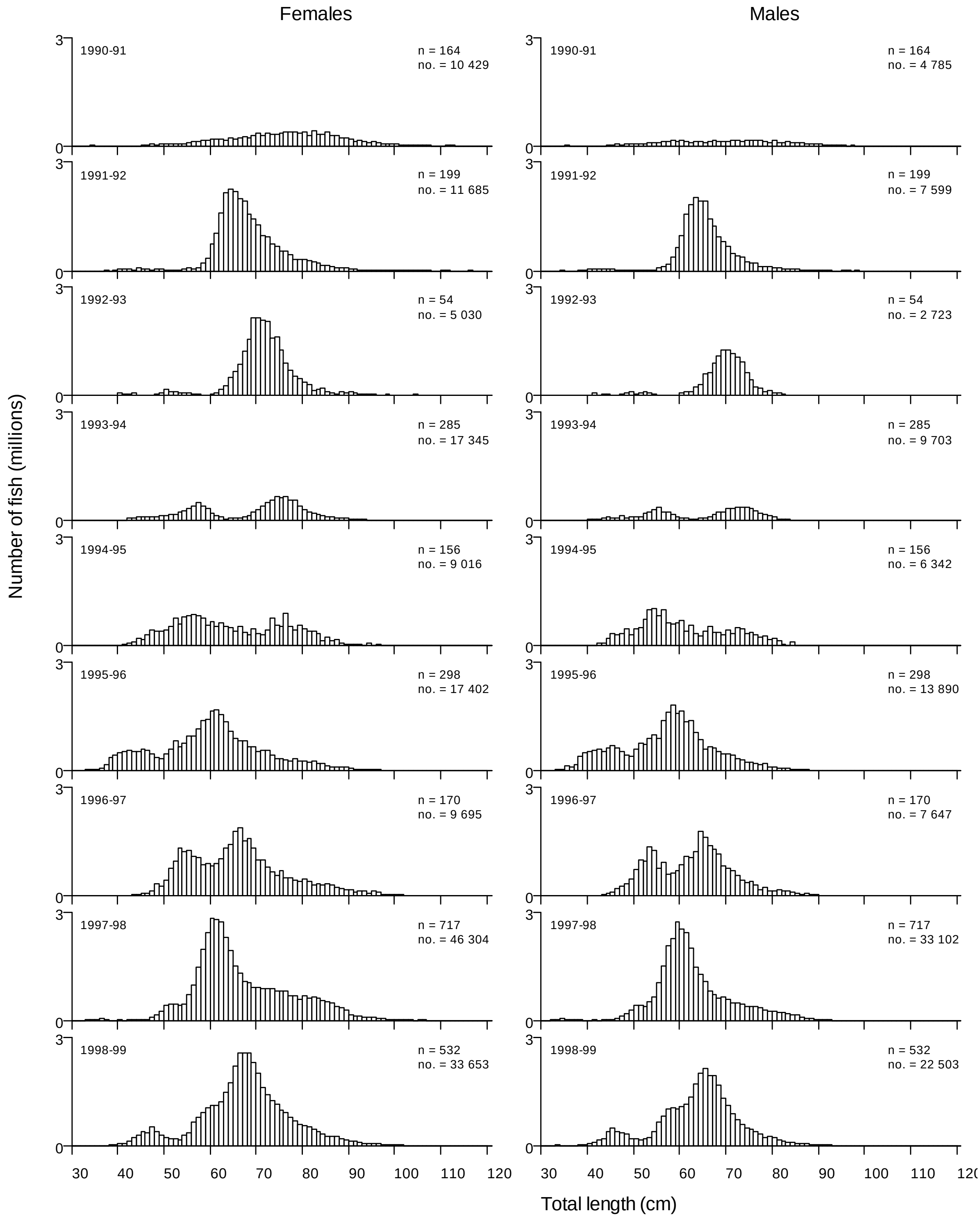


Figure 25: Length frequency of hoki taken in commercial catches from the Chatham Rise fishery from 1990–91 to 2010–11 sampled by the Observer Programme (and combined with Hoki Management Company data in 2000–01 to 2003–04). 2006–07 data only include target hoki or hake tows. n, number of tows sampled; no., number of fish sampled.

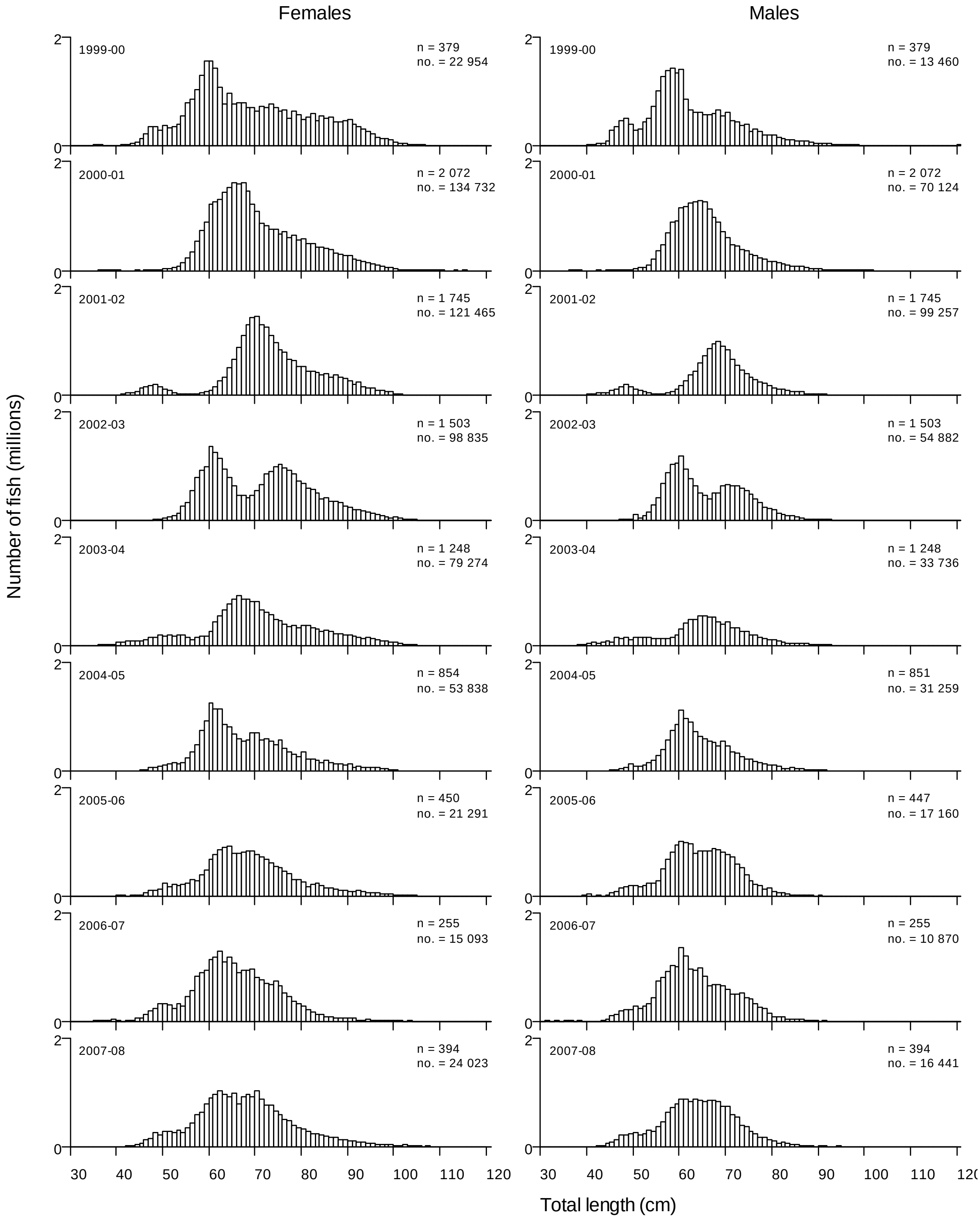


Figure 25: continued.

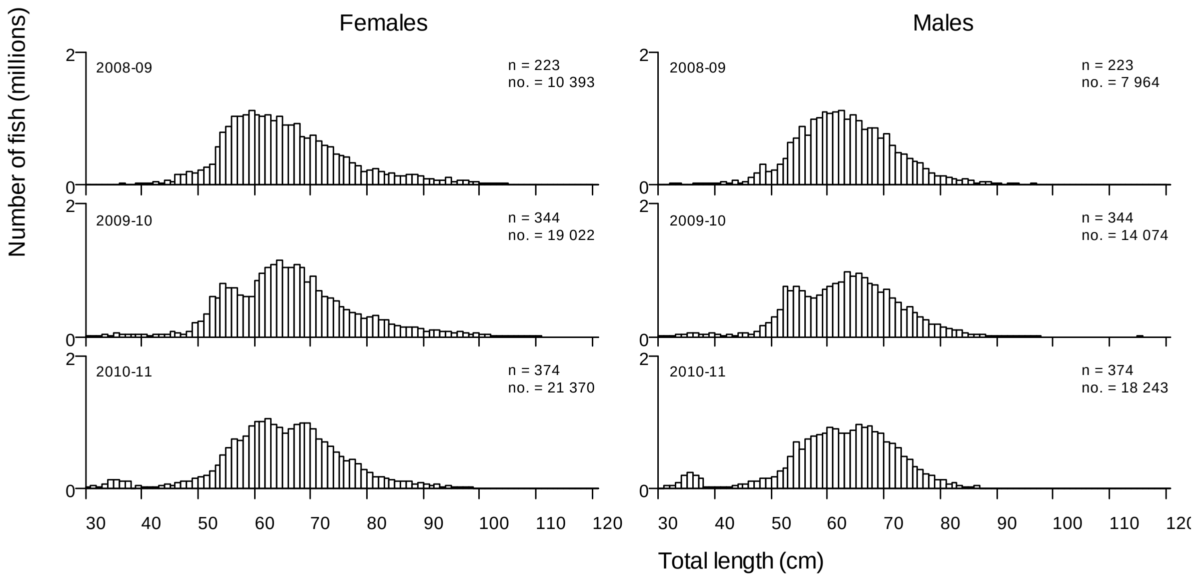


Figure 25: continued

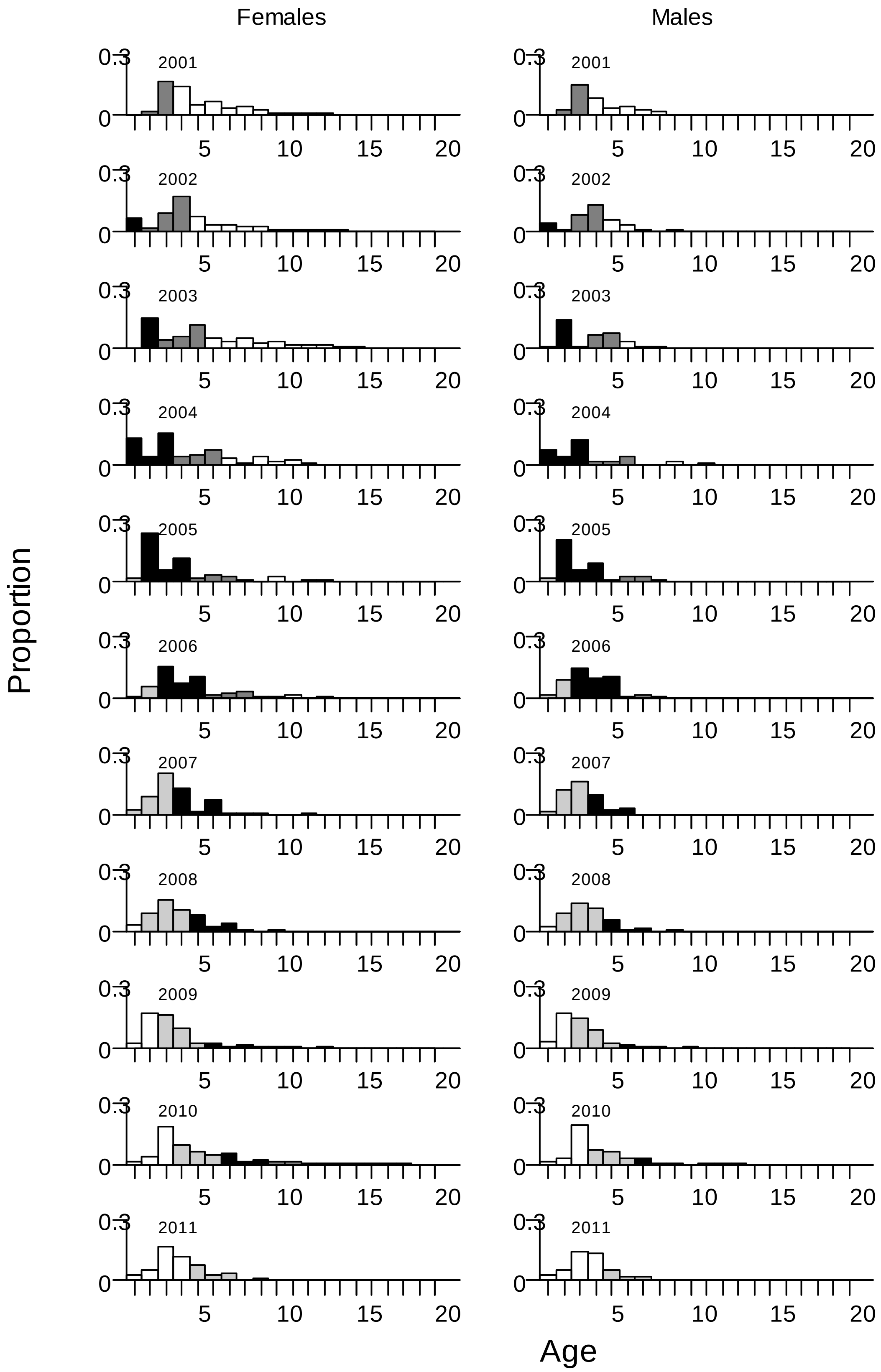


Figure 26: Proportions at age and sex in the catch from the Chatham Rise fishery as estimated by direct ageing of otoliths from 2000–01 to 2010–11. Dark grey bars show 1997–99 year-classes; black bars show 2000–02 year-classes; light grey bars show 2003–2005 year-classes.

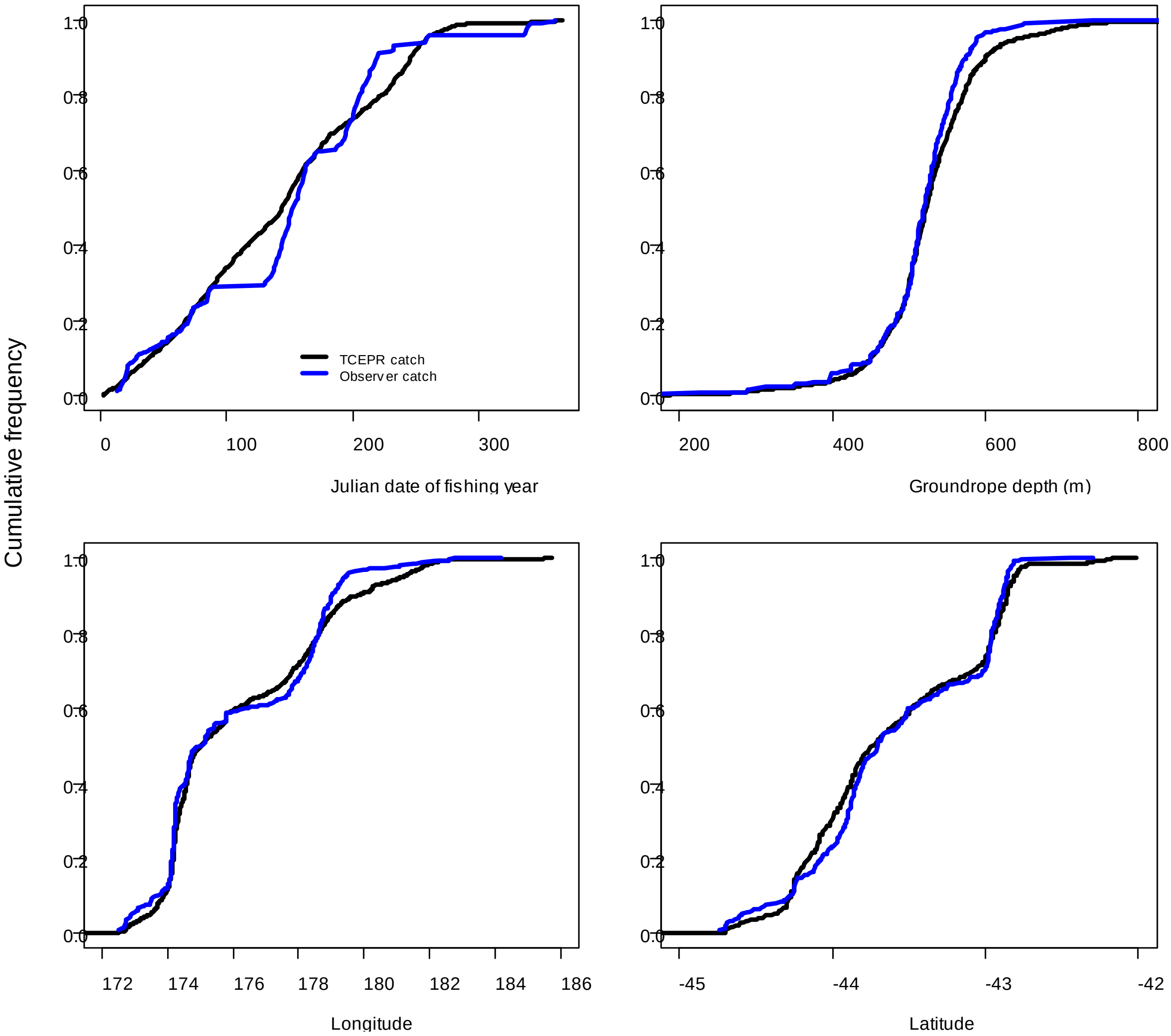


Figure 27: Comparison of Chatham Rise 2010–11 Observer Programme (OP) observer catch coverage with TCEPR catches by day of year, depth, latitude and longitude. If sampling is representative of the fishery, then blue lines (observed catches) should overlay black lines (TCEPR catch).

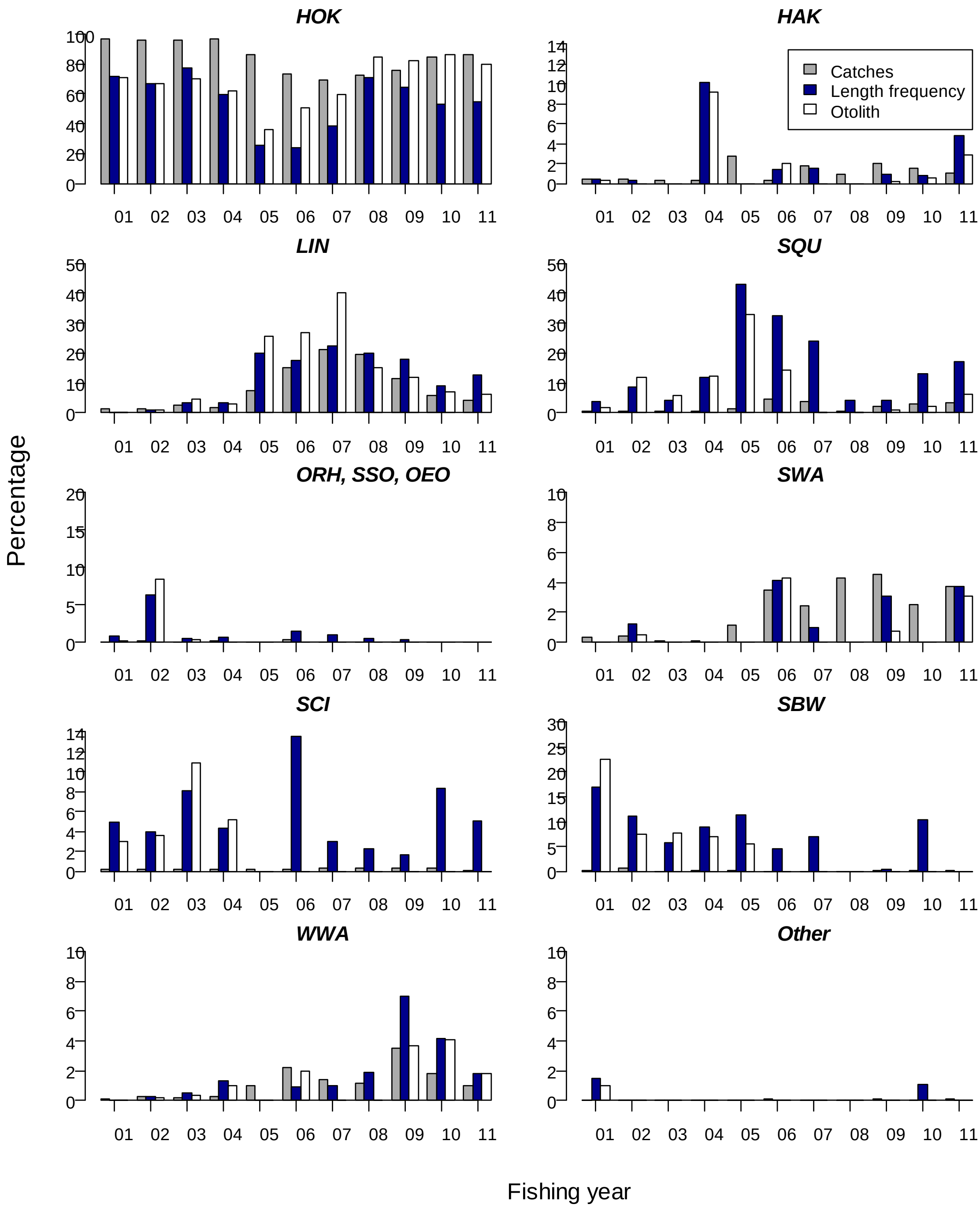


Figure 28: Percentages of hoki TCEPR, TCER and CELR catch, hoki length frequencies, and hoki otoliths collected by the Observer Programme by target species for the Sub-Antarctic fishery from 2000–01 to 2010–11. Three-letter codes denote target species: HOK, hoki; HAK, hake; SQU, squid; ORH, orange roughy, SSO, smooth oreo; OEO, oreo; SWA, silver warehou; SBW, southern blue whiting; SCI, scampi; LIN, ling; WWA, white warehou; Other, other target species combined.

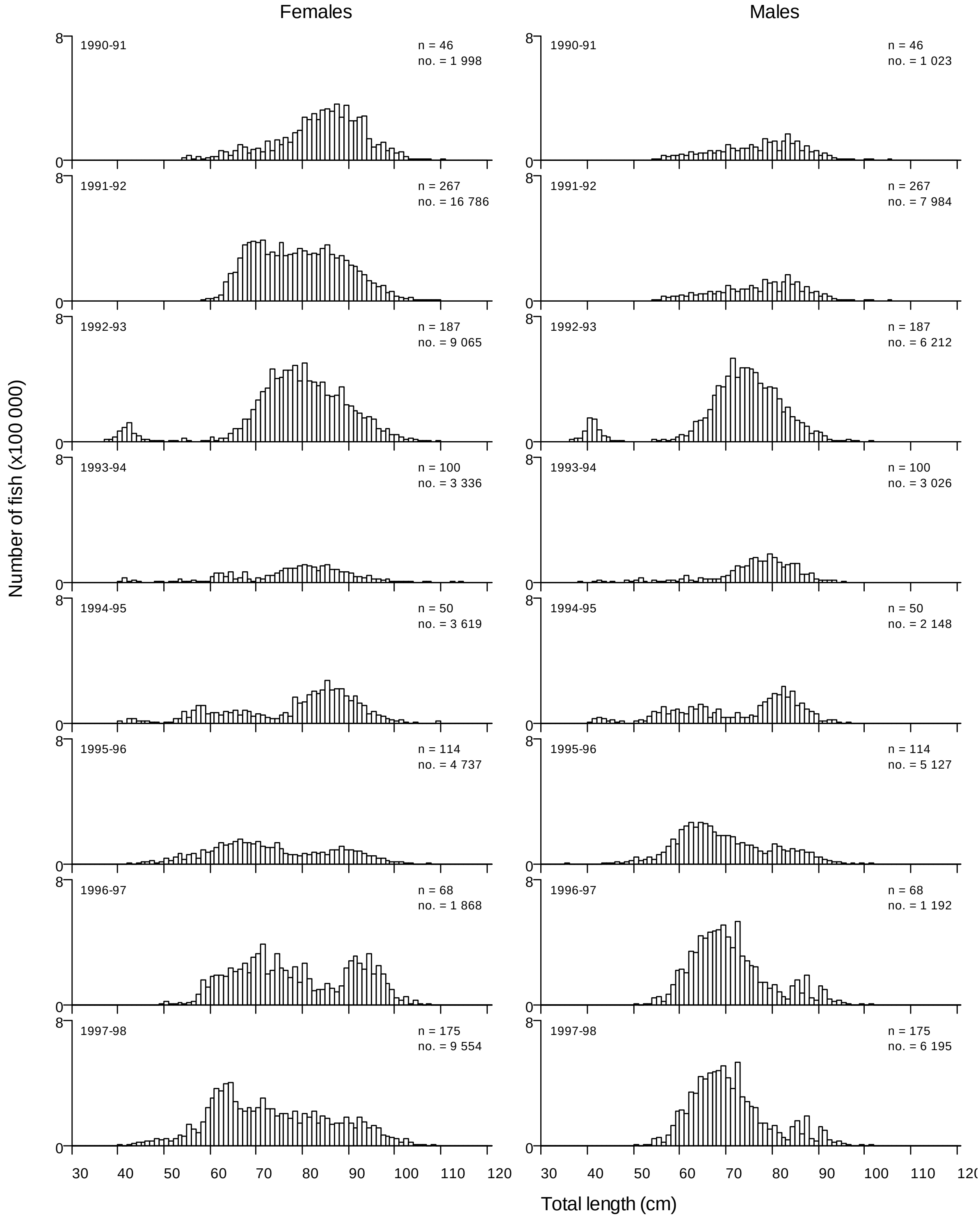


Figure 29: Length frequency of hoki taken in commercial catches from the Sub-Antarctic fishery from 1990–91 to 2010–11 sampled by the Observer Programme (and combined with Hoki Management Company data in 2000–01 to 2004–05). 2006–07 data only includes target hoki or ling tows. n, number of tows sampled; no., number of fish sampled.

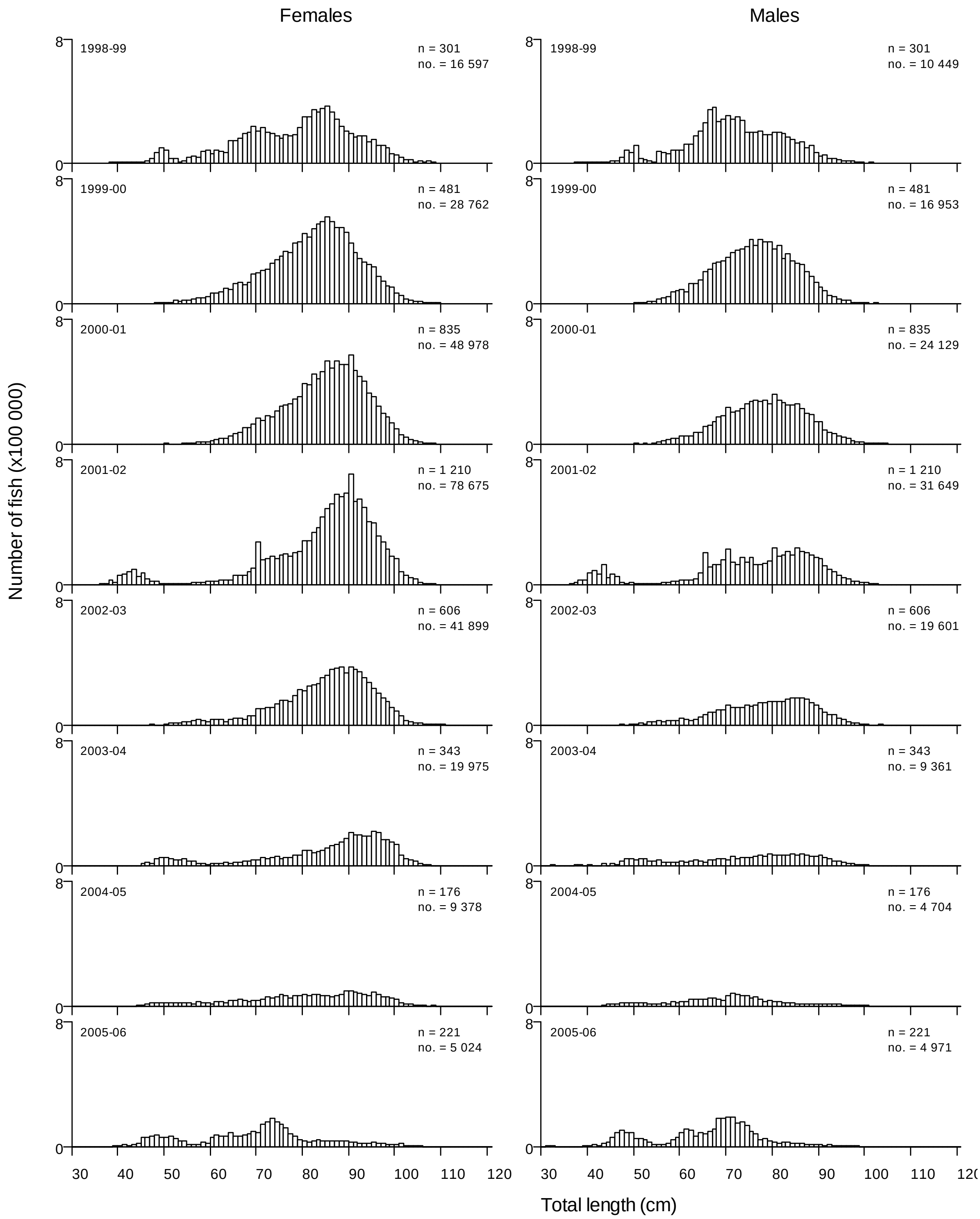


Figure 29: continued.

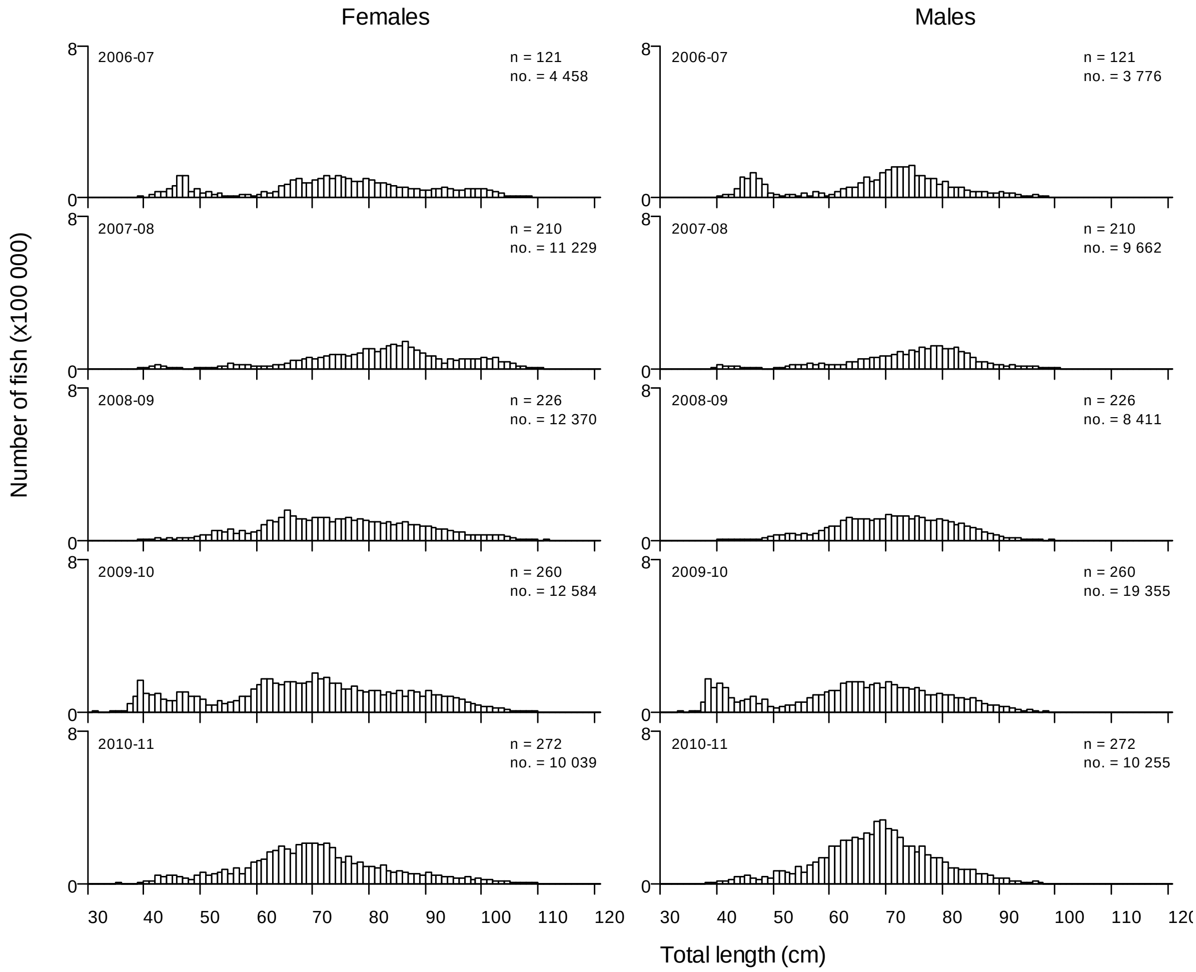


Figure 29: continued.

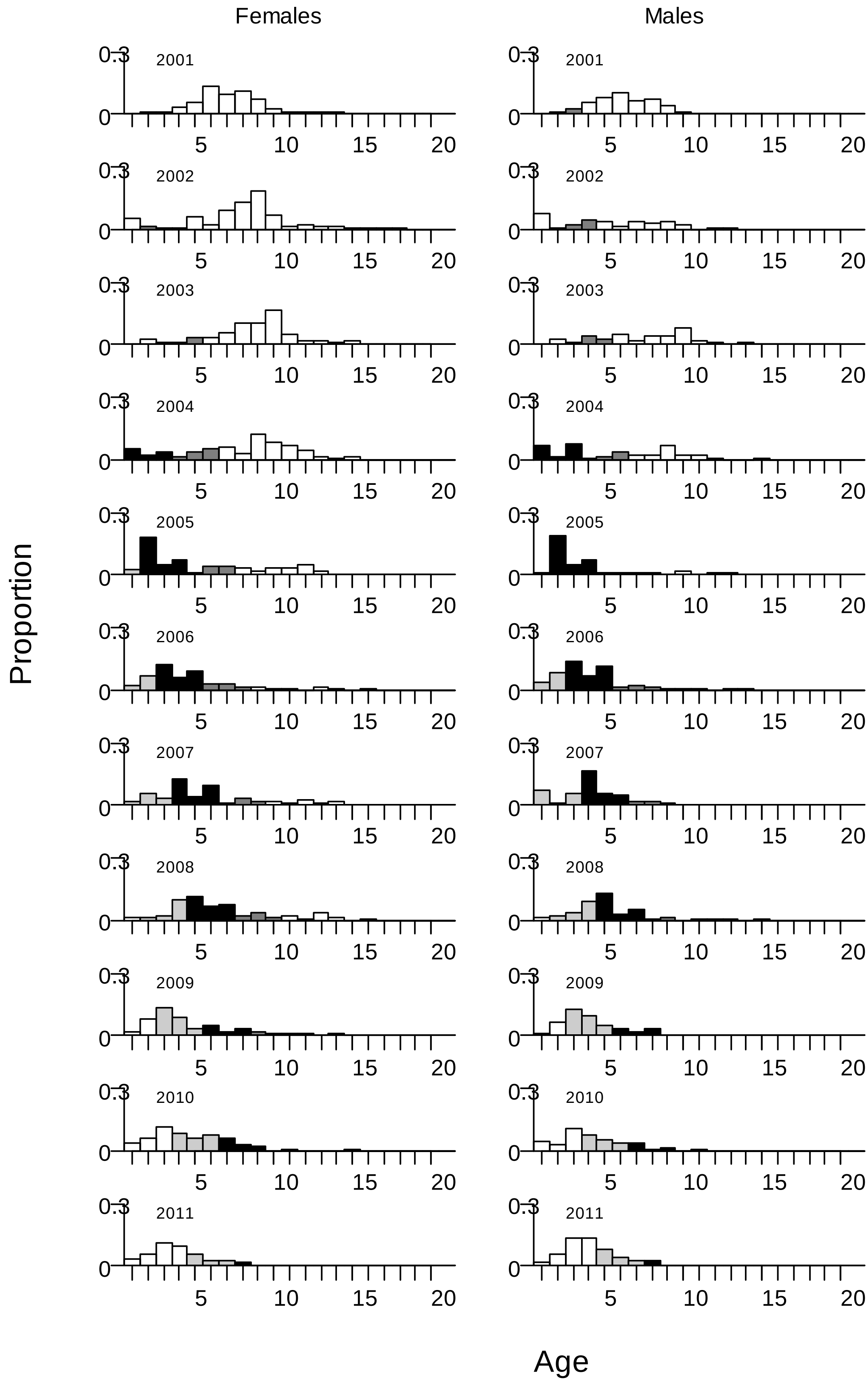


Figure 30: Proportions at age and sex in the catch from the Sub-Antarctic fishery as estimated by direct ageing of otoliths from 2000–01 to 2010–11. Dark grey bars show 1997–99 year-classes; black bars show 2000–02 year-classes; light grey bars show 2003–2005 year-classes.

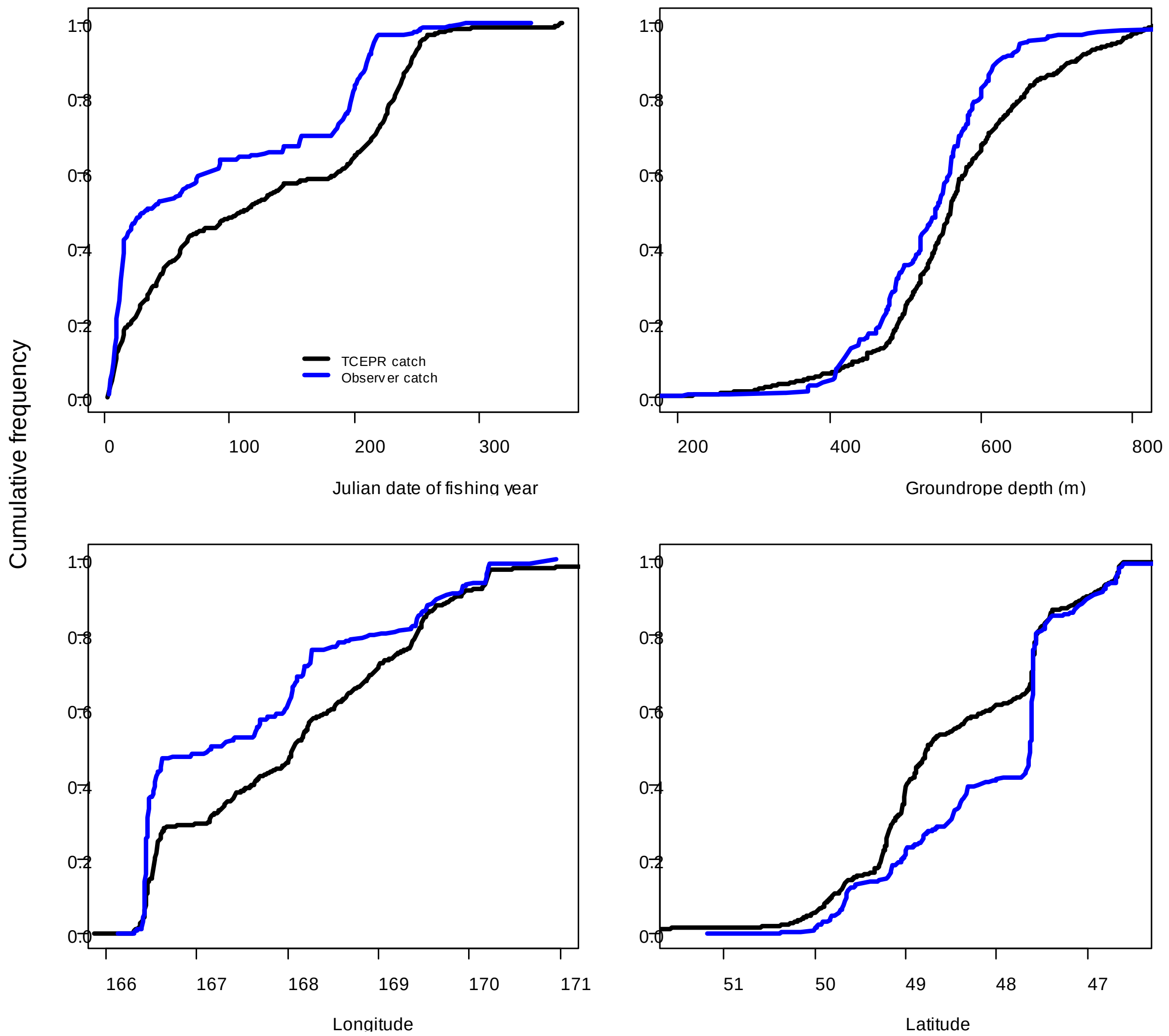


Figure 31: Comparison of Sub-Antarctic 2010–11 Observer Programme (OP) catch coverage with TCEPR catches by day of year, depth, latitude and longitude. If sampling is representative of the fishery, then blue lines (observed catches) should overlay black lines (TCEPR catch).

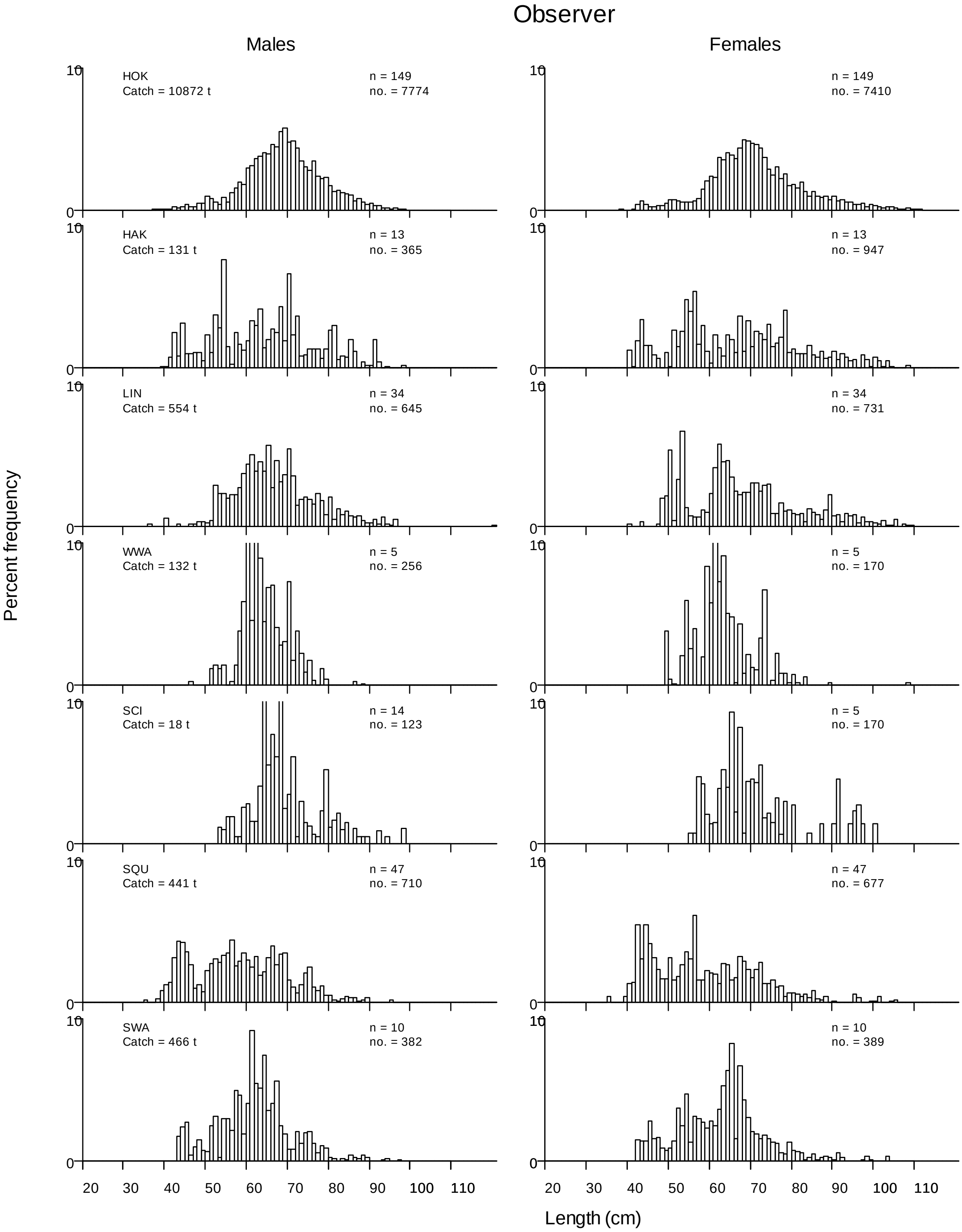
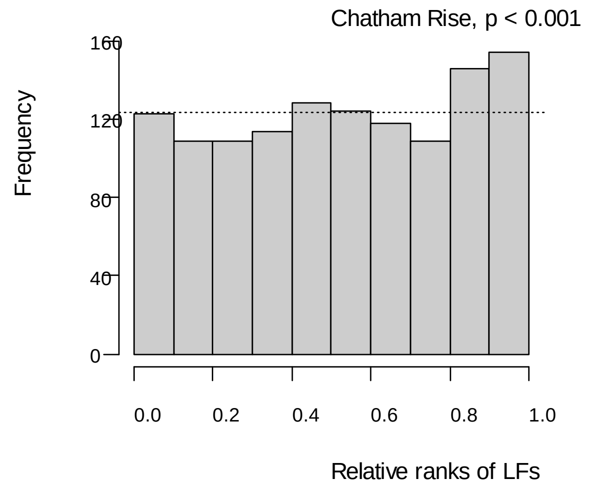


Figure 32: Comparison of length frequency of hoki taken in commercial catches from the 2010–11 Sub-Antarctic fishery sampled by Observer Programme by target species. n, number of tows sampled. Three-letter codes denote target species: HOK, hoki; HAK, hake; LIN, ling; SQU, squid; SCI, scampi; WWA, white warehou; SWA, Silver Warehou.



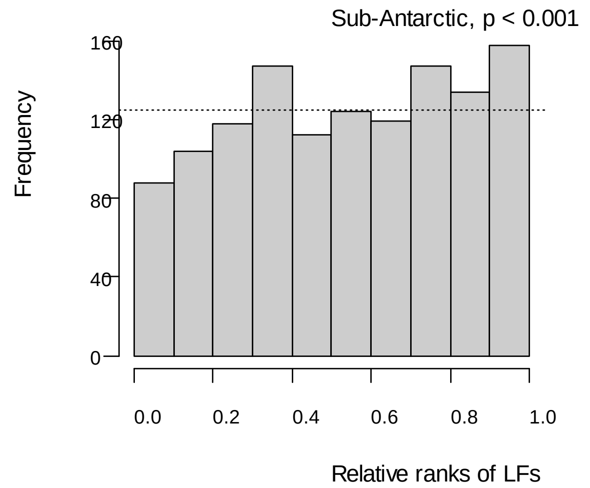


Figure 33: Histograms of ranks of the lengths that yielded 2010–11 Chatham Rise and Sub-Antarctic otoliths relative to the lengths of hoki measured for each tow. If sampling is random then the expected counts are given by the dotted line. The p-value is calculated using the rank-sum test.

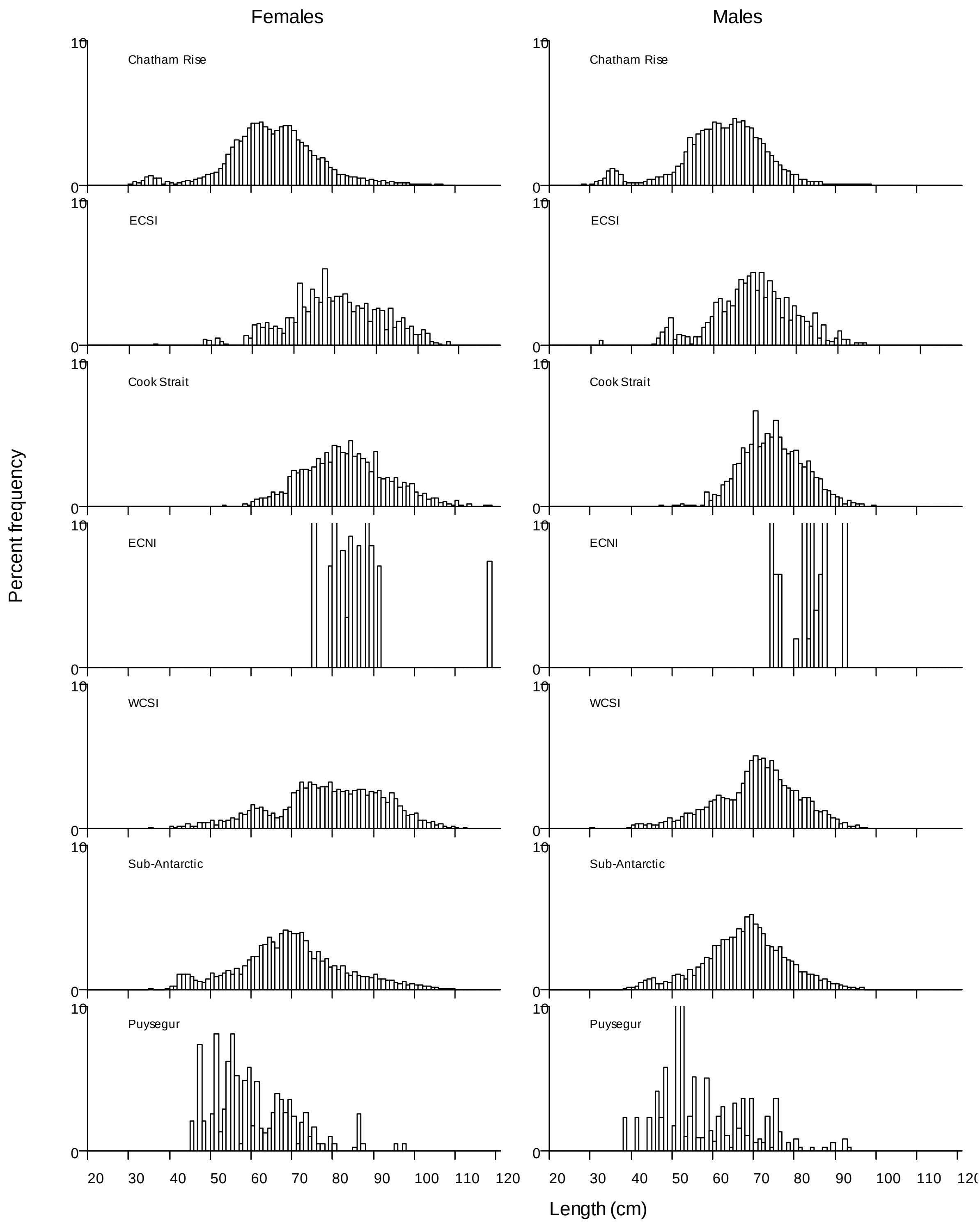


Figure 34: Length frequency of female and male hoki taken in commercial catches from different areas during the 2010–11 fishing year. All areas sampled by the Observer Programme.

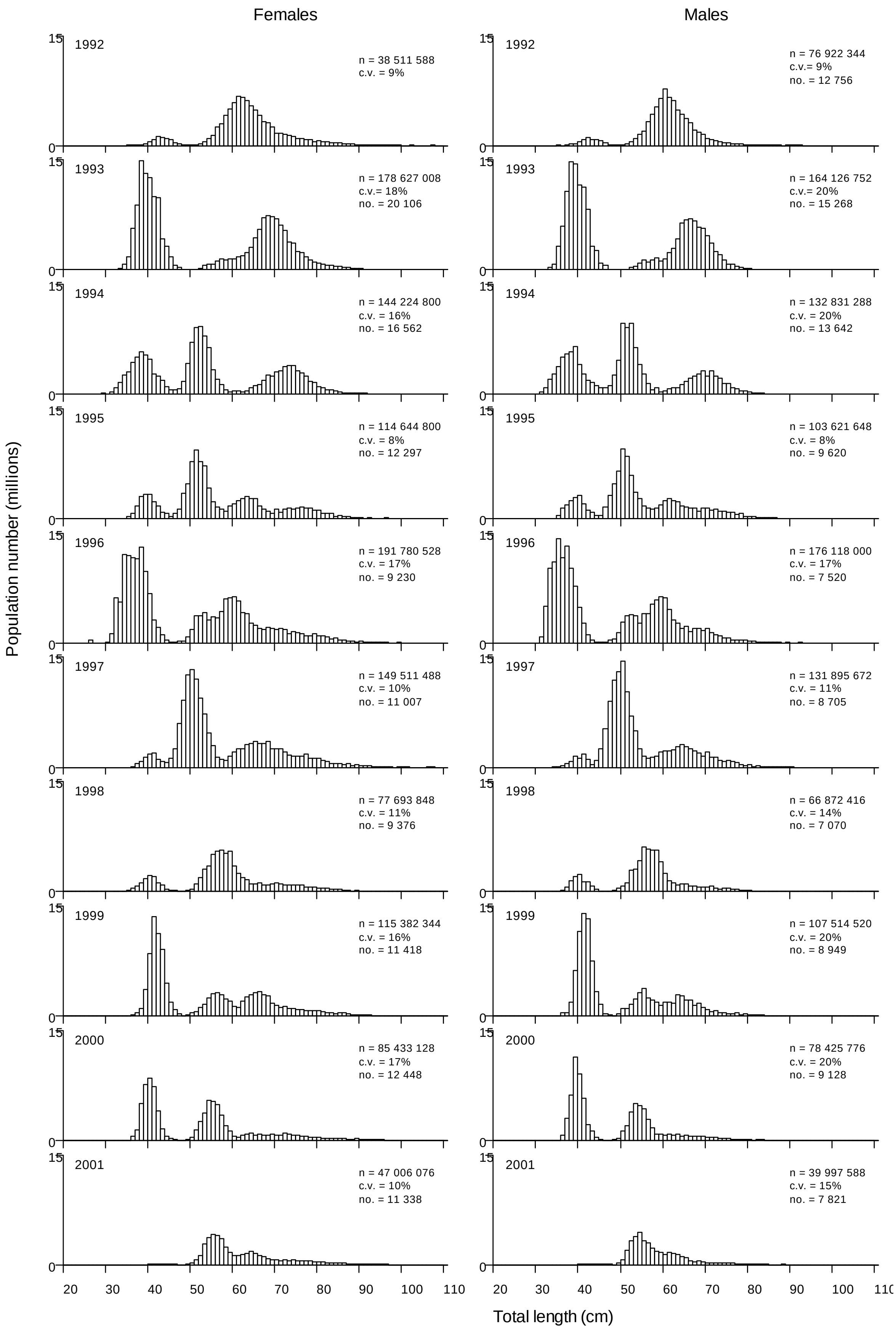


Figure 35: Scaled length frequency for hoki from Chatham Rise *Tangaroa* trawl surveys. n, population numbers of fish; c.v., coefficients of variation; no, number of fish measured.

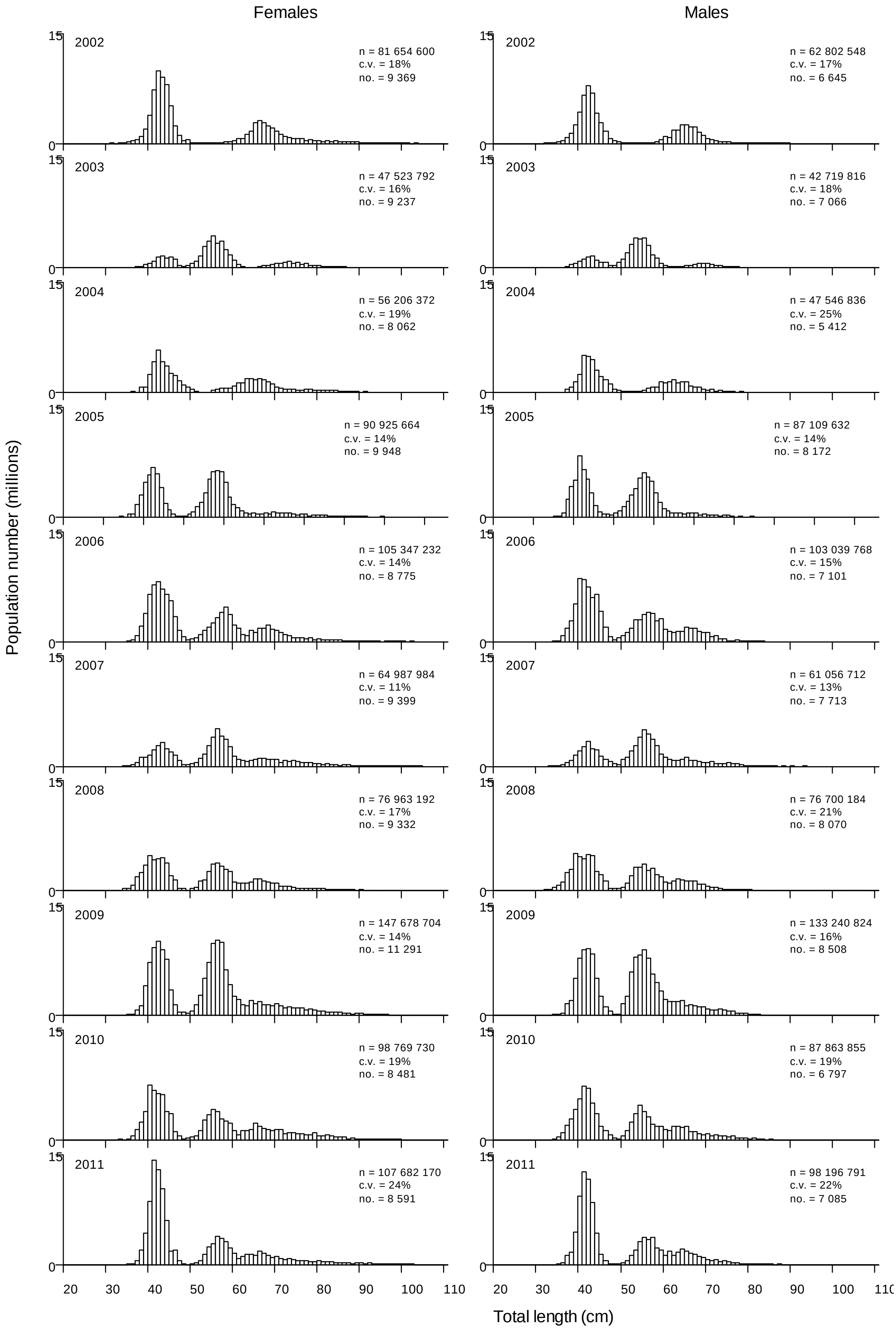


Figure 35: continued.

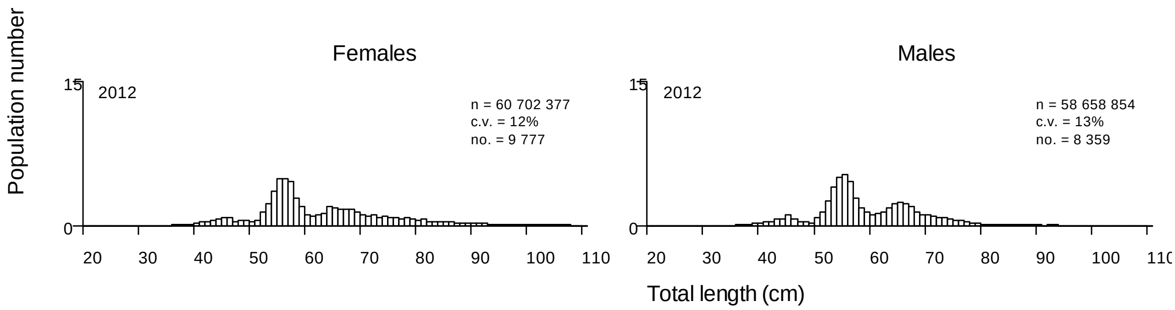


Figure 35: continued.

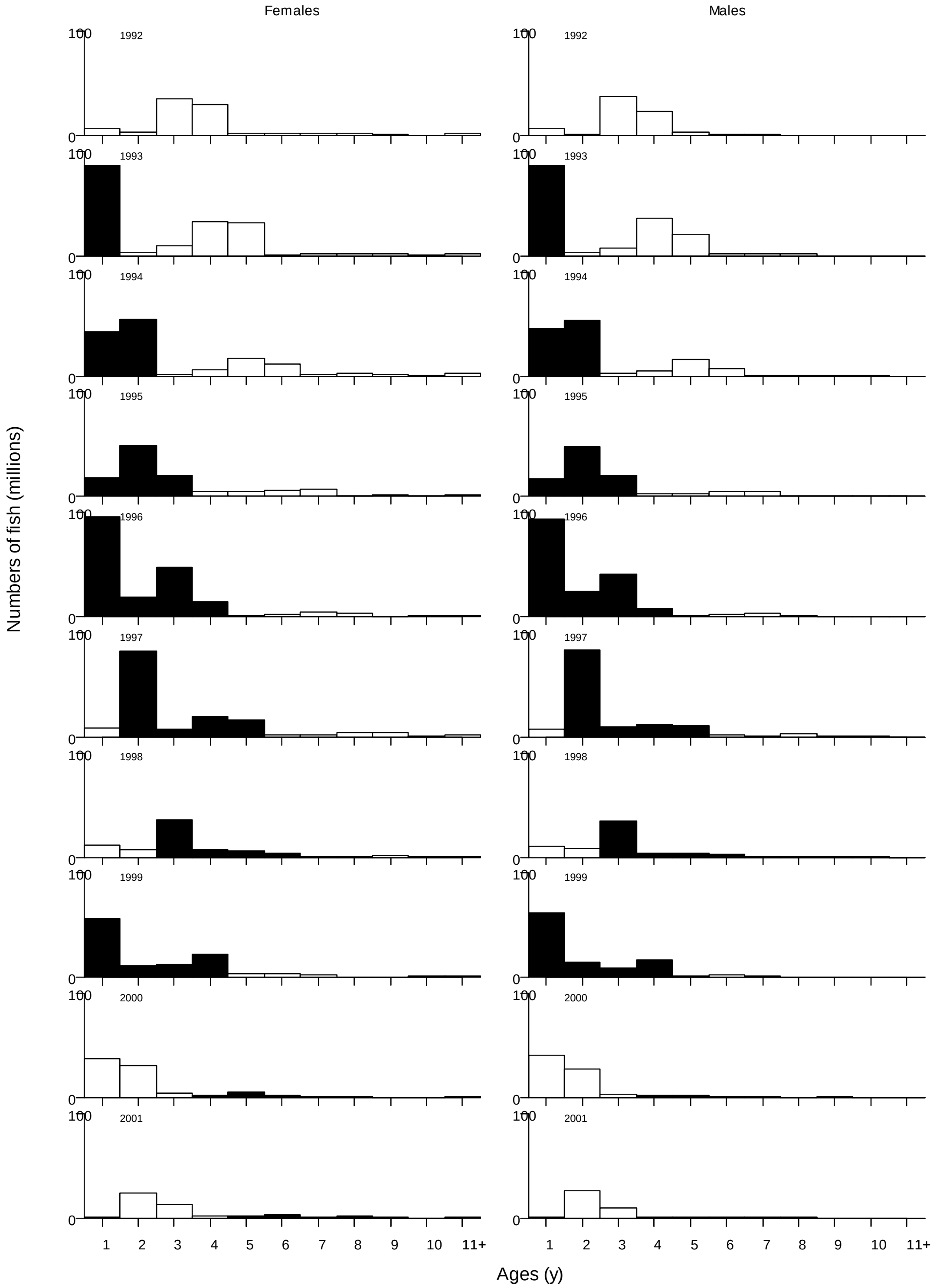


Figure 36: Scaled age frequency for hoki from Chatham Rise *Tangaroa* trawl surveys 1992–2011. Black bars show the 1991–1994 year-classes.

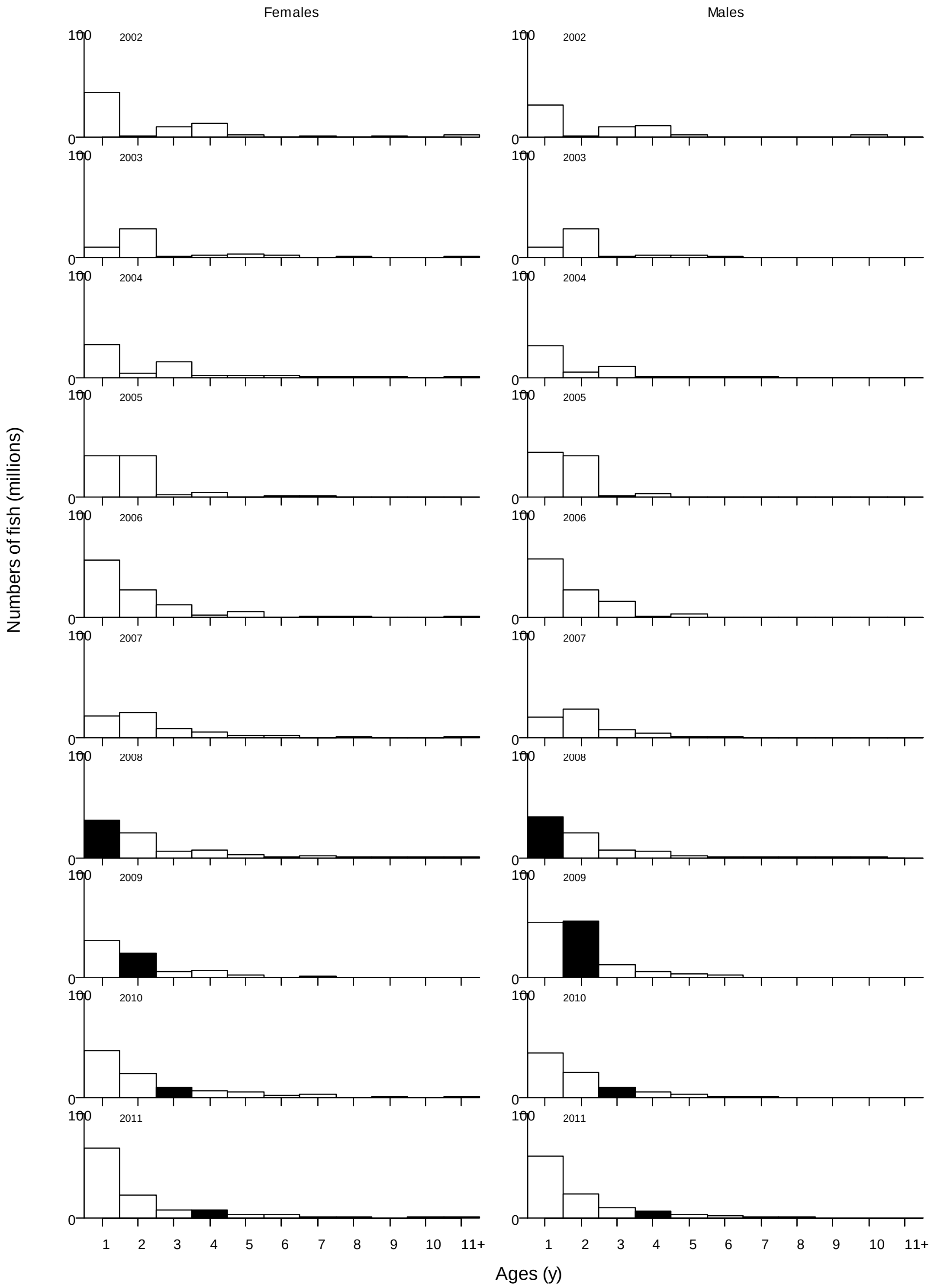


Figure 36: continued. Black bars show the 2006 year-class.

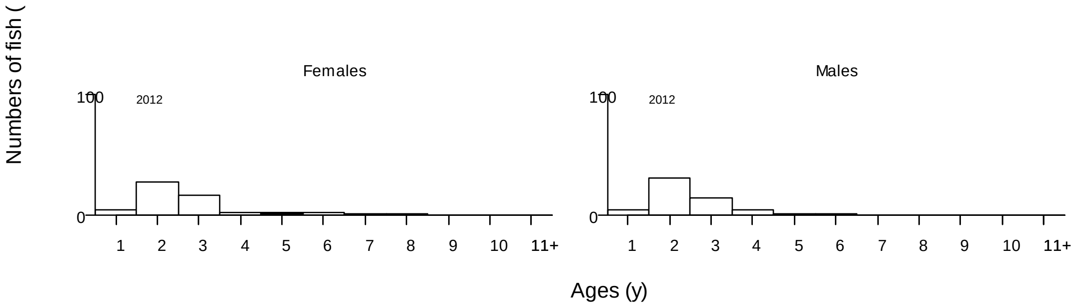


Figure 36: continued. Black bars show the 2006 year-class.

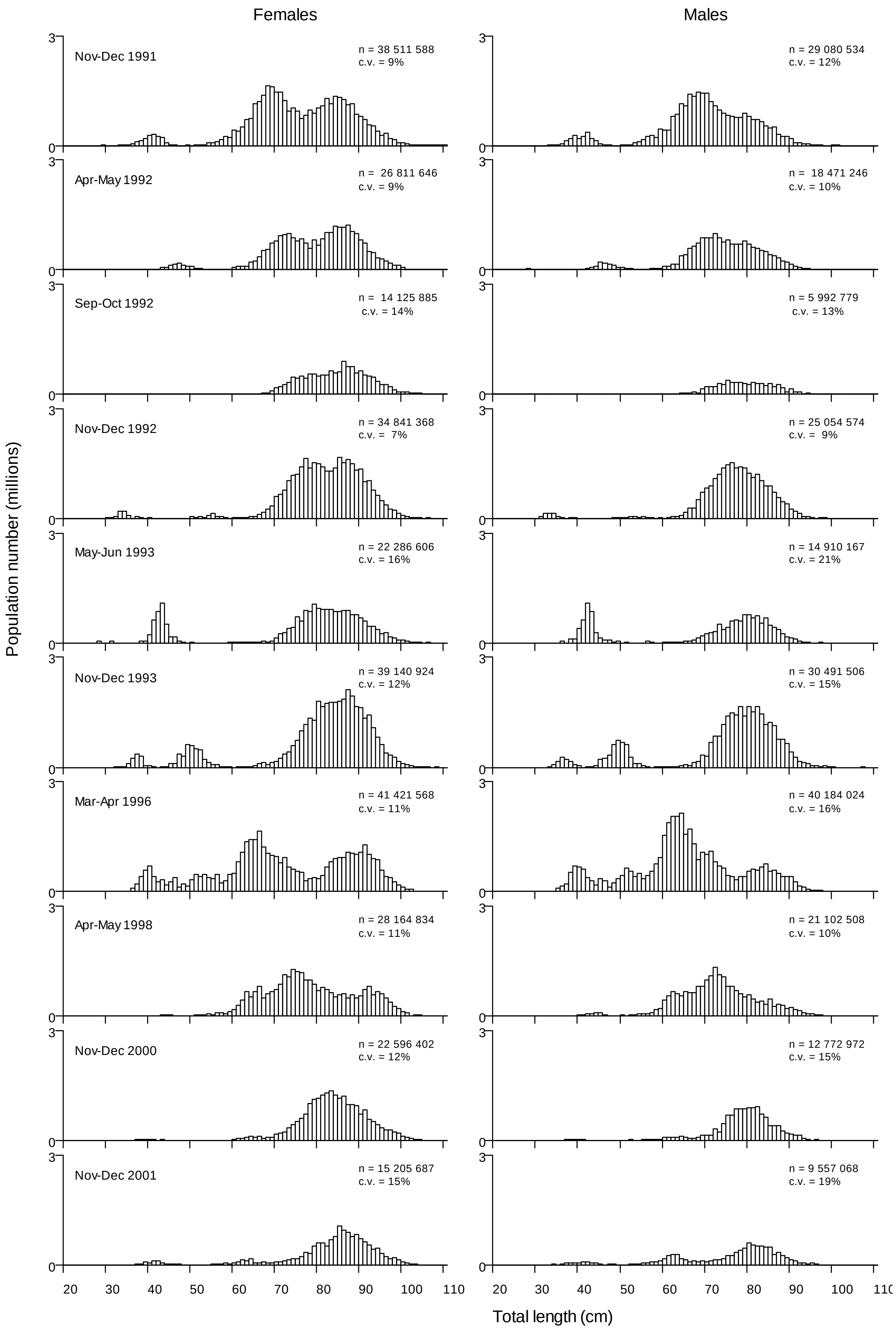


Figure 37: Scaled length frequency for hoki from all Sub-Antarctic *Tangaroa* trawl surveys for the core 300–800 m survey area. n, population numbers of fish; c.v., coefficients of variation.

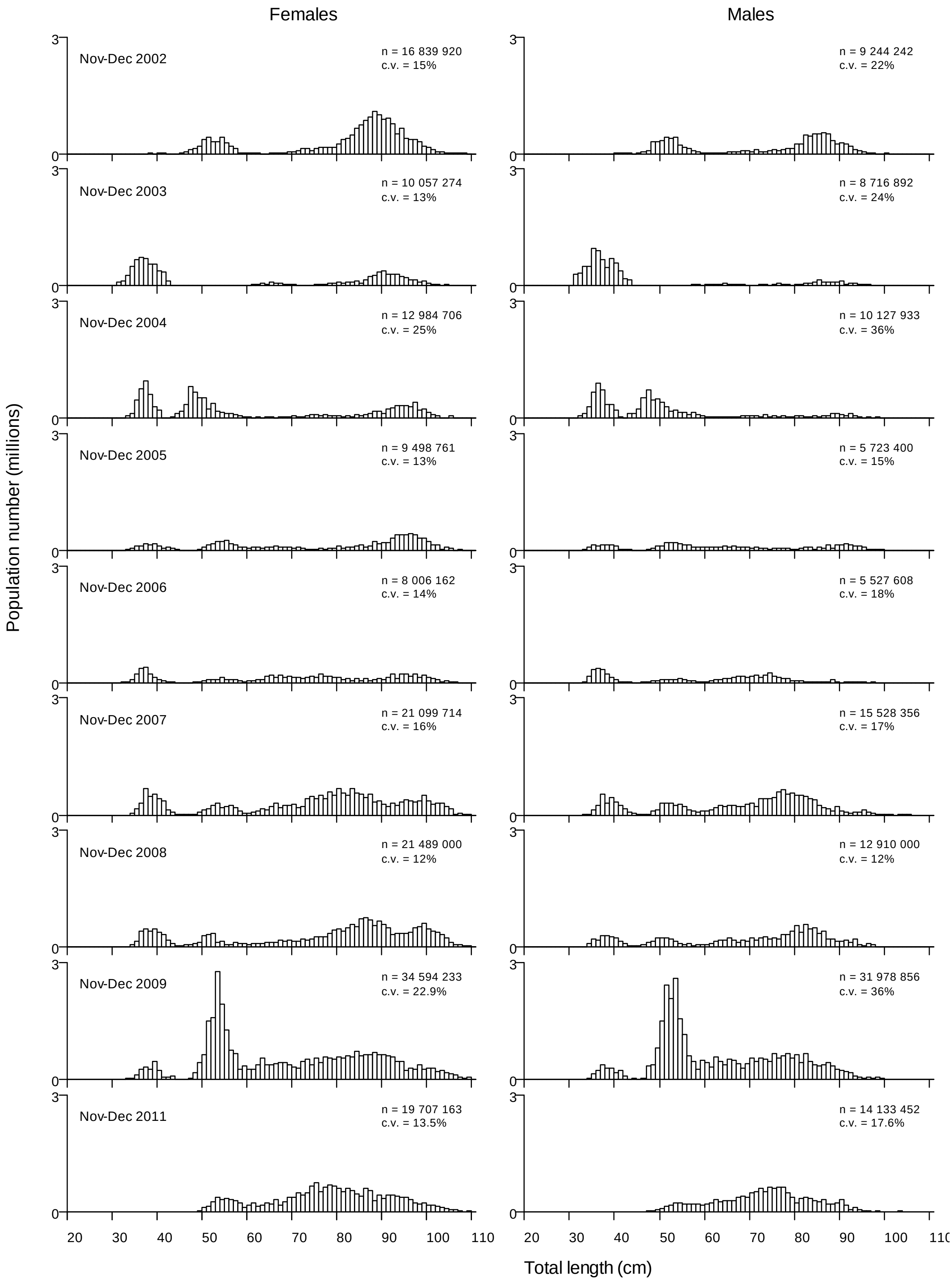


Figure 37: continued.

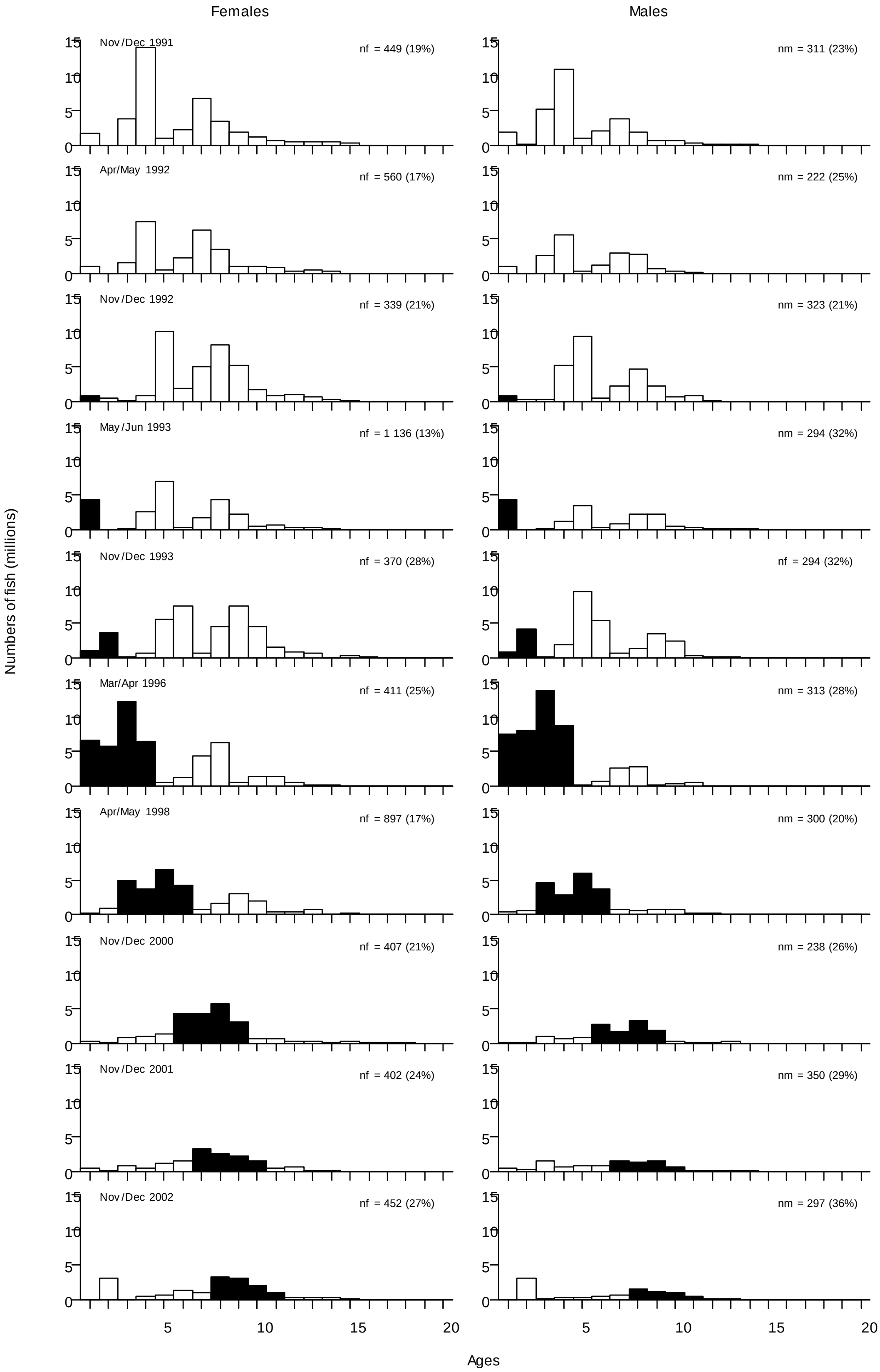


Figure 38: Scaled age frequency for hoki from all Sub-Antarctic *Tangaroa* trawl surveys for the core 300–800 m survey area. Number of fish aged (*nf* female and *nm* male values) are given with c.v.s in parentheses. Black bars show the 1991–94 year-classes.

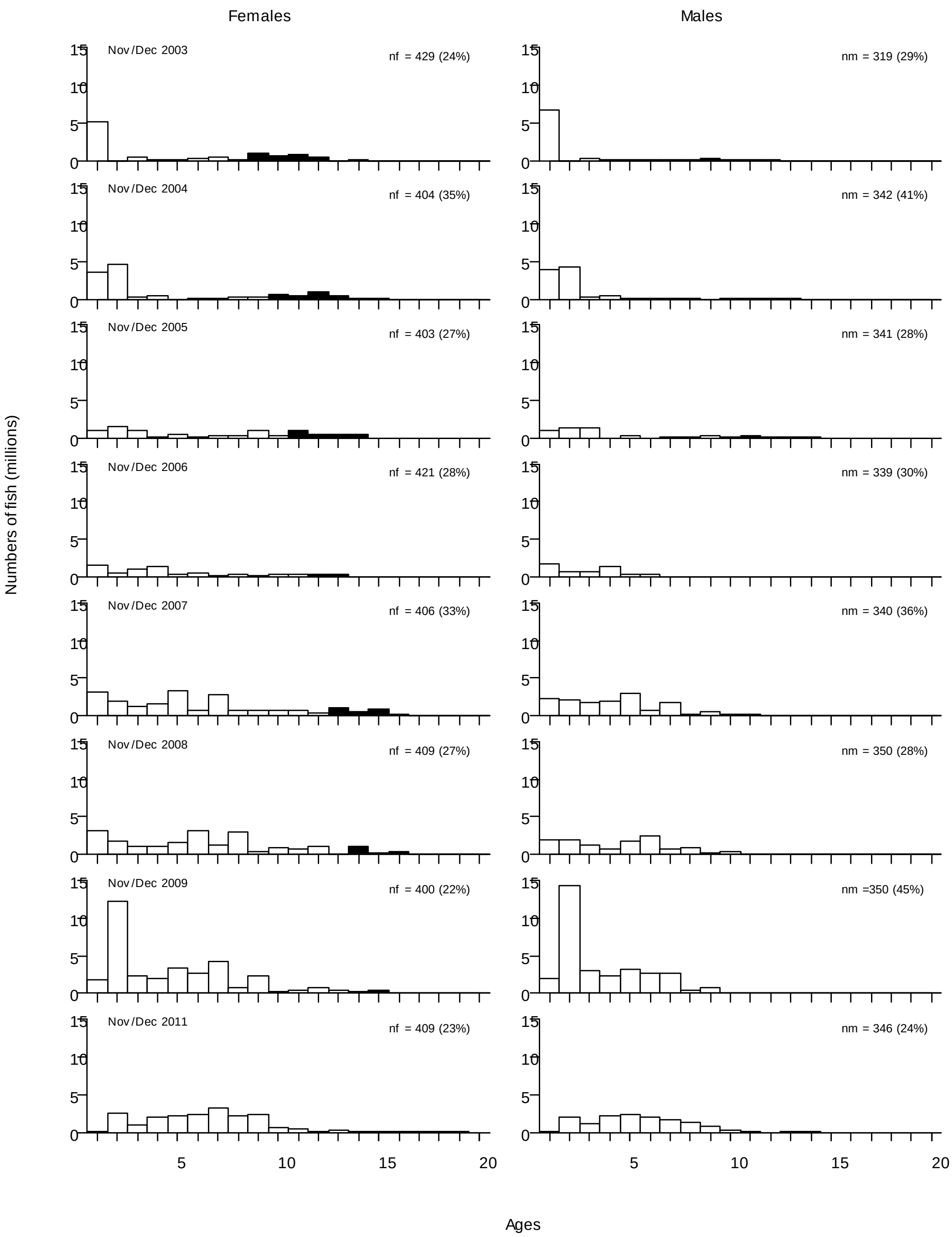


Figure 38: continued.

APPENDICES:

APPENDIX Table A1a: Number of vessels, tows, and total catch inside and outside the 25 nautical mile line of the 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 2011. It is assumed that all CELR data comes from inside the 25 nautical mile line.

	Number of Vessels					Number of Tows				
Year	TCEPR Outside	TCER Outside	TCEPR inside	TCER Inside	CELR	TCEPR outside	TCER outside	TCEPR Inside	TCER inside	CELR
1990	78	-	37	-	18	7 989	-	83	-	196
1991	75	-	42	-	22	8 135	-	68	-	302
1992	71	-	27	-	21	6 171	-	47	-	358
1993	63	-	24	-	22	6 886	-	108	-	511
1994	69	-	32	-	19	8 463	-	137	-	423
1995	64	-	42	-	25	7 800	-	183	-	317
1996	58	-	27	-	25	6 607	-	157	-	581
1997	74	-	47	-	26	7 699	-	443	-	742
1998	62	-	35	-	25	7 589	-	365	-	447
1999	53	-	35	-	18	6 835	-	280	-	624
2000	47	-	28	-	16	6 624	-	725	-	855
2001	52	-	45	-	17	6 953	-	1 380	-	819
2002	47	-	37	-	14	6 395	-	1 253	-	563
2003	44	-	29	-	9	6 614	-	829	-	680
2004	41	-	31	-	10	5 129	-	1 271	-	748
2005	37	-	15	-	10	3 622	-	530	-	464
2006	34	-	20	-	6	3 985	-	210	-	348
2007	30	-	9	-	6	2 620	-	146	-	253
2008	24	5	8	9	-	2 335	18	45	155	0
2009	24	6	3	11	-	1 961	15	3	253	0
2010	27	5	8	12	-	2 318	13	56	313	0
2011	28	5	9	16	-	2 802	39	298	473	0

								Catch (t)	Percent
Year	TCEPR Outside	TCER Outside	Total Outside	TCEPR Inside	TCER Inside	CELR	Total Inside	Total	inside
1990	158 447	-	158 786	1 585	-	366	1 585	159 392	1
1991	128 259	-	128 442	1 015	-	239	1 017	130 375	1
1992	100 507	-	100 508	849	-	190	952	99 802	1
1993	95 402	-	95 743	737	-	531	907	97 694	1
1994	113 833	-	114 385	1 110	-	706	1 202	115 331	1
1995	77 675	-	77 540	1 869	-	783	2 526	80 663	3
1996	68 463	-	70 406	2 539	-	1 934	2 539	74 078	3
1997	83 171	-	85 518	5 665	-	2 398	5 665	92 100	6
1998	95 944	-	98 460	5 522	-	2 620	5 543	105 600	5
1999	85 486	-	88 971	4 295	-	3 859	4 637	94 360	5
2000	87 547	-	92 261	9 443	-	4 767	9 447	101 908	9
2001	80 505	-	85 412	16 627	-	4 990	16 698	102 119	16
2002	70 670	-	74 833	17 846	-	4 186	17 861	92 608	19
2003	57 211	-	62 154	11 583	-	4 958	11 583	73 752	16
2004	26 287	-	31 171	13 922	-	4 885	13 922	45 110	31
2005	25 173	-	27 427	5 653	-	2 261	5 653	32 892	17
2006	33 742	-	36 119	2 731	-	2 483	2 836	38 934	7
2007	30 192	-	32 154	1 128	-	1 965	1 128	33 354	3
2008	19 926	32	19 958	327	567	-	894	20 796	4
2009	19 285	23	19 308	36	1102	-	1 139	20 467	6
2010	33 178	36	33 214	951	1983	-	2 935	36 157	8
2011	40 624	168	40 791	4 044	3438		7 483		16

APPENDIX 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. Year defined as June to October. There were no October data available for 2011.

	Number of Vessels				Number of tows			
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	-	1 374	3 331
1995	26	-	33	59	2 277	-	1 263	3 540
1996	42	-	37	79	4 699	-	1 433	6 132
1997	40	-	28	68	4 921	-	1 059	5 980
1998	31	-	28	59	3 022	-	1 315	4 337
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	0	27	668	581	0	1 249
2009	10	21	1	32	878	551	1	1 430
2010	8	18	0	26	841	523	0	1 364
2011	7	20	0	27	519	571	0	1 090

	Catch (t)			
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	27 707	-	7 674	35 381
1996	51 938	-	8 002	59 940
1997	49 946	-	6 562	56 507
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	18 745	-	4 431	23 176
2006	16 980	-	3 091	20 071
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	7 310	4 515		11 826

APPENDIX 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.

Fishing	Number of Vessels					Number of tows			
year	TCEPR	TCER	CELR trawl	CELR	Total	TCEPR	TCER	CELR trawl	Total
1989–90	47	-	23	35	82	3 325	-	529	3 967
1990–91	69	-	38	50	119	5 724	-	900	6 768
1991–92	76	-	30	45	121	8 601	-	539	9 241
1992–93	75	-	29	38	113	8 575	-	511	9 344
1993–94	78	-	26	40	118	6 447	-	525	7 196
1994–95	87	-	31	46	133	9 467	-	675	10 404
1995–96	102	-	26	39	141	11 044	-	399	11 780
1996–97	105	-	18	31	136	12 609	-	280	13 269
1997–98	97	-	18	31	128	16 176	-	210	16 859
1998–99	87	-	24	31	118	14 984	-	421	15 650
1999–00	70	-	16	28	98	13 432	-	330	13 891
2000–01	68	-	11	20	88	12 360	-	373	12 990
2001–02	60	-	14	20	80	10 343	-	280	10 849
2002–03	63	-	15	23	86	11 400	-	255	11 791
2003–04	59	-	11	18	78	9 511	-	211	9 896
2004–05	51	-	12	20	74	7 345	-	132	7 602
2005–06	52	-	14	20	75	7 038	-	134	7 404
2006–07	47	-	11	13	70	7 324	-	153	9 044
2007–08	42	11	0	2	67	7 012	65	0	8 475
2008–09	37	12	1	4	64	6 227	79	2	7 620
2009–10	39	16	0	1	64	6 003	278	0	7 519
2010–11	39	14	0	2	67	5 445	140	0	6 850

Fishing	Catch (t)				
year	TCEPR	TCER	CELR trawl	CELR	Total
1989–90	13 091	-	71	77	13 168
1990–91	29 965	-	162	168	30 133
1991–92	48 036	-	99	102	48 138
1992–93	44 169	-	63	71	44 239
1993–94	22 662	-	63	73	22 735
1994–95	38 650	-	190	201	38 851
1995–96	48 888	-	87	104	48 991
1996–97	55 726	-	93	108	55 834
1997–98	77 105	-	93	114	77 219
1998–99	72 656	-	929	938	73 594
1999–00	55 912	-	98	102	56 014
2000–01	49 307	-	532	539	49 847
2001–02	39 105	-	38	45	39 151
2002–03	39 071	-	17	21	39 092
2003–04	33 608	-	39	42	33 650
2004–05	30 662	-	8	11	30 673
2005–06	34 048	-	7	10	34 058
2006–07	37 797	-	10	10	37 813
2007–08	37 855	60	0	0	37 920
2008–09	38 997	8	0	1	39 011
2009–10	39 086	47	0	0	39 138
2010–11	38 374	40	0	0	38 419

APPENDIX 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’ includes all fishing methods reported on the CELR form, and ‘CELR trawl’ includes mid-water and bottom trawl tows only. There were no data available for October 2011.

Fishing	Number of Vessels					Number of tows			
year	TCEPR	TCER	CELR trawl	CELR	Total	TCEPR	TCER	CELR trawl	Total
1990	8	-	17	27	35	45	-	123	168
1991	12	-	20	33	45	134	-	234	368
1992	10	-	12	23	33	106	-	242	348
1993	9	-	13	22	31	32	-	274	306
1994	9	-	12	22	31	44	-	215	259
1995	12	-	10	22	34	44	-	72	116
1996	26	-	10	22	48	170	-	77	247
1997	21	-	6	14	35	194	-	153	347
1998	20	-	6	14	34	213	-	81	294
1999	19	-	9	15	34	141	-	151	292
1900	16	-	9	13	29	126	-	229	355
2001	16	-	8	14	30	197	-	251	448
2002	17	-	10	14	31	257	-	146	403
2003	21	-	11	15	36	555	-	219	774
2004	14	-	10	17	32	114	-	248	362
2005	12	-	3	9	21	240	-	69	309
2006	6	-	5	11	19	103	-	76	179
2007	12	-	4	8	24	108	-	27	135
2008	10	4	0	1	21	239	47	0	286
2009	11	3	0	2	25	103	37	0	140
2010	10	4	0	2	22	78	97	0	175
2011	8	5	0	1	20	129	74	0	203

Fishing	Catch (t)				
year	TCEPR	TCER	CELR trawl	CELR	Total
1990	51	-	229	235	51
1991	841	-	503	507	841
1992	547	-	396	399	547
1993	137	-	172	174	137
1994	164	-	353	356	164
1995	52	-	108	110	52
1996	1 061	-	105	108	1 061
1997	817	-	973	977	817
1998	1 300	-	371	375	1 300
1999	765	-	1 329	1 333	765
1900	599	-	1 822	1 826	599
2001	1 658	-	760	768	1 658
2002	2 806	-	225	227	2 806
2003	6 460	-	1 006	1 008	6 460
2004	1 370	-	927	929	1 370
2005	3 674	-	51	54	3 674
2006	894	-	58	65	894
2007	1 001	-	63	63	1 001
2008	2 302	40	-	0	2 302
2009	1 117	29	-	1	1 117
2010	600	138	-	0	600
2011	1 503	152	-	1	1 503

APPENDIX 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' includes all fishing methods reported on the CELR form, and 'CELR trawl' includes mid-water and bottom trawl tows only.

Fishing	Number of Vessels					Number of tows			
year	TCEPR	TCER	CELR trawl	CELR	Total	TCEPR	TCER	CELR trawl	Total
1989–90	64	-	-	-	64	2 787	-	-	2 787
1990–91	66	-	-	-	66	4 617	-	-	4 617
1991–92	76	-	-	1	77	7 025	-	-	7 025
1992–93	63	-	2	3	66	6 143	-	4	6 147
1993–94	65	-	-	2	67	3 718	-	-	3 718
1994–95	62	-	-	1	63	3 512	-	-	3 512
1995–96	68	-	1	3	71	3 810	-	2	3 812
1996–97	74	-	-	-	74	5 003	-	-	5 003
1997–98	68	-	1	1	69	5 419	-	4	5 423
1998–99	68	-	-	-	68	5 145	-	-	5 145
1999–00	56	-	1	1	57	7 677	-	3	7 680
2000–01	56	-	-	-	56	7 401	-	-	7 401
2001–02	55	-	1	1	56	8 443	-	25	8 468
2002–03	50	-	3	3	53	5 689	-	10	5 699
2003–04	46	-	-	-	46	3 850	-	-	3 850
2004–05	43	-	-	-	43	2 560	-	-	2 560
2005–06	41	-	-	-	41	2 374	-	-	2 374
2006–07	36	-	-	-	39	3 004	-	-	3 004
2007–08	35	-	-	-	35	2 731	-	-	2 731
2008–09	32	1	-	-	35	2 914	1	-	2 915
2009–10	34	2	-	-	37	3 171	2	-	3 173
2010–11	35	1	-	-	38	2 931	1	-	2 932

Fishing	Catch (t)				
year	TCEPR	TCER	CELR trawl	CELR	Total
1989–90	11 748	-	-	-	11 748
1990–91	16 669	-	-	-	16 669
1991–92	30 688	-	-	-	30 688
1992–93	24 836	-	-	-	24 836
1993–94	11 636	-	-	-	11 636
1994–95	13 412	-	-	-	13 412
1995–96	13 062	-	1	1	13 062
1996–97	21 771	-	-	-	21 771
1997–98	25 129	-	1	1	25 129
1998–99	23 753	-	-	-	23 753
1999–00	33 772	-	-	-	33 772
2000–01	30 076	-	-	-	30 076
2001–02	30 175	-	-	-	30 175
2002–03	20 194	-	5	5	20 199
2003–04	11 635	-	-	-	11 635
2004–05	6 244	-	-	-	6 244
2005–06	6 738	-	-	-	6 738
2006–07	7 661	-	-	-	7 661
2007–08	8 708	-	-	-	8 708
2008–09	9 807	-	-	-	9 807
2009–10	12 275	-	-	-	12 275
2010–11	12 646	-	-	-	12 646

APPENDIX 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' includes all fishing methods reported on the CELR form, and 'CELR trawl' includes mid-water and bottom trawl tows only. There were no October to December data available for 2011.

Fishing	Number of Vessels					Number of tows			
Year	TCEPR	TCER	CELR trawl	CELR	Total	TCEPR	TCER	CELR trawl	Total
1990	44	-	0	0	0	992	-	0	992
1991	41	-	0	0	0	780	-	0	780
1992	40	-	0	1	1	918	-	0	918
1993	28	-	2	2	2	385	-	10	395
1994	38	-	2	2	2	407	-	16	423
1995	28	-	2	2	2	330	-	6	336
1996	29	-	0	0	0	561	-	0	561
1997	39	-	0	0	0	799	-	0	799
1998	32	-	0	0	0	539	-	0	539
1999	30	-	1	1	1	535	-	3	538
1900	25	-	1	1	1	584	-	29	613
2001	38	-	1	1	1	862	-	8	870
2002	29	-	2	2	2	561	-	16	577
2003	33	-	1	1	1	498	-	10	508
2004	18	-	1	1	1	217	-	20	237
2005	24	-	1	1	1	443	-	12	455
2006	21	-	1	1	1	330	-	23	353
2007	14	-	2	2	2	191	-	21	212
2008	16	-	0	0	0	212	-	0	212
2009	8	1	0	1	1	146	12	0	158
2010	12	1	0	0	0	108	1	0	109
2011	13	4	0	0	0	178	13	0	191

Fishing	Catch (t)				
Year	TCEPR	TCER	CELR trawl	CELR	Total
1990	7 378	-	0	0	7 378
1991	4 870	-	0	0	4 870
1992	4 744	-	0	0	4 744
1993	2 039	-	0	0	2 039
1994	2 382	-	0	0	2 382
1995	1 093	-	0	0	1 094
1996	2 399	-	0	0	2 399
1997	5 847	-	0	0	5 847
1998	2 137	-	0	0	2 137
1999	2 867	-	4	4	2 871
1900	2 757	-	0	0	2 757
2001	6 587	-	1	1	6 588
2002	5 226	-	7	7	5 233
2003	5 821	-	16	16	5 838
2004	1 124	-	5	5	1 129
2005	5 527	-	0	0	5 527
2006	1 299	-	6	6	1 305
2007	376	-	9	9	385
2008	304	-	0	0	304
2009	198	4	0	0	203
2010	198	2	0	0	200
2011	1 154	2	0	0	1 156

APPENDIX 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 2011. Data are non-zero catches for TCEPR midwater tows.

All target species MW tows:

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	3.8
1994	63	105 195	7 139	3.0	8.9	3.3
1995	59	73 505	6 677	3.5	5.1	1.5
1996	59	65 986	5 167	3.5	6.9	2.0
1997	77	83 712	6 720	3.8	7.4	2.0
1998	66	95 709	6 683	3.5	10.4	2.8
1999	56	76 767	5 256	3.1	10.3	3.3
2000	52	79 535	5 316	2.7	12.0	4.4
2001	62	78 850	5 878	2.6	9.0	3.4
2002	56	61 528	4 654	2.3	9.8	4.2
2003	51	51 751	4 312	3.0	8.1	2.4
2004	51	32 050	4 230	2.4	4.6	1.5
2005	37	19 962	2 365	2.5	5.2	1.9
2006	36	21 459	2 015	3.0	6.9	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	29 582	1 514	2.0	17.2	8.8
All years	239	1 386 526	96 327	3.2	9	2.8

Target hoki MW tows:

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	3.4
1995	59	73 078	6 419	3.5	5.1	1.6
1996	59	65 917	5 111	3.5	6.9	2.0
1997	77	83 291	6 612	3.8	7.9	2.1
1998	66	95 515	6 618	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	4.6
2001	62	78 509	5 725	2.5	9.4	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	19 899	2 266	2.4	5.8	2.0
2006	34	21 114	1 734	2.6	8.7	3.2
2007	31	20 786	1 136	2.7	15.0	5.6
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	29 447	1 495	2.0	17.4	8.9
All years	239	1 381 636	93 666	3.2	9.3	2.9

APPENDIX 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 2011. Data are non-zero catches for TCEPR bottom tows.

All target species BT tows:

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	6 049	1 315	4.5	2.6	0.5
1996	38	5 006	1 586	4.7	2.1	0.4
1997	47	5 131	1 438	5.0	2.2	0.5
1998	40	5 881	1 300	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	2 393	4.6	5.0	1.0
2002	35	26 990	2 999	5.0	5.3	1.0
2003	39	17 057	3 192	5.3	2.3	0.4
2004	35	8 174	2 150	6.0	1.5	0.3
2005	30	10 855	1 793	6.6	2.5	0.4
2006	26	14 997	2 144	8.3	2.9	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	15 061	1 561	6.1	6.3	1.0
All years	144	254 478	37 821	5	3.2	0.6

Target hoki BT tows:

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	6 033	1 278	4.5	2.6	0.5
1996	37	4 977	1 544	4.7	2.1	0.4
1997	42	5 100	1 350	5.0	2.4	0.5
1998	34	5 843	1 209	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	4.5	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	9 870	1 240	5.6	4.6	0.8
2006	24	13 331	1 405	7.0	5.1	0.8
2007	20	8 874	731	4.8	9.3	1.7
2008	13	5 246	480	4.8	8.6	1.7
2009	13	4 460	350	4.5	11.2	2.6
2010	19	9 214	611	3.2	13.5	4.8
2011	17	11 699	908	4.1	11.4	2.9
All years	129	238 480	30 639	4.7	4.2	0.9

APPENDIX 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 2011. Data are non-zero catches for TCEPR midwater tows.

All target species tows:

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	1048	1.2	9.1	8.1
1991	22	22 033	2073	1.5	8.2	5.1
1992	22	19 372	1644	1.2	8.3	6.8
1993	20	17 372	1517	1.0	8.3	7.7
1994	28	25 326	1821	1.0	11.8	12.8
1995	24	25 541	2158	0.8	8.8	13.6
1996	36	43 130	3096	0.5	11.6	20.9
1997	34	42 591	3481	0.7	10.6	14.6
1998	29	31 035	2404	0.8	11.4	12.6
1999	21	28 452	2072	0.8	12.4	15.9
2000	21	27 950	1990	0.5	12.0	21.9
2001	25	23 573	1841	0.6	11.0	15.9
2002	15	17 147	1068	0.6	14.9	24.5
2003	20	26 979	1816	0.5	12.6	22.0
2004	19	27 714	1793	0.7	12.2	17.5
2005	13	18 425	1344	0.6	13.2	22.2
2006	11	16 631	1015	0.5	15.4	26.7
2007	7	12 444	952	0.6	11.0	17.5
2008	6	7 558	404	0.6	18.4	28.8
2009	8	9 095	740	0.4	10.1	24.6
2010	8	10 839	820	0.6	11.2	19.5
2011	6	7 065	482	0.4	12.3	24.9
All years	71	472 166	35579	0.8	10.7	14.4

Target hoki tows:

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	1048	1.2	9.1	8.1
1991	22	22 033	2073	1.5	8.2	5.1
1992	22	19 372	1644	1.2	8.3	6.8
1993	18	17 352	1511	1.0	8.5	7.7
1994	28	25 286	1815	1.0	11.8	12.9
1995	24	25 482	2154	0.8	8.8	13.6
1996	36	43 052	3085	0.5	11.7	21.2
1997	34	42 563	3478	0.7	10.6	14.6
1998	29	30 998	2402	0.8	11.4	12.6
1999	21	28 449	2071	0.8	12.4	15.9
2000	21	27 950	1990	0.5	12.0	21.9
2001	25	23 545	1838	0.6	11.0	15.9
2002	15	17 147	1068	0.6	14.9	24.5
2003	20	26 979	1814	0.5	12.6	22.0
2004	19	27 714	1791	0.7	12.2	17.5
2005	13	18 421	1343	0.6	13.2	22.3
2006	11	16 630	1014	0.5	15.4	26.8
2007	7	12 396	949	0.6	10.9	17.6
2008	5	7 555	397	0.6	18.8	29.4
2009	8	9 083	739	0.4	10.1	24.6
2010	8	10 783	818	0.6	11.2	19.3
2011	6	7 065	482	0.4	12.3	24.9
All years	71	471 748	35524	0.8	10.8	14.4

APPENDIX 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 target species tows:

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)
1989–90	47	13 001	3 297	4.0	1.5	0.5
1990–91	59	18 080	4 787	4.0	2.0	0.6
1991–92	72	43 456	8 169	4.0	3.1	0.8
1992–93	61	39 238	7 523	3.9	3.4	1.0
1993–94	64	18 125	5 305	3.5	2.1	0.7
1994–95	70	30 181	7 457	3.7	3.1	0.9
1995–96	84	36 998	8 875	3.6	3.1	0.9
1996–97	96	42 875	10 317	3.7	3.2	0.9
1997–98	82	55 752	12 460	4.0	3.3	0.9
1998–99	77	61 502	12 606	4.0	4.1	1.0
1999–00	60	44 753	10 746	4.1	3.0	0.8
2000–01	60	46 150	11 429	4.5	3.0	0.7
2001–02	55	36 271	9 489	4.4	2.9	0.7
2002–03	62	37 415	10 912	4.7	2.5	0.5
2003–04	58	31 656	9 131	5.0	2.3	0.5
2004–05	50	29 160	6 981	5.0	2.8	0.6
2005–06	50	33 434	6 896	4.8	3.5	0.7
2006–07	46	37 640	7 267	4.6	3.5	0.8
2007–08	38	37 375	6 890	4.8	3.6	0.8
2008–09	37	38 956	6 186	4.3	4.6	1.1
2009–10	38	38 454	5 833	4.5	5.3	1.2
2010–11	38	38 109	5 285	4.7	5.9	1.2
All years	199	808 582	177 841	4.1	3.1	0.8

Target hoki tows:

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)
1989–90	31	11 788	1 902	4.0	3.8	1.0
1990–91	41	16 761	3 285	4.0	3.5	0.9
1991–92	47	42 305	5 408	3.8	5.7	1.6
1992–93	40	38 354	5 169	3.5	5.7	1.6
1993–94	36	17 525	3 372	3.2	4.2	1.3
1994–95	42	29 679	6 047	3.5	4.1	1.2
1995–96	58	36 583	7 620	3.5	3.4	1.1
1996–97	73	42 358	8 984	3.5	3.7	1.1
1997–98	63	55 254	11 145	4.0	4.2	1.0
1998–99	46	60 812	11 238	4.0	4.4	1.1
1999–00	34	44 113	9 413	4.1	3.7	0.9
2000–01	40	44 928	9 762	4.5	3.5	0.8
2001–02	31	35 087	7 773	4.4	3.4	0.8
2002–03	32	36 051	9 196	4.8	3.0	0.6
2003–04	28	30 207	7 142	4.9	3.0	0.6
2004–05	21	27 774	4 956	5.0	4.1	0.8
2005–06	20	31 788	4 806	4.8	5.1	1.1
2006–07	21	34 746	4 733	4.5	5.8	1.2
2007–08	22	33 527	4 187	4.8	6.6	1.4
2008–09	21	33 645	3 896	4.2	7.3	1.7
2009–10	21	35 152	4 349	4.6	6.9	1.5
2010–11	23	34 786	4 056	4.8	7.2	1.5
All years	162	773 222	138 439	4.0	4.1	1.0

APPENDIX 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 2011. Data are not shown for MW vessels in 2009 or 2010 as there was only 1 vessel.

All target species mid-water tows:

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	2.2	7.5	2.4
2001	15	1 264	123	2.4	6.0	2.2
2002	10	2 003	145	2.2	10.9	4.5
2003	18	4 453	301	2.0	13.1	5.4
2004	5	1 444	85	2.2	10.5	6.1
2005	6	2 892	159	1.9	15.2	9.1
2006	4	494	41	1.5	10.2	5.7
2007	4	299	26	1.1	8.7	8.8
2008	3	263	28	2.8	8.1	2.8
2009	1	-	-	-	-	-
2010	1	-	-	-	-	-
2011	4	878	57	1.0	14.7	10.8

Target hoki mid-water tows:

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	2.2	7.5	2.4
2001	15	1 264	123	2.4	6.0	2.2
2002	10	2 003	145	2.2	10.9	4.5
2003	18	4 421	299	2.0	13.1	5.4
2004	5	1 444	85	2.2	10.5	6.1
2005	6	2 892	159	1.9	15.2	9.1
2006	4	485	40	1.5	10.6	6.1
2007	4	299	26	1.1	8.7	8.8
2008	3	213	21	3.8	8.1	2.7
2009	1	-	-	-	-	-
2010	1	-	-	-	-	-
2011	4	878	57	1.0	14.7	10.8

All target species bottom tows:

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	1.3
2002	16	828	126	2.5	3.9	1.7
2003	16	2 081	255	2.8	5.4	1.9
2004	7	251	44	2.4	3.1	1.1
2005	8	592	78	2.9	4.1	1.7
2006	7	166	31	2.1	2.1	1.6
2007	11	666	81	2.0	6.2	2.8
2008	12	2 112	215	2.8	7.5	2.6
2009	8	635	76	2.8	6.2	2.4
2010	8	533	70	2.8	7.3	2.1
2011	6	588	54	3.5	11.0	3.0

Target hoki bottom tows:

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	1.3
2002	11	821	120	2.6	3.9	1.8
2003	13	2 022	245	2.8	5.6	1.9
2004	4	251	40	2.8	3.5	1.2
2005	6	587	75	2.8	4.2	1.8
2006	4	107	21	2.1	3.0	1.6
2007	8	664	69	2.2	8.3	3.4
2008	8	1858	174	2.9	9.2	2.9
2009	6	612	67	2.8	8.2	2.5
2010	7	501	62	2.8	7.6	2.2
2011	6	588	53	3.5	11.1	3.0

APPENDIX 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 bottom non-zero TCEPR tows catching hoki.

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)
1989–90	36	11 542	2 589	4.0	2.6	0.6
1990–91	43	16 177	4 420	4.3	2.6	0.6
1991–92	58	29 688	6 877	4.2	3.1	0.8
1992–93	39	22 304	5 647	4.0	3.1	0.8
1993–94	45	9 051	3 163	4.2	1.6	0.4
1994–95	42	12 135	3 183	4.3	2.4	0.6
1995–96	46	10 793	3 342	4.2	2.1	0.5
1996–97	58	19 278	4 517	4.5	3.2	0.7
1997–98	49	24 213	5 191	4.3	3.3	0.8
1998–99	49	20 963	4 612	4.5	3.1	0.7
1999–00	43	31 570	7 150	4.2	3.0	0.8
2000–01	46	26 221	6 665	4.5	2.7	0.6
2001–02	47	29 568	8 093	4.4	2.1	0.6
2002–03	44	19 870	5 556	4.9	2.4	0.5
2003–04	41	11 168	3 728	5.0	2.0	0.4
2004–05	40	6 059	2 466	5.2	1.0	0.2
2005–06	34	6 475	2 284	5.2	0.7	0.1
2006–07	31	7 420	2 878	5.2	0.8	0.2
2007–08	29	8 015	2 625	5.5	1.0	0.2
2008–09	25	9 195	2 807	5.0	1.0	0.2
2009–10	29	11 551	3 023	5.4	1.0	0.2
2010–11	28	10 965	2 689	5.0	1.5	0.3
All years	164	354 219	93 505	4.5	2.2	0.5

Hoki target tows:

Fishing Year	Number of vessels	Total catch (t)	Number of tows	Median tow duration (h)	Median catch per tow (t)	Median catch per hour (t/h)
1989–90	20	10 922	2 048	4.0	3.6	0.9
1990–91	30	15 229	3 862	4.4	2.8	0.6
1991–92	33	28 278	5 314	4.1	4.1	1.0
1992–93	24	21 359	4 817	3.8	3.6	0.9
1993–94	22	8 748	1 977	4.0	3.2	0.9
1994–95	25	11 861	2 259	4.0	4.1	1.0
1995–96	25	10 547	2 343	4.0	3.2	0.9
1996–97	42	18 909	3 291	4.2	4.6	1.1
1997–98	34	23 665	4 266	4.2	4.2	1.0
1998–99	33	20 391	3 563	4.2	4.1	1.1
1999–00	30	30 884	5 806	4.0	3.9	1.0
2000–01	31	25 397	5 324	4.2	3.5	0.9
2001–02	33	28 612	6 253	4.2	2.9	0.8
2002–03	33	19 101	4 322	4.8	3.0	0.7
2003–04	26	10 815	2 864	4.9	3.0	0.6
2004–05	25	5 197	1 346	5.1	2.5	0.5
2005–06	16	4 691	707	4.9	4.1	0.8
2006–07	20	5 143	1 136	4.5	2.2	0.5
2007–08	13	5 828	909	4.8	4.5	0.9
2008–09	12	6 883	918	4.4	5.1	1.2
2009–10	12	9 687	1 231	4.5	6.1	1.3
2010–11	15	9 203	1 237	4.5	5.5	1.2
All years	109	331 350	65 793	4.2	3.6	0.9

APPENDIX 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 2011. 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	2.4	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	1.7	6.2	3.2
1994	17	2 219	266	3.0	4.0	1.1
1995	15	689	105	2.3	3.1	1.5
1996	12	1 471	155	2.7	7.2	3.2
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
1900	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	1.7
2003	20	5 137	309	2.7	12.1	3.7
2004	4	574	33	3.7	12.2	3.0
2005	9	5 018	218	2.1	22.3	10.3
2006	4	240	16	2.8	15.1	5.0
2007	1	-	-	-	-	-
2008	1	-	-	-	-	-
2009	1	-	-	-	-	-
2010	1	-	-	-	-	-
2011	2	1 046	75	3.2	12.9	3.2

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	2.4	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	1.7	6.2	3.2
1994	17	2 197	264	3.0	4.0	1.1
1995	15	689	105	2.3	3.1	1.5
1996	12	1 471	155	2.7	7.2	3.2
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
1900	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	1.7
2003	20	5 137	309	2.7	12.1	3.7
2004	3	572	29	3.5	13.2	5.1
2005	8	5 012	216	2.1	22.3	10.6
2006	4	240	16	2.8	15.1	5.0
2007	1	-	-	-	-	-
2008	1	-	-	-	-	-
2009	1	-	-	-	-	-
2010	1	-	-	-	-	-
2011	2	1 046	75	3.2	12.9	3.2

APPENDIX Table A2g: continued.

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	395	175	4.2	1.1	0.3
1995	12	214	126	5.7	0.5	0.1
1996	16	972	354	4.3	1.1	0.3
1997	25	1 162	336	5.5	0.8	0.2
1998	19	1295	252	4.8	2.8	0.6
1999	22	966	265	5.2	1.1	0.2
1900	20	849	273	5.4	1.0	0.2
2001	25	919	227	4.2	2.0	0.4
2002	20	1 855	199	3.8	6.4	1.5
2003	22	796	186	4.5	1.6	0.4
2004	16	199	85	4.7	0.5	0.1
2005	21	518	236	5.3	0.9	0.2
2006	16	1 020	257	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	6	48	42	4.2	0.6	0.2

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	357	138	4.4	1.1	0.3
1995	9	184	90	5.8	0.7	0.1
1996	16	908	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
1900	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	153	24	3.3	4.3	1.2
2005	8	243	51	3.2	2.2	0.9
2006	6	720	79	3.5	6.1	2.2
2007	2	57	14	3.8	2.1	0.5
2008	1	-	-	-	-	-
2009	1	-	-	-	-	-
2010	1	-	-	-	-	-
2011	0	-	-	-	-	-

APPENDIX Table A3: CPUE datasets for all vessels and for core vessels for each year (1990–2011) for main hoki areas

WCSI: All target species

	All vessels				Core Vessels			
Year	No. vessels	Catch	Effort	CPUE	No vessels	Catch	Effort	CPUE
1990	79	116 574.9	7 571	15.40	19	49 112.9	2 378	20.65
1991	75	104 109.4	7 754	13.43	27	61 369.1	2 981	20.59
1992	69	86 936.9	5 871	14.81	31	51 153.8	2 767	18.49
1993	63	78 434.2	6 240	12.57	35	51 537.0	3 638	14.17
1994	67	96 921.9	8 210	11.81	39	69 695.7	5 089	13.70
1995	63	63 908.1	7 574	8.44	37	47 973.3	4 988	9.62
1996	62	60 747.7	6 590	9.22	38	51 829.9	4 709	11.01
1997	77	78 919.5	7 698	10.25	45	63 824.1	5 621	11.35
1998	67	91 374.8	7 666	11.92	51	82 612.3	6 604	12.51
1999	59	83 108.8	6 816	12.19	45	78 456.7	6 186	12.68
2000	52	93 312.6	7 158	13.04	44	92 315.4	7 055	13.09
2001	63	93 037.0	8 080	11.51	45	86 539.8	7 279	11.89
2002	56	83 619.0	7 337	11.40	43	77 237.8	6 742	11.46
2003	51	65 558.8	7 131	9.19	41	61 473.4	6 725	9.14
2004	51	39 334.3	6 181	6.36	37	31 520.6	5 212	6.05
2005	38	29 298.2	3 989	7.34	34	27 599.3	3 765	7.33
2006	37	31 976.4	3 786	8.45	31	29 300.9	3 423	8.56
2007	32	30 032.2	2 472	12.15	28	28 204.5	2 257	12.50
2008	25	19 759.8	2 303	8.58	22	19 074.1	2 089	9.13
2009	24	18 908.7	1 822	10.38	21	18 250.2	1 724	10.59
2010	28	31 755.6	2 239	14.18	23	29 821.3	2 066	14.43
2011	28	42 969.0	2 914	14.75	25	41 144.1	2 771	14.85

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

	All vessels				Core Vessels			
Year	No vessels	Catch	Effort	CPUE	No vessels	Catch	Effort	CPUE
1990	17	11 314.0	1 003	11.28	9	7 319.0	659	11.11
1991	22	21 347.6	2 009	10.63	10	14 116.3	1 273	11.09
1992	22	17 131.3	1 522	11.26	11	11 846.6	962	12.31
1993	18	15 968.9	1 420	11.25	10	12 965.4	1 137	11.40
1994	28	22 370.5	1 645	13.60	13	15 819.7	1 056	14.98
1995	24	21 421.0	1 852	11.57	11	15 181.3	979	15.51
1996	36	34 858.7	2 588	13.47	15	19 706.9	1 225	16.09
1997	33	34 756.4	2 861	12.15	16	22 615.4	1 777	12.73
1998	28	26 055.9	2 038	12.79	15	21 738.8	1 633	13.31
1999	20	23 565.2	1 730	13.62	15	20 838.3	1 509	13.81
2000	21	22 655.3	1 639	13.82	15	20 059.1	1 404	14.29
2001	25	18 941.1	1 555	12.18	14	15 816.2	1 263	12.52
2002	14	13 631.9	842	16.19	12	12 966.7	795	16.31
2003	20	19 647.7	1 398	14.05	12	7 534.2	1 220	14.37
2004	19	21 492.0	1 462	14.70	12	18 536.3	1 264	14.66
2005	13	13 810.7	1 065	12.97	11	13 362.5	1 028	13.00
2006	11	13 379.8	860	15.56	9	13 110.9	838	15.65
2007	7	9 945.5	806	12.34	6	9 633.7	763	12.63
2008	5	5 821.6	315	18.48	5	5 821.6	315	18.48
2009	8	6 393.8	566	11.30	8	6 393.8	566	11.30
2010	7	8 935.7	704	12.69	6	8 905.9	699	12.74
2011	6	5 927.4	418	14.18	5	5 909.8	415	14.24

APPENDIX Table A3: continued.

Chatham Rise and ECSI non-spawning: All target species

	All vessels				Core Vessels			
Year	No vessels	Catch	Effort	CPUE	No vessels	Catch	Effort	CPUE
1990	33	10 583.9	1920	5.51	2	4 570.4	407	11.23
1991	41	14 889.0	3195	4.66	4	6 111.6	878	6.96
1992	59	38 180.8	6277	6.08	5	12 422.4	1488	8.35
1993	53	32 178.2	6088	5.29	7	13 739.9	2214	6.21
1994	53	13 973.1	4199	3.33	7	8 834.5	1841	4.80
1995	58	22 201.0	5457	4.07	9	16 720.8	3438	4.86
1996	60	27 316.2	6201	4.41	8	22 090.3	3710	5.95
1997	82	34 632.0	7766	4.46	15	28 881.7	5150	5.61
1998	78	43 117.1	9288	4.64	16	40 275.9	7572	5.32
1999	65	54 528.3	10354	5.27	15	49 286.2	8556	5.76
2000	52	38 086.6	8765	4.35	13	35 746.0	7345	4.87
2001	56	39 004.8	9371	4.16	15	35 293.7	7712	4.58
2002	52	29 595.6	7482	3.96	14	26 241.0	5912	4.44
2003	58	29 991.1	8606	3.48	15	25 980.8	6900	3.77
2004	55	20 381.0	6506	3.13	14	17 315.6	4762	3.64
2005	45	22 430.3	5180	4.33	11	19 848.1	3523	5.63
2006	43	27 273.1	5007	5.45	10	23 617.7	3535	6.68
2007	38	29 405.0	4968	5.92	8	25 196.1	3406	7.40
2008	33	28 351.8	4668	6.07	7	22 729.1	2775	8.19
2009	30	31 884.1	4522	7.05	7	24 272.9	2867	8.47
2010	33	32 161.3	4310	7.46	8	27 943.4	3449	8.10
2011	30	32 983.1	4237	7.78	8	27 787.8	3282	8.47

Sub-Antarctic: All target species

	All vessels				Core Vessels			
Year	No vessels	Catch	Effort	CPUE	No vessels	Catch	Effort	CPUE
1990	32	11 365.0	2478	4.59	3	2 362.2	560	4.22
1991	40	16 034.9	4354	3.68	4	7 600.2	2131	3.57
1992	55	29 339.8	6763	4.34	6	20 915.9	4080	5.13
1993	35	22 158.3	5587	3.97	7	18 523.6	4196	4.41
1994	41	9 017.9	3126	2.88	7	8 156.2	1818	4.49
1995	40	12 109.8	3164	3.83	6	11 659.4	2135	5.46
1996	43	10 729.1	3200	3.35	5	6 781.6	1447	4.69
1997	57	19 085.0	4426	4.31	10	15 577.4	2443	6.38
1998	49	23 911.0	5126	4.66	11	21 857.7	3747	5.83
1999	47	20 501.5	4495	4.56	10	16 809.6	2807	5.99
2000	39	31 178.8	6914	4.51	10	27 811.7	4899	5.68
2001	44	25 988.9	6530	3.98	11	22 124.3	4492	4.93
2002	46	29 075.7	7902	3.68	11	25 995.9	5414	4.80
2003	42	19 769.7	5477	3.61	11	16 199.2	3446	4.70
2004	39	11 145.4	3677	3.03	9	8 106.9	2117	3.83
2005	38	6 043.0	2435	2.48	7	3 946.3	1107	3.56
2006	33	6 415.4	2182	2.94	6	3 996.4	774	5.16
2007	29	7 285.6	2764	2.64	5	3 420.4	954	3.59
2008	28	7 937.2	2558	3.10	5	6 286.8	1229	5.12
2009	24	9 160.7	2599	3.52	5	7 702.7	1262	6.10
2010	27	11 516.3	2872	4.01	5	9 774.7	1330	7.35
2011	27	10 905.4	2518	4.33	4	8 402.0	1288	6.52

APPENDIX 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	CPUE	CI	CPUE	CI	CPUE	CI
1990	1.17	1.11–1.22	1.17	1.12–1.23	1.17	1.07–1.28
1991	1.18	1.13–1.23	1.19	1.14–1.24	0.91	0.86–0.98
1992	1.21	1.16–1.27	1.22	1.17–1.28	1.05	0.98–1.13
1993	1.02	0.99–1.06	1.10	1.06–1.14	0.91	0.85–0.98
1994	1.02	0.99–1.05	1.02	0.99–1.05	1.17	1.10–1.25
1995	0.73	0.71–0.75	0.72	0.70–0.74	1.36	1.27–1.45
1996	0.82	0.80–0.85	0.82	0.79–0.84	0.99	0.93–1.05
1997	0.81	0.79–0.83	0.81	0.78–0.83	0.94	0.89–0.99
1998	0.98	0.96–1.01	0.99	0.97–1.02	0.98	0.93–1.04
1999	1.05	1.02–1.07	1.05	1.02–1.08	0.93	0.88–0.98
2000	1.24	1.21–1.27	1.24	1.21–1.27	1.00	0.95–1.06
2001	0.91	0.89–0.93	0.90	0.88–0.93	0.80	0.76–0.85
2002	0.88	0.86–0.90	0.86	0.84–0.89	1.23	1.15–1.33
2003	0.68	0.66–0.70	0.67	0.65–0.68	1.02	0.96–1.09
2004	0.45	0.43–0.46	0.42	0.41–0.43	0.87	0.82–0.93
2005	0.57	0.55–0.59	0.52	0.50–0.54	0.83	0.78–0.89
2006	0.83	0.80–0.86	0.82	0.79–0.85	1.00	0.93–1.08
2007	1.18	1.13–1.23	1.29	1.23–1.36	0.79	0.74–0.85
2008	1.39	1.33–1.45	1.31	1.24–1.39	1.19	1.07–1.33
2009	1.56	1.49–1.64	1.82	1.71–1.94	0.81	0.74–0.89
2010	1.76	1.68–1.84	1.76	1.68–1.85	1.04	0.96–1.13
2011	1.80	1.73–1.87	1.68	1.61–1.76	1.23	1.11–1.36

	Chatham Rise All target species, BT		Chatham Rise Target hoki, BT		Chatham Rise All target species, BT, January	
Year	CPUE	CI	CPUE	CI	CPUE	CI
1990	1.07	0.961.19	1.06	0.951.18	-	-
1991	1.00	0.941.08	0.99	0.921.06	1.10	0.93–1.30
1992	1.21	1.141.28	1.20	1.141.27	1.15	1.01–1.32
1993	1.13	1.081.18	1.13	1.081.18	1.11	0.99–1.24
1994	1.03	0.981.08	1.03	0.981.08	1.12	0.99–1.27
1995	0.91	0.880.95	0.92	0.890.95	0.81	0.71–0.91
1996	1.07	1.031.11	1.07	1.031.11	1.11	1.00–1.23
1997	0.96	0.930.99	0.96	0.930.99	1.11	1.02–1.20
1998	0.91	0.890.94	0.92	0.890.94	1.02	0.96–1.10
1999	1.04	1.011.07	1.05	1.021.07	1.05	0.99–1.11
2000	0.87	0.840.89	0.87	0.850.89	0.96	0.90–1.03
2001	0.81	0.790.83	0.81	0.780.83	0.92	0.86–0.99
2002	0.82	0.800.85	0.82	0.790.84	0.76	0.71–0.81
2003	0.61	0.590.62	0.60	0.590.62	0.58	0.54–0.63
2004	0.56	0.540.58	0.56	0.540.58	0.46	0.42–0.49
2005	0.83	0.800.87	0.84	0.810.87	0.91	0.83–1.00
2006	1.07	1.031.11	1.09	1.051.13	1.23	1.12–1.34
2007	1.09	1.051.13	1.11	1.071.15	1.05	0.95–1.16
2008	1.39	1.331.44	1.36	1.311.42	1.33	1.21–1.45
2009	1.52	1.461.58	1.53	1.471.60	1.59	1.45–1.74
2010	1.32	1.271.36	1.32	1.271.36	1.16	1.07–1.25
2011	1.41	1.361.46	1.40	1.351.45	1.16	1.06–1.27

APPENDIX Table A4: continued.

	Sub-Antarctic All target species, BT		Sub-Antarctic Target hoki, BT		Sub-Antarctic All target species, BT, Nov–Dec, Snares Shelf	
Year	CPUE	CI	CPUE	CI	CPUE	CI
1990	0.74	0.67–0.81	0.72	0.66–0.79	0.69	0.58–0.83
1991	0.63	0.60–0.67	0.62	0.58–0.66	1.33	1.17–1.52
1992	1.10	1.05–1.16	1.10	1.05–1.16	1.35	1.20–1.52
1993	0.99	0.95–1.04	0.98	0.93–1.03	1.49	1.30–1.72
1994	1.13	1.06–1.19	1.12	1.06–1.19	1.33	1.14–1.57
1995	1.22	1.16–1.29	1.22	1.16–1.28	1.50	1.32–1.69
1996	1.05	0.99–1.11	1.05	0.99–1.11	1.99	1.74–2.26
1997	1.33	1.27–1.39	1.33	1.27–1.38	1.74	1.54–1.97
1998	1.15	1.11–1.19	1.15	1.11–1.19	1.15	0.88–1.49
1999	1.05	1.00–1.09	1.05	1.01–1.10	1.57	1.31–1.87
2000	1.05	1.02–1.09	1.05	1.01–1.09	0.82	0.73–0.93
2001	0.96	0.93–0.99	0.96	0.93–0.99	1.12	1.03–1.22
2002	0.97	0.94–1.00	0.96	0.93–0.99	0.80	0.71–0.89
2003	0.87	0.83–0.90	0.86	0.83–0.90	0.37	0.32–0.42
2004	0.63	0.60–0.66	0.64	0.61–0.67	0.46	0.40–0.53
2005	0.66	0.62–0.70	0.65	0.60–0.69	0.23	0.13–0.39
2006	0.92	0.85–0.99	0.95	0.87–1.04	0.52	0.45–0.60
2007	0.83	0.78–0.89	0.69	0.64–0.75	1.32	1.16–1.49
2008	1.18	1.11–1.26	1.27	1.18–1.37	1.62	1.43–1.84
2009	1.44	1.35–1.53	1.45	1.35–1.55	1.35	1.16–1.56
2010	1.50	1.42–1.59	1.54	1.44–1.63	1.03	0.91–1.18
2011	1.23	1.16–1.30	1.42	1.33–1.51	0.69	0.58–0.83