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Tini a Tangaroa

# Inshore trawl survey of the west coast South Island and Tasman and Golden Bays, March–April 2019 (KAH1902)

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This report presents the results from the fourteenth inshore trawl survey along the west coast of the South Island, from Farewell Spit to the Haast River mouth, and within Tasman and Golden Bays at depths from 20 to 400 m using RV *Kaharoa*.

The survey took place from 22 March to 16 April 2019 and used a stratified two-phase design optimised for giant stargazer, red cod, red gurnard, spiny dogfish, and tarakihi. Snapper were added as a target species in 2017 as the first of two pilot surveys with two new strata added to better sample them: stratum 20 covered depths of 10–20 m in Tasman Bay and stratum 21 covered depths of 10–20 m in Golden Bay. This was repeated in 2019. A total of 61 phase one stations were successfully completed in the core strata and a further eight phase one stations were carried out in stratum 20 and 21. Seven phase two stations were completed to reduce the coefficient of variation (CV) for red cod and tarakihi. Trends in relative biomass estimates, catch distributions for the target species, and population length frequencies for the major species are presented.

The biomass estimates for the target species for the core strata were: giant stargazer, 2081 t; red gurnard, 1642 t; red cod, 666 t; snapper, 972 t; spiny dogfish, 4031 t; and tarakihi, 1094 t. The snapper biomass estimate including the new strata was 1316 t. The additional inshore stations (and strata) included a higher proportion of snapper smaller than 30 cm, suggesting that they may be useful for estimating the biomass of pre-recruits. Target CVs of 20% were met for giant stargazer (18%), red gurnard (16%) and tarakihi (18%). The target CV for red cod of 25% was met (22%) and the target CV of 30% was met for snapper (12%). The CV for spiny dogfish (22%) was slightly higher than the target (20%). Other commercial species with CVs less than 20% were barracouta, jack mackerel (*Trachurus. novaezelandiae*), rig, and school shark.

The 1+ cohort of snapper is the largest ever seen in time series, coming mostly from the 10–20 m strata first surveyed in 2017. These strata may provide important information on future recruitment and should continue to be sampled. The snapper biomass was the highest ever in the time series and a 66% increase on the previous survey. Gurnard biomass remains high with the previous two surveys having the highest estimates in the time series. Giant stargazer biomass was the second highest estimate for the time series. The record number of 1+ John dory seen in the 2017 survey do not appear to have translated into large numbers of 3+ fish in 2019 and the biomass has decreased substantially from the time series highs seen in the previous two surveys. Red cod biomass is the second lowest in the time series and continues an overall declining trend with the 1+ fish that were so abundant in the past being conspicuously absent in the last two surveys. Spiny dogfish biomass was also low with the second lowest estimate of the time series, up only slightly from the time series low of 2017.

An analysis of mean rankings of species biomass estimates across all surveys in the time series showed that for both the Tasman and Golden Bays region and the west coast South Island, the 2019 survey falls within the 95% confidence intervals and so is not regarded as having extreme catchability.

## 1. INTRODUCTION

This report presents results from the fourteenth stratified random trawl survey using RV *Kaharoa* at depths of 20–400 m off the west coast of the South Island, and in Tasman and Golden Bays. Other surveys have taken place in 1992, 1994, 1995, 1997, 2000, 2003, 2005, 2007, 2009, 2011, 2013, 2015, and 2017. The survey design was optimised to estimate the relative biomass of giant stargazer (*Kathetostoma giganteum*), red cod (*Pseudophycis bachus*), red gurnard (*Chelidonichthys kumu*), snapper (*Pagrus auratus*), spiny dogfish (*Squalus acanthias*), and tarakihi (*Nemadactylus macropterus*). Changes in the relative biomass and length frequency distributions over time should reflect changes in the absolute biomass and size distributions of the fish populations.

The results of earlier surveys in this series were reported by Drummond & Stevenson (1995a, 1995b, 1996), Stevenson (1998, 2002, 2004, 2006, 2007a, 2012), Stevenson & Hanchet (2010), MacGibbon & Stevenson (2013) and Stevenson & MacGibbon (2015, 2018). The first four surveys in the series were reviewed by Stevenson & Hanchet (2000). Additional analyses of the non-target species were completed to determine for which species relative abundance trends and size comparison information should be provided in each survey report (Stevenson 2007b).

The 2019 survey also included the second of two planned pilot surveys aimed at determining the feasibility of estimating snapper biomass in future surveys. The station optimization for existing core strata included snapper catch rates from past surveys in the inputs. The pilot surveys had two new strata in 10–20 m in Tasman and Golden Bays to better cover the geographic distribution of snapper. Commercial data from these strata were modelled to establish the number of stations required. The final number of four stations for each of the two new strata in 2017 was based on logistics as the simulation modelling suggested that a higher number of tows would be needed than was feasible. In 2019 four stations were again carried out in each of these new strata as only one year of survey data was available to model. Should these strata continue to be included in future surveys then the optimization could be run on past survey catch rates now that there is more than one year of survey data to use as input.

This report details the 2019 trawl survey design and methods and provides relative biomass estimates for commercially important species managed under the Quota Management System (QMS). The trawl survey time series of relative biomass estimates for key inshore species provide information used for stock assessment and fisheries management advice.

This report fulfils the final reporting requirement of Fisheries New Zealand project INT2018-01.

## 1.1 Programme objective

To determine the relative abundance and distribution of inshore finfish species off the west coast of the South Island, and Tasman Bay and Golden Bay; focusing on red cod (*Pseudophycis bachus*), red gurnard (*Chelidonichthys kumu*), giant stargazer (*Kathetostoma giganteum*), tarakihi (*Nemadactylus macropterus*), John Dory (*Zeus faber*), and spiny dogfish (*Squalus acanthias*).

### Specific project objectives

1. To determine the relative abundance and distribution of red cod, red gurnard, giant stargazer, tarakihi, John dory and spiny dogfish off the west coast of the South Island from Farewell Spit to the Haast River mouth, and within Tasman Bay and Golden Bay by carrying out a trawl survey. The target coefficients of variation (CV) of the biomass estimates for these species are as follows: red cod (20–25%), red gurnard (20%), giant stargazer (20%), tarakihi (20%) and spiny dogfish (20%).

2. To collect the data and determine the length frequency, length-weight relationship and reproductive condition of red cod, red gurnard, giant stargazer, tarakihi, John Dory and spiny dogfish.

3. To collect otoliths from red gurnard, giant stargazer, tarakihi and red cod.

4. To collect the data to determine the length frequencies of all other Quota Management System (QMS) species.

5. To complete experimental trawl stations for snapper in Tasman/Golden Bays including the collection of otoliths from snapper.

6. To collect data to underpin the development of assessment and monitoring capabilities for biodiversity and ecosystems.

7. To present biomass trends and size composition information for all QMS species for which the WCSI survey reliably monitors relative abundance trends.

## 2. METHODS

### 2.1 Survey area and design

The survey was a two-phase stratified random survey after Francis (1984). The survey area covered depths of 20–200 m off the west coast of the South Island from Cape Farewell to Karamea; 25–400 m from Karamea to Cape Foulwind; 20–400 m from Cape Foulwind to the Haast River mouth; and 10–70 m within Tasman and Golden Bays inside a line drawn between Farewell Spit and Stephens Island (Figure 1a–b). The maximum depth on the west coast north of Karamea was limited to 200 m because of historically low catch rates in the 200–400 m range.

The survey area of 25 595 km$^2$, including untrawlable ground, was divided into 18 strata by area and depth (Table 1, Figure 1a–b). The core strata (strata 1–19) were identical to those used in previous surveys in the time series and two strata in the 10–20 m depth range in Tasman and Golden Bays were the same as those introduced in the previous survey in 2017. Eighty-four percent of the total survey area was trawlable ground.

Phase one station allocation was optimised using the R (R Core Team 2017) function *allocate* (Francis 2006) to achieve the target CVs. The *allocate* function uses stratum area and catch rate data from previous trawl surveys in the time series to simulate optimal station allocation for a given target CV. Simulations were run for each target species separately. Based on the simulation results, the survey plan was to carry out 61 phase one stations in the core strata to provide CVs of 30% for snapper, 25% for red cod and 20% for all other target species. An allocation of eight stations for the two 10–20 m strata (solely for snapper) was based on the allocation used in 2017, as two or more surveys were required to run allocate on past survey catch rates. The 2017 allocation for the 10–20 m strata was based on available survey time as modelling commercial catch data required more stations than there was time available for.

Station positions were randomly generated using NIWA's custom software 'RandomStation'. The stations were required to be a minimum of 5.6 km (3 nautical miles) apart. Non-trawlable ground was identified before the voyage from data collected during previous trawl surveys in the area, and that ground was excluded from the station allocation program.

### 2.2 Vessel, gear, and trawling procedure

RV *Kaharoa* is a 28 m stern trawler with a beam of 8.2 m, displacement of 302 t, engine power of 522 kW, and capable of trawling to depths of 500 m. The two-panel trawl net used during the survey was designed and constructed in 1991 specifically for South Island inshore trawl surveys. The net was fitted with a 60 mm knotless codend (inside measurement). Details of the net design were given by Beentjes & Stevenson (2008). Gear specifications were the same as for previous surveys (Drummond & Stevenson 1996).

Procedures followed those recommended by Stevenson & Hanchet (1999). All tows were undertaken in daylight, and four to five tows a day were planned. For each tow the vessel steamed to the station position and, if necessary, the bottom was checked with the echosounder to determine trawlability. Once the station was considered trawlable, the gear was shot away so that the midpoint of the tow would coincide as closely as possible with the position generated by RandomStation. The direction of the tow was influenced by a combination of factors including weather conditions, tides, bottom contours, and the location of the next tow, but was usually in the direction of the next station.

If the station was found to be in an area of foul ground or the depth was out of the stratum range, an area within 5 km of the station was searched for a replacement tow path. If the search was unsuccessful, the station was abandoned and the next alternative station within the stratum was chosen from the random station list. Standard tows were one hour duration at a speed over the ground of 3 knots and the distance covered was measured by GPS. The tow was deemed to have started when the net monitor indicated that the net was on the bottom and was completed when hauling began. A warp length of 200 m was used for all tows less than 70 m depth. At greater depths, the warp to depth ratio decreased linearly to about 2.4:1 at 400 m.

## 2.3 Water temperatures

The surface and bottom temperatures at each station were recorded by a calibrated Seabird Microcat CTD unit. Surface temperatures were taken at a depth of 5 m below the surface. Bottom temperatures were taken at about 5 m above the sea floor because the CTD is attached just behind the headline.

## 2.4 Catch and biological sampling

The catch from each tow was sorted into species on deck and weighed on electronic motion-compensating Marel scales to the nearest 0.1 kg. Organisms were identified to species where possible. Crustaceans, shellfish, and other invertebrate species not readily identified were frozen for later identification on shore. Unidentified specimens were placed in sealed plastic bags with a label noting the trip code and station number.

Length, to the nearest whole centimetre (cm) below the actual length, and sex (where possible) were recorded for all species managed under the QMS and a selection of non-QMS species, either for the whole catch or a randomly selected subsample of up to 200 fish per tow. For target species, more detailed biological examinations were carried out on a sub-sample of up to 20 fish per tow. This included individual fish weight (grams), length to the nearest millimetre (mm), sex, and gonad stage. Otoliths were also removed for later ageing for red cod, red gurnard, giant stargazer, snapper, and tarakihi.

## 2.5 Data analysis

Biomass estimates and population scaled length-frequency distributions and their associated CVs were estimated by the area-swept method (Francis 1981, 1989) using the SurvCalc Program (Francis & Fu 2012). All data were entered into Fisheries New Zealand's *trawl* database.

The following assumptions were made for calculating biomass estimates with the SurvCalc Programme:

1. The area swept during each tow equalled the distance between the doors multiplied by the distance towed.
2. Vulnerability was 1.0. This assumes that all fish in the area swept were caught and there was no escapement.
3. Vertical availability was 1.0. This assumes that all fish in the water column were below the headline height and available to the net.

4. Areal availability was 1.0. This assumes that the fishstock being sampled was entirely within the survey area at the time of the survey.
5. Within the survey area, fish were evenly distributed over both trawlable and non-trawlable ground.

None of these assumptions are likely to be correct, but were adopted for all the trawl survey time series of relative biomass (Stevenson & Hanchet 1999). Given that the assumptions are likely to be violated, trawl survey series are input to stock assessments as relative indices of abundance.

In the core strata, 68 stations from phases one and two were used for biomass estimation where gear performance was satisfactory (gear performance of 1 or 2). For snapper, biomass estimates are reported separately for the core strata and for all strata including the additional strata 20 and 21. Where strata 20 and 21 are included for snapper, the total number of stations is 69 (61 phase one stations from the core strata and eight phase one stations from the 10–20 m strata). Phase two stations for the core strata are not included for snapper as the Southern Inshore Working Group agreed that by the time phase two commences snapper are likely to have begun migrating out of the survey area. Further evidence of this was demonstrated in the 2017 survey when the length frequency distribution of snapper from phase two stations in outer Tasman Bay (allocated to reduce the CV of spiny dogfish) showed a shift to smaller snapper than the length frequency distribution from phase one (Stevenson & MacGibbon 2018). Biomass estimates for all other species do not include data from strata 20 and 21.

Length frequencies were scaled by the percentage of catch sampled, area swept, and stratum area. The geometric mean functional relationship was used to calculate the length-weight coefficients for species where sufficient length-weight data were collected on the 2019 survey. For other species, coefficients were chosen from the *rdb* database based on whether there were coefficients for a given species from previous surveys in this time series or on the best match between the size range of the fish used to calculate the coefficients in *rdb* and the sample size range from this survey (Appendix 1).

Sex ratios were calculated using scaled population numbers and are expressed as the ratio of males to females.

# 3. RESULTS

## 3.1 Timetable and personnel

RV *Kaharoa* departed Wellington on 22 March and began trawling in Tasman Bay the following day. Twenty-four phase one stations in Tasman and Golden Bays were successfully completed by 29 March during which time fish was unloaded to Talley's Nelson on 25 March. Fishing commenced on the west coast of the South Island on 30 March and continued until 5 April when the vessel docked in Nelson to unload fish and exchange three scientific staff members. Fishing resumed on 6 April and phase one was completed on 13 April at which point phase two commenced. Phase two was completed on 15 April when the vessels began steaming for Nelson. RV *Kaharoa* docked in Nelson on 16 April for the final unload of fish to Talley's Nelson and remained in Nelson for essential maintenance.

Dan MacGibbon was voyage leader and was responsible for final database editing. The skipper was Lindsay Copland. The project manager was Dan MacGibbon.

A total of 61 core phase one stations were completed. Seven phase two stations were carried out in stratum 15 (one station), stratum five (three stations), and stratum one (three stations). This was to reduce the CV for tarakihi (strata 1 and 15) and red cod (stratum 5). A minimum of three stations were completed in all core strata. Four phase one stations were carried out in the 10–20 m strata in Tasman and Golden Bays to give a total of 76 valid trawl stations for the entire survey. Two other stations were not used for biomass estimation: one was a gear trial shot to test out the new Marport net monitoring and door spread sensor system, and the other was rejected for poor performance after catching part of a tree which put several turns in the lengthener of the trawl.

The survey area, with stratum boundaries and station positions, is shown in Figures 1a and 1b and individual station data are given in Appendix 2.

A summary of gear and tow parameters by depth are shown in Table 2. Doorspread ranged from 67.4 to 99.2 m and headline height varied between 4.1 and 4.9 m (Table 2, Appendix 2). Measurements of headline height and doorspread, together with bottom contact sensor output and observations that the doors and trawl gear were polishing well, indicated that the gear was operating correctly. Overall, gear parameters were similar to those of previous years, indicating consistency between surveys (Stevenson & Hanchet 2000).

### 3.2 Catch composition

A total of about 37.6 t of fish and invertebrates were caught from the 76 valid biomass tows at an average of 494.1 kg per tow. Amongst the fish catch, 18 chondrichthyan and 74 teleost species were recorded. Species codes, common names, scientific names, and catch weights of all species identified during the survey are given in Appendix 3. Benthic macro-invertebrate species identified from the catch are given in Appendix 4.

The most abundant species by weight was spiny dogfish with 5.9 t caught (16% of the total catch). The top five species by catch weight: spiny dogfish (*Squalus acanthias*), snapper (*Pagrus auratus*), barracouta (*Thyrsites atun*), red gurnard (*Chelidonichthys kumu*), and giant stargazer (*Kathetostoma giganteum*) made up 53% of the total. The target species giant stargazer, red cod (*Pseudophycis bachus*), red gurnard, spiny dogfish and tarakihi (*Nemadactylus macropterus*) made up 38% of the catch. Spiny dogfish, arrow squid (*Nototodarus sloanii* and *N. gouldi*), barracouta, school shark (*Galeorhinus galeus*), red gurnard, and witch (*Arnoglossus scapha*) all occurred in over 70% of the tows.

Forty-five species or species groups of benthic macro-invertebrates were identified during the survey or from retained specimens (Appendix 4). The number of invertebrate species does not necessarily reflect biodiversity in the survey area because the gear is not designed to collect benthic macroinvertebrates. In addition, station location strongly influences the incidence of some groups. For example, some bryozoans prefer hard substrate, so if no trawl station fell on such substrate then this group may not be represented in the catch.

### 3.3 Catch rates and species distribution

Distribution by stratum and catch rates for the target species are shown in Figures 2a–2f. Catch rates are given in kilograms per square kilometre.

Giant stargazer catch rates were highest in the 100–200 m strata (Figure 2a), south of Greymouth. Catches north of Cape Foulwind and in the Tasman and Golden Bay region were low.

Red cod catch rates were highest in the 30–100 m strata on the west coast from Cape Foulwind south (Figure 2b), followed by 100–200 m strata. Catch rates in the 200–400 m strata on the west coast and in Tasman and Golden Bays were low in comparison.

Red gurnard catch rates were highest in the 30–100 m strata on the west coast and in Tasman and Golden Bay (Figure 2c). All stations less than 100 m contained red gurnard. Catch rates in the 100–200 m strata were almost non-existent and no red gurnard were caught in the 200–400 m strata.

Spiny dogfish were caught throughout the survey area and were present in 80% of stations. The highest catch rates for spiny dogfish were from the 30–100 m strata on the west coast (Figure 2d). Catch rates were lower in the 100–200 m strata, and lowest in the 200–400 m strata.

Snapper catch rates were highest in Tasman and Golden Bays, in particular in stratum 21 (10–20 m inner Golden Bay) (Figure 2e). Catch rates were lower in outer Tasman Bay and in the 30–100 m strata on the upper west coast. Catches were almost non-existent south of Cape Foulwind.

Highest overall catch rates for tarakihi were in the south of the west coast area between Greymouth and Haast in the 100–200 m strata (Figure 2f). There was one single large catch in stratum 1 near Farewell Spit which necessitated phase two stations there to reduce the tarakihi CV. Catch rates were lower in Tasman and Golden Bays compared to the previous survey.

Mean catch rates by stratum for the 20 most abundant QMS species are given in Table 3.

### 3.4 Biomass estimation

References to 'biomass' are to relative abundance estimates unless otherwise stated.

Biomass estimates for QMS species caught in all surveys in the series are given in Table 4. Estimated biomass and coefficients of variation (CV) for the target species in 2019 were: giant stargazer, 2081 t (18%); red gurnard, 1642 t (16%); red cod, 666 t (23%); snapper (core strata), 972 t (14%); snapper (all strata), 1316 t (12%); spiny dogfish, 4031` t (22%); tarakihi, 1094 t (19%); and John dory 274 (31%).

Recruited lengths and biomass estimates for the following species are given in Table 5: barracouta, blue warehou (*Seriolella brama*), giant stargazer, John dory, ling (*Genypterus blacodes)*, red cod, red gurnard, rig (*Mustelus lenticulatus*), snapper (all strata), school shark, and tarakihi. Estimates of total recruited biomass for giant stargazer, red cod, red gurnard, snapper and tarakihi were 99%, 57%, 66%, 95% and 97% of the total biomass respectively. Recruited lengths were determined following discussions with the commercial fishing industry and reflect the minimum lengths considered desirable for sale to the public; they are often the minimum legal sizes previously set for fishery management (but not all species have minimum legal sizes).

Biomass estimates by year class (where they were discernible from the length frequency distributions) for barracouta, blue warehou, red cod, red gurnard, school shark, snapper and tarakihi are given in Table 6. For red cod, the 1+ cohort made up 24% of the total biomass. While this has increased from the 2017 estimates (when it comprised 7% of the total biomass), this estimate is well below previous surveys estimates when the 1+ year class made up more than 60% of the total biomass for red cod. For red gurnard, the 1+ cohort made up 20% of the total biomass. The 1+ cohort for snapper comprised 6% of the total biomass. For tarakihi the 0+ and 1+ cohorts made up 0.4% and 1% of the total respectively.

The biomass estimates and CVs for the 20 most abundant QMS species are given by stratum in Table 7.

Trends in biomass for selected species are shown in Figure 3 and discussed in Section 3.7.

### 3.5 Length frequency and biological data

Length frequencies and biological samples taken during the survey are given in Table 8. Comparative population scaled length frequency distributions for the target species and for the eight other species monitored by the survey are shown in Figures 5a–n. Length frequency distributions are presented in alphabetical order by common name.

Length-weight coefficients were determined for giant stargazer, John dory, red cod, red gurnard, snapper, spiny dogfish, and tarakihi from data collected on this survey (Appendix 1).

Ageing material collected included 289 pairs of otoliths from giant stargazer, 431 from red cod, 489 from red gurnard, 372 snapper, and 440 from tarakihi (Table 8).

Details of maturity stages for giant stargazer, red cod, red gurnard, snapper, and tarakihi are given in Table 9a and maturity stage details for spiny dogfish are given in Table 9b and are discussed in Section 3.6.

## 3.6 Trends in target species

### 3.6.1 Giant stargazer

Giant stargazer were caught at 36 stations, with the highest catch rates south of Greymouth at depths of 100–200 m (strata 12, 14, and 15) (Figure 2a, Table 3). The biomass was fairly constant for the first four surveys but declined in 2000 and again in 2003 to a low of 834 t. The biomass has steadily increased since, with the highest estimate (2118 t) in 2013. The biomass estimate for 2017 declined to 1674 t, which is nearer the average for the time series (1546 t), but increased to the second highest estimate in the time series (2081 t) in 2019 (Table 4, Figure 3). As in previous years, most of the biomass was from the west coast South Island region, with Tasman and Golden Bays contributing little of the total biomass (Figure 4). Eighty-five percent of the biomass was caught south of Cape Foulwind, and 82% was from the 100–200 m depth range (Table 7). About 95% of the biomass was adult fish (over 45 cm, 1968 t) (Table 5, Figure 5d, Figure 6). Males made up slightly more of the juvenile biomass than females (Figure 7). For adult biomass in most years, females comprised more of the total biomass than males but in 2019 the male biomass was slightly higher. Adult and juvenile indices track each other fairly closely in most years. However, in 2019 juvenile biomass declined slightly compared with 2017 and adult biomass increased substantially.

There were fewer fish under 45 cm caught on the 2019 survey than in 2017, and only three surveys have caught fewer fish under 45 cm than the 2019 survey: 1992, 1994, and 2003 (Figure 5d). As in other years few fish larger than 45 cm occur in the Tasman and Golden Bay region (Figure 5d) with the 2019 survey being particularly low with just three fish over 40 cm being caught. No obvious year class modes were apparent in the length frequency distribution, though there are possibly two juvenile modes at 9–12 cm and 20–25 cm. The sex ratio (male:female) was 1.67:1 overall (Figure 5d), up from the 2017 survey (1.21:1). Nearly all females shorter than 50 cm were immature or had resting gonads, but above this size, most had maturing gonads. There were also a small number of spent fish. Most males under 40 cm were immature or resting, and most males over 40 cm were maturing (Table 9a). The survey takes place in autumn; the spawning period of giant stargazer is believed to be in winter so it is not unexpected to observe some spawning activity in autumn.

### 3.6.2 Red cod

Red cod were caught at 43 stations, with the highest catch rates in strata 5, 11 and 15 (Figure 2b, Table 3). Total biomass estimates were fairly stable for the first four surveys varying from 2546 t to 3370 t. There was a sharp decline in 2000 to 414 t but the biomass gradually increased to 2782 t in 2009. The biomass estimate of 666 t from the 2019 survey is the second lowest in the time series and is part of an overall declining trend since 2009 (Table 4, Figure 3). The biomass came almost entirely from the west coast with, little from the Tasman and Golden Bay region (Figure 4).

Population numbers were lower than in 2017 by around 10% with most of the reduction coming from fish greater than 23 cm (Figure 5h). Numbers of 0+ fish (smaller than 23 cm) were higher than in 2017. The continued low numbers of 1+ fish (25–40 cm) from this survey may be significant for the commercial fishery in 2019–20 given the dependence on recruitment (Beentjes 2000). The estimated biomass in Tasman and Golden Bays totalled 16 t. Seventy percent of the total biomass was from five strata (5, 11, 12, 14 and 15) and 90% was from depths less than 200 m (Table 7). Adult biomass (over 50 cm) was 237 t, about 36% of the total (Table 5, Figures 6, and 7). In most years juvenile males have been more abundant than juvenile females and adults of both sexes and adult males have historically contributed the least to total biomass (Figure 7). Adult and juvenile indices previously tracked each other fairly closely. The sex ratio was 1.33:1 overall (Figure 5h). Almost all red cod examined had immature or resting gonads, but a few larger fish were ripening or running ripe (Table 9a). Since red cod spawn from late winter to spring (Ministry of Fisheries 2009), the lack of fish with maturing or ripe gonads was not unexpected.

### 3.6.3 Red gurnard

Red gurnard were caught at all stations in Tasman and Golden Bays, and all stations in depths less than 100 m along the west coast (Figure 2c). The highest catch rates were in strata 5, 7, and 19 (Table 3). The biomass estimates were consistent from 1992–2000 but showed a sharp decline in 2003. There was a steady increase over the last five surveys and the estimate for 2019 (1642 t) was the third highest in the time series and only slightly lower than 2017 and the time series high of 1776 in the 2015 survey (Table 4, Figure 3). A significant proportion of the biomass has always occurred in the Tasman and Golden Bay region, but from 2011–2017 more came from the west coast South Island (Figure 4). In 2019, however, markedly more biomass was recorded in Tasman and Golden Bays.

The length frequency distribution was similar to 2013–2017 although there were more larger fish (over 30 cm) in Tasman and Golden Bays and fewer larger fish from the west coast (Figure 5i). There were also more smaller fish from the west coast than in most previous years. The estimates of recruited and adult biomass (30 cm or greater) was 1079 t (66% of the total biomass) with equal amounts coming from the west coast and Tasman and Golden Bays region (540 t each) (Table 5). The majority of the biomass is adult biomass (1079 t, equal to the recruited biomass) (Table 8). Juvenile males contribute more to the biomass than do juvenile females, but adult biomass is generally even between the sexes, although this in not the case for 2017 and 2019 (Figure 7). Adult and juvenile indices track each other fairly closely, although in 2019 the adult female biomass had decreased, whereas adult males and juveniles of both sexes had increased, so the slight biomass decrease in 2019 when compared with 2017 comes entirely from the adult female population. Almost all (99%) the red gurnard biomass was in depths less than 100 m (Table 7). The overall sex ratio has increased in favour of males to 1.36:1 compared with 1.06:1 in 2017 (Figure 5i). Most red gurnard longer than 30 cm and a few smaller fish (particularly males) had developing or mature gonads (Table 9a). Red gurnard have a long spawning period and ripe individuals can be found in the Hauraki Gulf throughout the year, so the presence of fish with developing gonads is not surprising (Ministry of Fisheries 2009).

### 3.6.4 Snapper

Large numbers of 1+ snapper (around 14–19 cm) were caught on the 2009 survey (Figure 5l) (Stevenson & Hanchet 2010) and this appeared to indicate a strong year class of fish spawned over the summer of 2007–08. In each survey since 2013, this year class has been dominant in the length frequency distribution. The mode is no longer as clear as it once was and probably contains fish from the 2011 year class which was also relatively strong (Parker et al. 2015) and 2013 year class which was also strong (Parsons et al. 2018). The 2019 biomass estimate for snapper from the core strata was 972 t and combined with the 10–20 m strata was 1316 t (Table 4). This is a time series high for the core strata, and is the higher of the two estimates now available for the core + 10–20 m survey, an increase of 66% relative to the 2017 estimate.

The highest catch rates were again in the two Golden Bay strata (17 and 21) followed by the 10–20 m stratum in Tasman Bay (stratum 20). Phase two stations were not included in the biomass estimates because snapper are known to begin moving out of the bays by the time phase two is underway. A comparison of the length frequency distributions in stratum 19 between fish caught during phase one and fish caught during phase two showed that the latter caught more small fish and fewer large fish, despite a similar geographic spread of stations across the stratum (Stevenson & MacGibbon 2018).

For 2019, the length frequency distribution shows the strongest ever 1+ peak in the time series at around 13–22 cm (note the much larger y-axis in 2019 compared with other years) (Figure 5l). There appear to be no 2+ fish in the distribution with almost no fish whatsoever between 22 and 29 cm. The rest of the distribution shows no clear modes but is likely to comprise a number of year classes. There is also possibly another mode of 0+ fish under 13 cm. Almost all snapper of both sexes were immature or resting (more than 99%) (Table 9a). Since snapper spawn in summer maturing or ripe fish were not expected during the survey which takes place in autumn.

### 3.6.5 Spiny dogfish

Spiny dogfish were caught at 61 stations with the highest catch rates in strata 12 and 15 (Table 3, Figure 2d). The biomass estimates were relatively stable from 1992 to 2007 but there was a sharp increase in 2009 to 10 270 t. This was mainly due to a single large catch and so the associated CV was high (Table 4, Figure 3). The 2011 biomass was similar to the rest of the time series, decreasing to 6154 t, the 2013 estimate was the highest in the time series at 15 086 t, but the biomass for 2015 decreased to 7613 t and even further in 2017 to 3255 t, the lowest estimate in the series. The 2019 estimate was slightly higher at 4031 t. The decrease has come almost entirely from the west coast strata; biomass from Tasman and Golden Bays has been relatively stable and low in comparison to the west coast strata over the time series (Figure 4). The associated CV for the 2019 biomass estimate was 22%.

Overall numbers of spiny dogfish have increased in 2019 although there was a decrease in the proportion of fish under 40 cm (Figure 5m). Adult and juvenile biomass were roughly even (Table 5, Figure 6). Juvenile males have historically made up the smallest portion of the total biomass but in 2019 adult females contribute the least. Juvenile female and adult male biomass are about the same (Figure 7). Adult and juvenile indices track each other fairly closely through the time series. Over 83% of the biomass was at depths less than 200 m (Table 7). The sex ratio was almost even between males and females at 1.08:1 overall (Figure 5m). Maturity stages for spiny dogfish are shown in Table 9b. Most males were mature (59%) and most females were immature or maturing (approximately 65%). Twenty-six percent of all females contained pups compared to 41% in 2017. All males less than 40 cm and all females less than 50 cm were immature.

### 3.6.6 Tarakihi

Tarakihi were caught at 50 stations with the highest catch rates in strata 14, 15 and 16 (Table 3, Figure 2e). The biomass estimates show a gradually declining trend until 2003 with a sharp increase in 2005 and a subsequent decline in the next five surveys to levels similar to those seen from 1997 to 2003 (Table 4, Figure 3). The biomass estimate from the 2017 survey was the second highest of the series at 1857 t, representing an increase of over 75% from 2015 but the 2019 estimate of 1094 t is similar to the time series mean of 1282 t. Most of the biomass has always been from the west coast region, with little from Tasman and Golden Bays (Figure 4). Almost 97% of the biomass estimate was recruited fish (25 cm or over) while the adult biomass (over 31 cm) made up 81% of the total (Table 5). The juvenile biomass was at a similar level to that seen throughout most of the survey (Figure 6). Adult females have historically contributed most of the total biomass, followed by adult males (Figure 7).

The length frequency data shows a decline in the overall numbers of fish, particularly from Tasman and Golden Bays but also from the west coast (Figure 5n). There appear to be distinct (but not abundant) modes at about 9–15 cm (0+) which are mostly Tasman and Golden Bays fish and 16–20 cm (1+ fish) which are mostly west coast fish. No other cohorts are clearly discernible in the length frequency distribution. Nearly all fish over 25 cm were from the west coast (Table 5). Of the total tarakihi biomass, over 96% was on the west coast (1058 t), and 92% (1011 t) of the total was at depths less than 200 m (Table 7). The male to female sex ratio for the estimated population was 0.52:1, a decrease from a ratio of 0.83:1 in 2017 (Figure 5n). There was little reproductive development in tarakihi under 30 cm, but for bigger fish the full range of gonad stages was recorded, although the majority were still resting or starting to mature (Table 9a). Most males greater than 30 cm were running ripe or spent, but most females greater than 30 cm were still resting or ripening.

### 3.6.7 Trends in other species

*Barracouta*

Barracouta were caught at 56 stations and represented 8.4% of the total catch (Appendix 3). The highest catch rates were in strata 1 and 12 (Table 3). The biomass has varied almost 3-fold during the series but did not show a consistent trend (Table 4, Figure 3). Biomass has been predominately from the west coast region, with little from Tasman and Golden Bays (Figure 4). The 2019 estimate of 2568 t was below average for the series. In most years that had a strong 0+ mode, a large proportion of these fish were from the Tasman and Golden Bay region (Figure 5a). In 2013 however, this mode was almost entirely made up of fish from the west coast. Since then the mode has been substantially weaker than pre-2013 although the relative contribution of Tasman and Golden Bays to the mode increased in 2015 and 2017. Also, there were usually distinct modes centred at about 45 and 55 cm in most years, both of which were all but absent in 2013 and were again weak in 2015. For 2017, the mode at 45 cm appeared much stronger but the 55 cm mode remained weak. Both modes were nearly absent in 2019.

*Blue warehou*

Blue warehou were caught at 25 stations, with the highest catch rates in strata 1 and 15 (Table 3). The biomass estimate for 2019 (312 t) was a substantial decrease from 2017 but still slightly above the time series mean of 278 t (Table 4, Figure 3). Biomass has been predominately from the west coast region (Figure 4) and in 2019 was spread across the coast with the highest catch rates in stratum 1 (northern-most west coast strata) and stratum 15 (southern-most west coast stratum) (Table 7). Catches between these two strata were relatively low, accounting for approximately 26% of the biomass. There was a weak but distinct mode in the 2019 length frequency distribution at 14–17 cm (0+ fish) (Figure 5b). There is another possible mode at around 50–60 cm although this may contain multiple year classes. There are no fish apparent in the length frequency distribution between these two modes. Stevenson & Hanchet (2000) noted that because of the poor precision in the biomass estimates the surveys are probably not suitable for monitoring adult or pre-recruit blue warehou. However, Stevenson (2007b) suggested that the survey may be able to provide information on year class strength, but ageing of the commercial catch would be required to show if this is the case.

*Gemfish*

Gemfish were caught at 23 stations, the second highest number in the time series (Appendix 3, Table 8). The biomass estimate of 559 t was the second highest in the series. Overall, indices did not show any particular trend, though biomass has steadily increased since 2011 (Table 4, Figure 3). Gemfish have never been caught in the Tasman and Golden Bay region (Figure 4). The length frequency distribution on some surveys have shown apparently strong year classes (Figure 5c). The strong 0+ year class from 2017 (17–22 cm) appears to have tracked through to 2019 (now 2+, around 41–55 cm). This is the only distinct year class in the 2019 length distribution.

*Jack mackerel (Trachurus declivis)*

*Trachurus declivis* were caught at 32 stations (Appendix 3). The biomass estimate of 174 t was a large increase from 2017 (58 t), and above the time series mean of 113 t (Figure 3, Table 4). As in previous years, most of the biomass was from the west coast. There appear to be two distinct modes for each area, with some overlap of length classes (Figure 5e). The Tasman and Golden Bay mode appeared to be around 14–18 cm and the west coast mode 16–23 cm. It is possible that they are one mode from 14–23 cm, but it seems unlikely that the two tails of a single mode are present in each of the two areas.

*John dory*

John dory were caught at 40 stations, with the highest catch rates in Tasman and Golden Bays and north of Cape Foulwind (Appendix 3, Table 3). The biomass estimate of 274 t was down from the time series highs in 2015 and 2017 but above the time series mean of 221 t (Table 4, Figure 3). In most years more biomass has been from the west coast (Figure 4), mostly north of Cape Foulwind (Table 7). In 2019, only 26% of biomass was from the Tasman and Golden Bay region, down from 38% in 2017. Total biomass has declined since 2017 in both areas. In 2017 the length frequency distribution showed a mode at 21–32 cm (1+ fish), which was stronger than the 1+ mode from any previous survey in the series (Figure 5f). This does not appear to have translated into higher biomass in 2019, with the right tail of the distribution having lower numbers of fish. The 1+ mode in 2019 (around 23–32 cm) is relatively distinct but not abundant. Most smaller fish were from the Tasman and Golden Bay region, which is typical of most years.

*Ling*

Ling were caught at 30 stations, with the highest catch rates in stratum 16 (Appendix 3, Table 3). The biomass estimate of 316 t was higher than the 2017 estimate and above the time series mean of 259 t (Table 4, Figure 3). As in all other surveys, almost all of the biomass in 2019 was from the west coast region, with little from Tasman and Golden Bays (Figure 4). The 2019 length frequency distribution shows a large mode at around 35–52 cm but low numbers of fish larger than this (Figure 5g).

*Rig*

Rig were caught at 50 stations, with the highest catch rates in strata 5, 17 and 18 (Appendix 3, Table 3). The estimated biomass of 467 t was the fourth highest in the time series (Table 4, Figure 3). Biomass from the Tasman and Golden Bay regions accounted for about 32% of the total in 2019 (Figure 4). The length frequency distributions in 2019 did not show any particularly strong modes but the 0+ mode of fish less than 40 cm is stronger than the rest (Figure 5j). In the survey series, there were often few females measured longer than about 80 cm, compared with relatively abundant large males (up to 100 cm), which may indicate that the survey does not sample adult female rig well.

*School shark*

School shark were caught at 56 stations, with the highest catch rates in strata 5, 15, 17, and 19 (Appendix 3, Table 3). The estimated biomass of 720 t was down from 2017 (933 t) and is also below the time series mean of 961 t (Table 4, Figure 3).  As in previous years most of the biomass was from the west coast (Figure 4). The length frequency distribution for 2019 is less clear than in 2017 but possibly shows two modes at around 30–40 cm and 42–45 cm (Figure 5k). There were fewer large school shark (over 100 cm) caught in the Tasman and Golden Bay region compared to the west coast.

## 4. SURVEY REPRESENTATIVENESS

Representativeness refers to the survey catchability and whether the average biomass estimate over a range of species was within an acceptable range (representative) or was considered extreme (non-representative). This approach was derived from the work by Francis et al. (2001) who examined data from 17 trawl survey time series including the west coast South Island inshore trawl survey time series from 1992 to 2000. The method involves ranking species in order of increasing biomass index, and then averaging across species to obtain a mean rank for each year. This analysis has been updated here to include all surveys, split by Tasman and Golden Bays and the west coast South Island separately.

For Tasman and Golden Bays the analysis shows that catchability was close to the mean of the time series (Figure 8, upper plot). For the west coast South Island, the catchability was also close to the mean (Figure 8, lower plot). This suggests that catchability was normal and the survey can be considered to be representative of the time series.

## 5. CONCLUSIONS

The 2019 ($14^{th}$) survey successfully extended the March-April RV *Kaharoa* time series for the west coast South Island and Tasman and Golden Bays. The 2019 results show that the series continues to monitor the target species and adults and/or pre-recruits and juveniles of several other species well. The biomass estimates for snapper were the highest in the time series and represented a 66% increase from the 2017 survey. The 1+ cohort of snapper is the strongest ever seen in the time series. Most of this has come from 10–20 m strata piloted in 2017, which suggests that these strata should continue to be sampled in the future and are likely to provide information on snapper recruitment. The red gurnard biomass continues to be high with the last three surveys having the three highest estimates and appears to be relatively stable. The giant stargazer biomass was the second highest in the time series. John dory biomass was down substantially from 2017, but still above the time series mean. The red cod biomass was the second lowest in the time series and the low numbers of 1+ fish may have implications for the immediate future of a recruitment-driven fishery. The spiny dogfish biomass also continues to remain low.

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**Table 1: Stratum depth ranges, survey area, non-trawlable area, number of successful phase one and phase two biomass stations and station density.**

| Stratum | Depth (m) | Area (km$^2$) | Non-trawlable area (km$^2$) | No. of phase 1 Stations | No. of phase 2 stations | Station density (km$^2$ per station) |
|---|---|---|---|---|---|---|
| 1 | 20–100 | 1 343 | 102 | 3 | 3 | 224 |
| 2 | 100–200 | 4 302 | 300 | 5 | - | 860 |
| 5 | 25–100 | 1 224 | 0 | 3 | 3 | 204 |
| 6 | 100–200 | 3 233 | 238 | 3 | - | 1 078 |
| 7 | 25–100 | 927 | 0 | 3 | - | 309 |
| 8 | 100–200 | 2 354 | 214 | 4 | - | 589 |
| 9 | 200–400 | 1 877 | 1 456 | 3 | - | 626 |
| 11 | 25–100 | 1 438 | 63 | 5 | - | 288 |
| 12 | 100–200 | 2 054 | 501 | 5 | - | 411 |
| 13 | 200–400 | 1 101 | 466 | 3 | - | 367 |
| 14 | 25–100 | 851 | 36 | 3 | - | 284 |
| 15 | 100–200 | 881 | 373 | 3 | 1 | 220 |
| 16 | 200–400 | 319 | 35 | 3 | - | 106 |
| 17 | 20–33 | 307 | 27 | 3 | - | 102 |
| 18 | 20–42 | 947 | 30 | 5 | - | 189 |
| 19 | 20–70 | 2 436 | 193 | 7 | - | 203 |
| 20 | 10–20 | 217 | 0 | 4 | - | 54 |
| 21 | 10–20 | 165 | 0 | 4 | - | 41 |
| Total | | 25 976 | 4 034 | 69 | 7 | 342 |

**Table 2: Gear parameters for valid biomass stations by depth range (*n*, number of stations; s.d., standard deviation).**

| | *n* | Mean | s.d. | Range |
|---|---|---|---|---|
| **All stations** | 76 | | | |
| Headline height (m) | | 4.5 | 0.15 | 4.1–4.9 |
| Doorspread (m) | | 81.9 | 8.33 | 67.4–99.2 |
| Distance (n. miles) | | 3 | 0.07 | 2.5–3.1 |
| Warp:depth ratio | | 4.3 | 2.54 | 2.3–11.8 |
| **Tasman/Golden Bays** | | | | |
| 10–20 m | 8 | | | |
| Headline height (m) | | 4.6 | 0.21 | 4.3–4.8 |
| Doorspread (m) | | 71 | 2.66 | 67.4–74.7 |
| Distance (n. miles) | | 2.9 | 0.15 | 2.5–3.0 |
| Warp:depth ratio | | 10.8 | 0.68 | 10–11.8 |
| 20–70 m | 15 | | | |
| Headline height (m) | | 4.5 | 0.13 | 4.2–4.7 |
| Doorspread (m) | | 76.3 | 1.36 | 74.2–79.7 |
| Distance (n. miles) | | 3 | 0.03 | 2.9–3.0 |
| Warp:depth ratio | | 5 | 1.31 | 3.4–7.1 |
| 10–70 m | 23 | | | |
| Headline height (m) | | 4.5 | 0.16 | 4.2–4.8 |
| Doorspread (m) | | 74.4 | 3.17 | 67.4–79.7 |
| Distance (n. miles) | | 3 | 0.09 | 2.5–3.0 |
| Warp:depth ratio | | 7 | 3.04 | 3.4–11.8 |
| **West coast** | | | | |
| 20–400 m | 53 | | | |
| Headline height (m) | | 4.5 | 0.15 | 4.1–4.9 |
| Doorspread (m) | | 85.1 | 7.78 | 73.6–99.2 |
| Distance (n. miles) | | 3 | 0.05 | 2.8–3.1 |
| Warp:depth ratio | | 3.1 | 0.91 | 2.3–6.2 |
| 20–100 m | 23 | | | |
| Headline height (m) | | 4.6 | 0.16 | 4.1–4.9 |
| Doorspread (m) | | 77.5 | 2.67 | 73.6–83.3 |
| Distance (n. miles) | | 3 | 0.04 | 2.9–3.1 |
| Warp:depth ratio | | 3.7 | 1.13 | 2.7–6.2 |
| 100–200 m | 21 | | | |
| Headline height (m) | | 4.5 | 0.12 | 4.3–4.7 |
| Doorspread (m) | | 88.9 | 3.49 | 78.7–94.4 |
| Distance (n. miles) | | 3 | 0.05 | 2.8–3.0 |
| Warp:depth ratio | | 2.8 | 0.07 | 2.6–2.9 |
| 200–400 m | 9 | | | |
| Headline height (m) | | 4.5 | 0.16 | 4.3–4.8 |
| Doorspread (m) | | 95.8 | 3.28 | 90.2–99.2 |
| Distance (n. miles) | | 3 | 0.05 | 2.9–3.1 |
| Warp:depth ratio | | 2.5 | 0.09 | 2.3–2.6 |

**Table 3: Mean catch rates (kg km$^{-2}$) by stratum for the 20 most abundant QMS species in order of catch abundance. Species codes are given in Appendix 3.**

| | | | | | | | | | | Species code |
|---|---|---|---|---|---|---|---|---|---|---|
| Stratum | SPD | SNA | BAR | GUR | GIZ | HOK | NMP | SPO | RCO | JMN |
| 1 | 218 | 11 | 345 | 16 | 1 | 0 | 113 | 4 | 0 | 2 |
| 2 | 31 | 2 | 113 | 1 | 0 | 0 | 4 | 0 | 0 | 0 |
| 5 | 140 | 96 | 117 | 258 | 3 | 0 | 9 | 88 | 135 | 18 |
| 6 | 42 | 9 | 123 | 3 | 93 | 0 | 20 | 3 | 0 | 0 |
| 7 | 161 | 3 | 101 | 153 | 0 | 0 | 4 | 39 | 40 | 0 |
| 8 | 228 | 6 | 19 | 3 | 143 | 4 | 91 | 19 | 0 | 0 |
| 9 | 3 | 0 | 0 | 0 | 7 | 0 | 5 | 3 | 0 | 0 |
| 11 | 133 | 2 | 81 | 123 | 73 | 59 | 32 | 34 | 101 | 6 |
| 12 | 586 | 0 | 250 | 1 | 390 | 135 | 112 | 10 | 60 | 0 |
| 13 | 22 | 0 | 0 | 0 | 47 | 7 | 28 | 0 | 10 | 0 |
| 14 | 220 | 0 | 71 | 36 | 173 | 107 | 120 | 14 | 83 | 9 |
| 15 | 837 | 0 | 86 | 1 | 293 | 623 | 160 | 28 | 88 | 20 |
| 16 | 159 | 0 | 7 | 1 | 179 | 140 | 120 | 3 | 57 | 0 |
| 17 | 16 | 1 040 | 4 | 198 | 1 | 0 | 2 | 96 | 0 | 297 |
| 18 | 46 | 219 | 31 | 91 | 0 | 0 | 16 | 68 | 7 | 54 |
| 19 | 66 | 105 | 57 | 323 | 2 | 0 | 8 | 24 | 4 | 97 |
| 20 | - | 551 | - | - | - | - | - | - | - | - |
| 21 | - | 1 367 | - | - | - | - | - | - | - | - |

| | | | | | | | | | | Species code |
|---|---|---|---|---|---|---|---|---|---|---|
| Stratum | SCH | RSO | GSH | FRO | LIN | WAR | SQU | LEA | JDO | SSK |
| 1 | 39 | 0 | 30 | 12 | 2 | 113 | 17 | 0 | 25 | 29 |
| 2 | 7 | 1 | 38 | 16 | 0 | 0 | 48 | 0 | 19 | 5 |
| 5 | 73 | 0 | 4 | 27 | 1 | 17 | 3 | 0 | 5 | 10 |
| 6 | 38 | 4 | 40 | 22 | 4 | 0 | 21 | 0 | 22 | 0 |
| 7 | 17 | 0 | 1 | 14 | 1 | 1 | 5 | 0 | 1 | 0 |
| 8 | 14 | 3 | 24 | 10 | 5 | 4 | 10 | 0 | 5 | 0 |
| 9 | 0 | 87 | 0 | 0 | 3 | 0 | 47 | 0 | 0 | 14 |
| 11 | 29 | 0 | 0 | 4 | 30 | 1 | 3 | 0 | 0 | 2 |
| 12 | 45 | 120 | 13 | 108 | 21 | 12 | 24 | 0 | 0 | 25 |
| 13 | 4 | 70 | 21 | 11 | 71 | 0 | 23 | 0 | 0 | 11 |
| 14 | 15 | 0 | 0 | 6 | 20 | 26 | 18 | 0 | 0 | 0 |
| 15 | 55 | 11 | 31 | 47 | 69 | 90 | 24 | 0 | 0 | 19 |
| 16 | 5 | 123 | 136 | 23 | 115 | 0 | 15 | 0 | 0 | 34 |
| 17 | 50 | 0 | 0 | 0 | 0 | 1 | 1 | 21 | 21 | 0 |
| 18 | 37 | 0 | 0 | 0 | 0 | 1 | 2 | 47 | 12 | 0 |
| 19 | 52 | 0 | 0 | 0 | 0 | 0 | 13 | 115 | 23 | 6 |

NB: Strata 20 and 21 only applicable to snapper.

**Table 4: Relative biomass estimates (t) and CVs by trip from the entire survey area for QMS species. Species codes are given in Appendix 3.**

| Species | KAH9204 | | KAH9404 | | KAH9504 | | KAH9701 | | KAH0004 | | KAH0304 | | KAH0503 | | KAH0704 | | KAH0904 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| code | Biomass | CV | Biomass | CV | Biomass | CV | Biomass | CV | Biomass | CV | Biomass | CV | Biomass | CV | Biomass | CV | Biomass | CV |
| BAR | 2 420 | 15 | 5 228 | 16 | 4 474 | 13 | 2 993 | 19 | 1 787 | 11 | 4 485 | 20 | 2 763 | 13 | 2 582 | 14 | 3 512 | 17 |
| ELE | 21 | 42 | 167 | 33 | 84 | 35 | 94 | 33 | 42 | 63 | 48 | 34 | 59 | 33 | 28 | 53 | 185 | 83 |
| ESO | 68 | 33 | 68 | 16 | 38 | 31 | 45 | 29 | 16 | 32 | 21 | 57 | 27 | 45 | 39 | 71 | 75 | 32 |
| FRO | 24 | 33 | 27 | 23 | 89 | 31 | 259 | 32 | 316 | 16 | 494 | 22 | 423 | 45 | 529 | 39 | 835 | 35 |
| GIZ | 1 450 | 14 | 1 358 | 17 | 1 556 | 16 | 1 450 | 15 | 1 023 | 12 | 834 | 15 | 1 458 | 19 | 1 630 | 13 | 1 952 | 19 |
| GSH | 380 | 17 | 722 | 14 | 767 | 24 | 1 591 | 21 | 2 259 | 8.8 | 544 | 15 | 832 | 22 | 2 215 | 21 | 900 | 17 |
| GUR | 564 | 16 | 551 | 14 | 577 | 19 | 470 | 13 | 625 | 14 | 270 | 20 | 442 | 17 | 553 | 17 | 651 | 18 |
| HAK | 390 | 25 | 99 | 31 | 5 197 | 27 | 1 019 | 46 | 15 | 36 | 55 | 47 | 1 673 | 30 | 359 | 35 | 212 | 56 |
| HOK | 404 | 16 | 826 | 49 | 3 611 | 21 | 1 100 | 25 | 103 | 50 | 233 | 22 | 701 | 55 | 772 | 52 | 1 302 | 46 |
| JDO | 101 | 29 | 73 | 27 | 27 | 36 | 17 | 31 | 141 | 16 | 288 | 19 | 222 | 14 | 174 | 26 | 269 | 23 |
| JMD | 90 | 24 | 97 | 26 | 106 | 20 | 162 | 19 | 168 | 33 | 87 | 21 | 118 | 22 | 62 | 23 | 79 | 23 |
| JMN | 258 | 57 | 68 | 23 | 57 | 29 | 363 | 27 | 194 | 46 | 126 | 49 | 98 | 21 | 214 | 62 | 399 | 24 |
| LEA | 185 | 30 | 230 | 23 | 153 | 34 | 231 | 34 | 236 | 50 | 254 | 18 | 139 | 20 | 252 | 40 | 323 | 27 |
| LIN | 280 | 19 | 261 | 20 | 373 | 16 | 151 | 30 | 95 | 46 | 150 | 33 | 274 | 37 | 180 | 27 | 291 | 37 |
| LSO | 86 | 19 | 77 | 25 | 124 | 21 | 68 | 21 | 59 | 19 | 2 | 44 | 21 | 42 | 119 | 46 | 62 | 16 |
| NMP | 1 351 | 13 | 1 403 | 13 | 1 417 | 10 | 1 087 | 12 | 964 | 19 | 912 | 20 | 2 050 | 12 | 1 189 | 21 | 1 088 | 22 |
| NSD | 130 | 19 | 159 | 21 | 89 | 28 | 164 | 46 | 256 | 18 | 111 | 27 | 180 | 22 | 134 | 29 | 189 | 28 |
| RCO | 2 690 | 13 | 3 370 | 18 | 3 077 | 15 | 2 546 | 23 | 414 | 26 | 906 | 24 | 2 610 | 18 | 1 638 | 19 | 2 782 | 25 |
| RSK | 171 | 25 | 198 | 22 | 250 | 22 | 185 | 31 | 186 | 23 | 43 | 34 | 58 | 30 | 256 | 23 | 114 | 22 |
| RSO | 130 | 19 | 68 | 29 | 21 | 55 | 704 | 83 | 120 | 30 | 137 | 23 | 474 | 49 | 101 | 19 | 143 | 29 |
| SCH | 975 | 21 | 1 176 | 40 | 1 201 | 35 | 1 432 | 25 | 896 | 13 | 655 | 18 | 774 | 14 | 816 | 20 | 1 085 | 16 |
| SFL | 98 | 30 | 203 | 23 | 132 | 28 | 106 | 28 | 62 | 22 | 10 | 33 | 62 | 25 | 67 | 47 | 170 | 32 |
| SNA | 71 | 32 | 15 | 56 | 22 | 47 | 115 | 48 | 21 | 59 | 10 | 93 | 10 | 70 | 56 | 70 | 81 | 58 |
| SPD | 3 856 | 15 | 7 093 | 7.1 | 8 370 | 10 | 5 275 | 13 | 4 777 | 13 | 4 446 | 15 | 6 175 | 12 | 6 291 | 14 | 10 270 | 19 |
| SPE | 233 | 21 | 425 | 18 | 667 | 23 | 338 | 14 | 302 | 22 | 76 | 25 | 150 | 20 | 163 | 19 | 336 | 20 |
| SPO | 286 | 14 | 378 | 10 | 487 | 10 | 308 | 18 | 333 | 18 | 144 | 22 | 153 | 19 | 383 | 33 | 274 | 26 |
| SQU | 2 765 | 18 | 1 195 | 9.2 | 3 467 | 14 | 966 | 13 | 523 | 11 | 2 255 | 12 | 889 | 9.3 | 1 228 | 9 | 402 | 16 |
| SSK | 330 | 18 | 336 | 18 | 315 | 20 | 302 | 26 | 140 | 29 | 91 | 79 | 80 | 30 | 55 | 44 | 67 | 61 |
| SWA | 267 | 37 | 64 | 35 | 39 | 19 | 204 | 20 | 99 | 34 | 69 | 27 | 72 | 28 | 165 | 20 | 80 | 24 |
| WAR | 123 | 40 | 80 | 22 | 113 | 29 | 842 | 31 | 272 | 37 | 191 | 66 | 116 | 40 | 286 | 50 | 175 | 27 |

**Table 4—continued (SNA biomass does not include phase 2 stations)**

| Species | KAH1104 | | KAH1304 | | KAH1503 | | KAH1703 | | KAH1902 | |
|---|---|---|---|---|---|---|---|---|---|---|
| code | Biomass | CV | Biomass | CV | Biomass | CV | Biomass | CV | Biomass | CV |
| BAR | 4 958 | 21 | 3 423 | 16 | 2 662 | 21 | 4 153 | 30 | 2 568 | 15 |
| ELE | 169 | 53 | 110 | 26 | 72 | 45 | 92 | 65 | 61 | 48 |
| ESO | 26 | 42 | 25 | 26 | 92 | 40 | 119 | 20 | 36 | 28 |
| FRO | 251 | 29 | 424 | 24 | 341 | 34 | 518 | 23 | 520 | 22 |
| GIZ | 1 620 | 16 | 2 118 | 9 | 1 984 | 11 | 1 674 | 14 | 2 081 | 18 |
| GSH | 2 348 | 23 | 981 | 23 | 1 211 | 55 | 772 | 37 | 518 | 27 |
| GUR | 837 | 21 | 754 | 12 | 1 776 | 16 | 1 708 | 12 | 1 642 | 16 |
| HAK | 44 | 36 | 36 | 41 | 81 | 37 | 217 | 61 | 111 | 33 |
| HOK | 1 527 | 61 | 1 545 | 43 | 2 129 | 36 | 539 | 62 | 1064 | 41 |
| JDO | 327 | 18 | 231 | 21 | 487 | 16 | 431 | 12 | 274 | 31 |
| JMD | 217 | 37 | 106 | 43 | 43 | 40 | 58 | 23 | 174 | 31 |
| JMN | 95 | 39 | 56 | 35 | 399 | 38 | 156 | 19 | 438 | 19 |
| LEA | 111 | 20 | 231 | 19 | 239 | 30 | 170 | 15 | 333 | 44 |
| LIN | 234 | 43 | 405 | 44 | 472 | 53 | 150 | 18 | 316 | 26 |
| LSO | 62 | 16 | 43 | 37 | 90 | 22 | 85 | 16 | 47 | 11 |
| NMP | 1 331 | 15 | 1 272 | 22 | 1 060 | 17 | 1 857 | 18 | 1 094 | 19 |
| NSD | 368 | 29 | 211 | 26 | 259 | 22 | 180 | 25 | 177 | 47 |
| RCO | 2 055 | 28 | 1 247 | 38 | 989 | 45 | 1 247 | 21 | 666 | 23 |
| RSK | 261 | 21 | 243 | 24 | 150 | 20 | 270 | 21 | 132 | 26 |
| RSO | 101 | 34 | 113 | 28 | 186 | 17 | 545 | 28 | 559 | 22 |
| SCH | 1 099 | 14 | 912 | 12 | 788 | 17 | 933 | 15 | 720 | 20 |
| SFL | 71 | 23 | 48 | 52 | 84 | 33 | 112 | 21 | 26 | 24 |
| SNA (core strata) | 66 | 31 | 277 | 56 | 837 | 32 | 674 | 20 | 972 | 14 |
| SNA (+ 10-20 m) | | | | | | | 791 | 17 | 1316 | 12 |
| SPD | 6 154 | 14 | 15 086 | 57 | 7 613 | 21 | 3 255 | 22 | 4 031 | 22 |
| SPE | 548 | 39 | 161 | 20 | 191 | 21 | 153 | 31 | 133 | 28 |
| SPO | 264 | 20 | 278 | 20 | 622 | 27 | 506 | 33 | 467 | 14 |
| SQU | 153 | 14 | 308 | 14 | 419 | 21 | 280 | 16 | 572 | 29 |
| SSK | 180 | 34 | 188 | 29 | 342 | 25 | 62 | 37 | 204 | 28 |
| SWA | 69 | 32 | 68 | 28 | 109 | 32 | 86 | 22 | 17 | 54 |
| WAR | 263 | 27 | 248 | 22 | 222 | 36 | 646 | 51 | 312 | 45 |

**Table 5: Estimates of recruited biomass (fish length ≥ recruited length) and adult biomass (fish length ≥ 50% maturity length).**

| Species | Recruited length (cm) | Tasman and Golden Bays | | West coast | | Total survey area | | 50% maturity length (cm) | Total survey area | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Biomass | CV % | Biomass | CV % | Biomass | CV % | | Biomass | CV % |
| Barracouta | 50 | 164 | 31 | 2342 | 16 | 2506 | 15 | | | |
| Blue warehou | 45 | 0 | 0 | 305 | 46 | 305 | 46 | | | |
| Giant stargazer | 30 | 4 | 50 | 2072 | 18 | 2076 | 18 | 45 | 1968 | 19 |
| John dory | 25 | 72 | 19 | 202 | 42 | 273 | 31 | | | |
| Ling | 65 | 0 | 0 | 219 | 35 | 219 | 35 | | | |
| Red cod | 40 | 6 | 68 | 376 | 30 | 382 | 30 | 50 | 237 | 32 |
| Red gurnard | 30 | 540 | 28 | 540 | 17 | 1079 | 16 | 30 | 1079 | 16 |
| Rig | 90 | 39 | 35 | 89 | 21 | 127 | 18 | | | |
| Snapper (all strata) | 25 | 1055 | 15 | 190 | 22 | 1246 | 13 | 25 | 1246 | 13 |
| Spiny dogfish (male) | | | | | | | | 58 | 1515 | 31 |
| Spiny dogfish (female) | | | | | | | | 72 | 463 | 22 |
| School shark | 90 | 49 | 54 | 216 | 34 | 265 | 30 | | | |
| Tarakihi | 25 | 17 | 39 | 1044 | 19 | 1061 | 19 | 31 | 882 | 17 |

**Table 6: Biomass estimates (t) by year class estimated from length frequency distributions.**

| Species | Year class | Length range (cm) | Biomass | CV (%) |
|---|---|---|---|---|
| Barracouta | 1 + | 17–28 | 18.0 | 64.6 |
| Blue warehou | 0 + | <19 | 3.2 | 37.4 |
| Red cod | 0 + | <24 | 70.7 | 39.6 |
| | 1 + | 24–34 | 159.0 | 30.1 |
| Red gurnard | 0 + | <18 | 1.0 | 43.6 |
| | 1 + | 18–27 | 324.4 | 14.8 |
| School shark | 0 + | <44 | 14.7 | 32.5 |
| | 1 + | 44–54 | 27.4 | 15.9 |
| Snapper | 1 + | 13–22 | 70.7 | 41.9 |
| Tarakihi | 0 + | 9–15 | 4.5 | 34.8 |
| | 1 + | 16–20 | 11.3 | 32.3 |

**Table 7: Estimated biomass (t) and CV (%) by stratum for the 20 most abundant commercially important species in order of catch abundance. Species codes are given in Appendix 3. –, no data, + less than 0.5 t**.

| | | | | | | | | | Species code | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stratum | SPD | SNA | BAR | GUR | GIZ | HOK | NMP | SPO | RCO | JMN |
| 1 | 293 | 14 | 463 | 21 | 1 | 0 | 152 | 5 | 1 | 2 |
| | (48) | (100) | (29) | (49) | (73) | (0) | (83) | (100) | (90) | (44) |
| 2 | 133 | 10 | 487 | 4 | 0 | 0 | 16 | 0 | 0 | 0 |
| | (54) | (100) | (35) | (100) | (0) | (0) | (65) | (0) | (0) | (0) |
| 5 | 171 | 118 | 143 | 315 | 3 | + | 11 | 107 | 166 | 23 |
| | (46) | (28) | (45) | (32) | (100) | (100) | (98) | (24) | (64) | (92) |
| 6 | 136 | 28 | 398 | 9 | 301 | 0 | 64 | 8 | 0 | 0 |
| | (61) | (52) | (21) | (100) | (97) | (0) | (100) | (100) | (0) | (0) |
| 7 | 149 | 3 | 93 | 142 | 0 | 0 | 4 | 37 | 37 | 0 |
| | (89) | (100) | (94) | (44) | (0) | (0) | (100) | (57) | (64) | (0) |
| 8 | 537 | 15 | 44 | 6 | 338 | 10 | 214 | 46 | + | 0 |
| | (63) | (76) | (61) | (52) | (33) | (100) | (39) | (87) | (100) | (0) |
| 9 | 6 | 0 | 0 | 0 | 14 | 0 | 9 | 5 | 0 | 0 |
| | (100) | (0) | (0) | (0) | (85) | (0) | (50) | (100) | (0) | (0) |
| 11 | 192 | 3 | 117 | 177 | 105 | 84 | 46 | 48 | 146 | 8 |
| | (39) | (100) | (95) | (14) | (83) | (96) | (84) | (11) | (58) | (45) |
| 12 | 1204 | 0 | 514 | 1 | 800 | 277 | 230 | 21 | 124 | 0 |
| | (52) | (0) | (49) | (100) | (19) | (41) | (19) | (71) | (34) | (0) |
| 13 | 24 | 0 | 0 | 0 | 52 | 7 | 31 | 0 | 11 | 0 |
| | (92) | (0) | (0) | (0) | (33) | (7) | (51) | (0) | (48) | (0) |
| 14 | 187 | 0 | 60 | 31 | 147 | 91 | 102 | 12 | 71 | 8 |
| | (38) | (0) | (21) | (45) | (66) | (81) | (91) | (57) | (65) | (26) |
| 15 | 737 | 0 | 76 | 1 | 258 | 549 | 141 | 25 | 78 | 18 |
| | (58) | (0) | (79) | (62) | (34) | (75) | (30) | (38) | (22) | (96) |
| 16 | 51 | 0 | 2 | + | 57 | 45 | 38 | 1 | 18 | 0 |
| | (40) | (0) | (62) | (100) | (10) | (46) | (46) | (100) | (19) | (0) |
| 17 | 5 | 319 | 1 | 61 | + | 0 | 1 | 30 | 0 | 91 |
| | (70) | (11) | (100) | (18) | (100) | (0) | (59) | (41) | (0) | (67) |
| 18 | 44 | 207 | 30 | 87 | 0 | 0 | 15 | 64 | 6 | 51 |
| | (41) | (35) | (56) | (23) | (0) | (0) | (59) | (24) | (98) | (31) |
| 19 | 161 | 255 | 140 | 788 | 4 | 0 | 20 | 57 | 10 | 236 |
| | (33) | (38) | (34) | (30) | (50) | (0) | (32) | (38) | (39) | (19) |
| 20 | - | 120 | - | - | - | - | - | - | - | - |
| | - | (41) | - | - | - | - | - | - | - | - |
| 21 | - | 225 | - | - | - | - | - | - | - | - |
| | - | (30) | - | - | - | - | - | - | - | - |

NB: Strata 20 and 21 are only applicable to snapper

**Table 7–cont'd**

| Stratum | SCH | RSO | GSH | FRO | LIN | WAR | SQU | LEA | JDO | SSK |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Species code |
| 1 | 52 | 0 | 40 | 16 | 3 | 151 | 23 | + | 33 | 39 |
| | (60) | (0) | (57) | (33) | (93) | (87) | (44) | (74) | (27) | (65) |
| 2 | 0 | 29 | 2 | 166 | 69 | 0 | 0 | 207 | 0 | 80 |
| | (0) | (90) | (100) | (38) | (96) | (0) | (0) | (73) | (0) | (95) |
| 5 | 89 | 0 | 5 | 33 | 2 | 21 | 3 | + | 6 | 12 |
| | (72) | (0) | (68) | (96) | (100) | (61) | (90) | (100) | (66) | (64) |
| 6 | 124 | 11 | 128 | 72 | 14 | 0 | 67 | 0 | 71 | 0 |
| | (67) | (59) | (92) | (100) | (100) | (0) | (91) | (0) | (50) | (0) |
| 7 | 15 | 0 | 1 | 13 | 1 | 1 | 4 | 0 | 1 | 0 |
| | (20) | (0) | (100) | (100) | (100) | (100) | (100) | (0) | (100) | (0) |
| 8 | 34 | 7 | 56 | 23 | 13 | 10 | 24 | 0 | 11 | 0 |
| | (34) | (44) | (34) | (80) | (93) | (100) | (48) | (0) | (37) | (0) |
| 9 | 0 | 164 | 0 | 0 | 5 | 0 | 88 | 0 | 0 | 26 |
| | (0) | (59) | (0) | (0) | (100) | (0) | (18) | (0) | (0) | (86) |
| 11 | 42 | 0 | 0 | 6 | 43 | 1 | 5 | 0 | 0 | 3 |
| | (34) | (0) | (0) | (62) | (48) | (59) | (81) | (0) | (0) | (100) |
| 12 | 92 | 247 | 28 | 223 | 43 | 25 | 50 | 0 | 0 | 52 |
| | (13) | (27) | (56) | (20) | (33) | (100) | (40) | (0) | (0) | (61) |
| 13 | 5 | 77 | 23 | 12 | 78 | 0 | 26 | 0 | 0 | 12 |
| | (100) | (52) | (51) | (31) | (87) | (0) | (35) | (0) | (0) | (57) |
| 14 | 13 | 0 | 0 | 6 | 17 | 22 | 15 | 0 | 0 | 0 |
| | (82) | (0) | (0) | (100) | (42) | (75) | (89) | (0) | (0) | (0) |
| 15 | 48 | 10 | 27 | 41 | 60 | 79 | 21 | 0 | 0 | 17 |
| | (38) | (73) | (55) | (48) | (42) | (39) | (38) | (0) | (0) | (100) |
| 16 | 2 | 39 | 44 | 7 | 37 | 0 | 5 | 0 | 0 | 11 |
| | (77) | (23) | (50) | (54) | (67) | (0) | (15) | (0) | (0) | (82) |
| 17 | 15 | 0 | 0 | 0 | 0 | + | + | 6 | 6 | 0 |
| | (79) | (0) | (0) | (0) | (0) | (100) | (100) | (40) | (7) | (0) |
| 18 | 35 | 0 | 0 | 0 | 0 | 1 | 2 | 45 | 11 | 0 |
| | (47) | (0) | (0) | (0) | (0) | (47) | (53) | (67) | (33) | (0) |
| 19 | 126 | 0 | 0 | 0 | 0 | + | 31 | 281 | 55 | 14 |
| | (60) | (0) | (0) | (0) | (0) | (100) | (48) | (51) | (23) | (100) |

**Table 8: Number of biological and length frequency records. Measurement methods; 1, fork length; 2, total length; 5, pelvic length; G, chimaera length. †, data includes one or more of the following: fish length, fish weight, gonad/maturity stage, otoliths. Species codes are given in Appendix 3.**

| | | Length frequency data | | Biological data (†) | | |
|---|---|---|---|---|---|---|
| Species code | Measurement method | No. of samples | No. of fish | No. of samples | No. of fish | No. of otoliths |
| ATT | 1 | 13 | 258 | | | |
| BAR | 1 | 56 | 1 654 | | | |
| BCO | 2 | 16 | 377 | | | |
| BEN | 1 | 1 | 6 | | | |
| BGZ | 2 | 1 | 1 | 1 | 1 | |
| BRA | 5 | 1 | 1 | 1 | 1 | |
| BRI | 2 | 7 | 20 | | | |
| BTS | 5 | 3 | 7 | | | |
| CAR | 2 | 2 | 5 | | | |
| CBI | 2 | 5 | 129 | | | |
| CCX | 2 | 2 | 92 | | | |
| CDO | 2 | 1 | 41 | | | |
| CUC | 1 | 4 | 185 | | | |
| EGR | 5 | 5 | 32 | | | |
| ELE | 1 | 8 | 38 | | | |
| EMA | 1 | 8 | 12 | | | |
| ERA | 5 | 5 | 13 | 3 | 10 | |
| ESO | 2 | 14 | 279 | | | |
| FHD | 2 | 1 | 16 | 1 | 16 | |
| FRO | 1 | 29 | 559 | | | |
| GIZ | 2 | 36 | 899 | 36 | 411 | 289 |
| GSH | G | 29 | 591 | | | |
| GUR | 1 | 55 | 3 634 | 55 | 823 | 489 |
| HAK | 2 | 23 | 598 | | | |
| HAP | 2 | 3 | 3 | | | |
| HEX | 2 | 1 | 1 | | | |
| HOK | 2 | 21 | 1 348 | | | |
| JAV | 2 | 3 | 92 | | | |
| JDO | 2 | 40 | 326 | 40 | 318 | |
| JMD | 1 | 30 | 662 | | | |
| JMM | 1 | 1 | 2 | | | |
| JMN | 1 | 39 | 3 039 | | | |
| KIN | 1 | 11 | 17 | 7 | 11 | |
| LDO | 2 | 1 | 10 | | | |
| LEA | 2 | 18 | 882 | | | |
| LIN | 2 | 30 | 384 | | | |
| LSO | 2 | 41 | 373 | | | |
| NMP | 1 | 50 | 1 872 | 50 | 675 | 440 |
| NSD | 2 | 13 | 46 | 1 | 12 | |
| OPE | 1 | 1 | 44 | | | |
| PCO | 2 | 1 | 22 | | | |

**Table 8 cont'd**

| | | | | | | |
|---|---|---|---|---|---|---|
| RBT | 1 | 7 | 55 | | | |
| RCO | 2 | 43 | 1 903 | 43 | 628 | 431 |
| RHY | 1 | 1 | 3 | | | |
| RMU | 1 | 5 | 12 | | | |
| RSK | 5 | 31 | 122 | | | |
| RSO | 1 | 23 | 634 | | | |
| SCG | 1 | 17 | 829 | | | |
| SCH | 2 | 56 | 581 | 5 | 27 | |
| SDO | 2 | 9 | 311 | | | |
| SEV | 2 | 1 | 1 | | | |
| SFL | 2 | 25 | 364 | | | |
| SNA | 1 | 39 | 2 093 | 39 | 498 | 372 |
| SPA | 1 | 1 | 32 | | | |
| SPD | 2 | 61 | 3 154 | 61 | 1062 | |
| SPE | 2 | 33 | 841 | | | |
| SPM | 1 | 3 | 64 | | | |
| SPO | 2 | 50 | 774 | 6 | 24 | |
| SPZ | 2 | 7 | 23 | 7 | 23 | |
| SRH | 1 | 1 | 4 | | | |
| SSH | 2 | 3 | 12 | | | |
| SSI | 1 | 5 | 85 | | | |
| SSK | 5 | 20 | 35 | 7 | 7 | |
| SWA | 1 | 19 | 132 | | | |
| TRE | 1 | 13 | 282 | | | |
| TUR | 2 | 2 | 6 | | | |
| WAR | 1 | 25 | 235 | | | |
| WIT | 2 | 14 | 331 | | | |
| YBF | 2 | 10 | 66 | | | |
| YBO | 1 | 1 | 2 | | | |
| YEM | 1 | 5 | 115 | | | |

**Table 9: Number of individuals for each of the six target species sampled at each reproductive stage (small fish of undetermined sex were not included). –; no data.**

**a) Teleosts**

| | Male gonad stages | | | | | | | Female gonad stages | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Length (cm) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Total |
| **Giant stargazer** | | | | | | | | | | | | | | | |
| 11–20 | 1 | - | - | - | - | - | - | 1 | - | - | - | - | - | - | 2 |
| 21–30 | 7 | - | - | - | - | - | - | 2 | - | - | - | - | - | - | 9 |
| 31–40 | 16 | - | - | 1 | - | - | - | 4 | - | - | - | - | - | - | 21 |
| 41–50 | 12 | 16 | 23 | 19 | 5 | - | - | 12 | 3 | - | 1 | - | - | - | 91 |
| 51–60 | 2 | 14 | 42 | 31 | 7 | - | 3 | 2 | 10 | 33 | - | - | 1 | 7 | 152 |
| 61–70 | - | 2 | 5 | 5 | - | - | 2 | - | 4 | 77 | 2 | - | 1 | 26 | 124 |
| >70 | - | - | - | - | - | - | - | - | - | 4 | - | - | - | - | 4 |
| Total | 38 | 32 | 70 | 56 | 12 | 0 | 5 | 21 | 17 | 114 | 3 | 0 | 2 | 33 | 403 |
| | | | | | | | | | | | | | | | |
| **Red cod** | | | | | | | | | | | | | | | |
| <20 | 59 | - | - | - | - | - | - | 59 | - | - | - | - | - | - | 118 |
| 21–30 | 110 | 12 | 5 | 1 | 6 | - | - | 32 | 23 | - | - | - | - | - | 189 |
| 31–40 | 32 | 22 | - | 2 | 8 | - | - | 9 | 58 | - | - | - | - | - | 131 |
| 41–50 | 3 | 27 | 6 | 5 | 8 | - | - | - | 31 | - | - | - | - | 1 | 81 |
| 51–60 | 1 | 12 | 5 | 12 | 10 | - | - | - | 46 | 3 | 1 | - | - | 3 | 93 |
| >60 | - | - | - | - | - | - | - | - | 7 | - | - | - | - | - | 7 |
| Total | 205 | 73 | 16 | 20 | 32 | 0 | 0 | 100 | 165 | 3 | 1 | 0 | 0 | 4 | 619 |
| | | | | | | | | | | | | | | | |
| **Red gurnard** | | | | | | | | | | | | | | | |
| <21 | 6 | - | - | - | - | - | - | 5 | - | - | - | - | - | - | 11 |
| 21–30 | 66 | 71 | 7 | 7 | 22 | - | - | 72 | 92 | 7 | 1 | - | - | 4 | 349 |
| 31–40 | 5 | 52 | 17 | 16 | 59 | 5 | 1 | 6 | 95 | 65 | 13 | 3 | 1 | 37 | 375 |
| >40 | - | 5 | 2 | 2 | 6 | 1 | 1 | - | 7 | 28 | 7 | 2 | - | 9 | 70 |
| Total | 77 | 128 | 26 | 25 | 87 | 6 | 2 | 83 | 194 | 100 | 21 | 5 | 1 | 50 | 805 |
| | | | | | | | | | | | | | | | |
| **Snapper** | | | | | | | | | | | | | | | |
| <21 | 65 | - | - | - | - | - | - | 32 | 1 | - | - | - | - | - | 98 |
| 21–30 | 1 | 5 | - | - | - | - | - | - | 2 | - | - | - | - | - | 8 |
| 31–40 | 1 | 28 | - | - | - | - | - | - | 37 | - | - | - | - | - | 66 |
| 41–50 | - | 92 | - | - | 1 | - | - | - | 113 | 1 | - | - | - | - | 207 |
| 51–60 | - | 42 | 1 | - | - | - | - | 1 | 50 | - | - | - | - | - | 94 |
| 61–70 | - | 6 | 1 | - | - | - | - | - | 6 | - | - | - | - | - | 13 |
| >70 | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | 1 |
| Total | 67 | 173 | 2 | 0 | 1 | 0 | 0 | 33 | 210 | 1 | 0 | 0 | 0 | 0 | 487 |
| | | | | | | | | | | | | | | | |
| **Tarakihi** | | | | | | | | | | | | | | | |
| <11 | 1 | - | - | - | - | - | - | 3 | - | - | - | - | - | - | 4 |
| 11–20 | 48 | - | - | - | - | - | - | 42 | - | - | - | - | - | - | 90 |
| 21–30 | 37 | 32 | 1 | - | 2 | - | - | 33 | 46 | 1 | - | - | - | - | 152 |
| 31–40 | 1 | 28 | 7 | 10 | 39 | - | 4 | 2 | 73 | 134 | 6 | 3 | 3 | 9 | 319 |
| >40 | - | - | 5 | - | 4 | - | - | - | 2 | 59 | 5 | 1 | 2 | 5 | 83 |
| Total | 87 | 60 | 13 | 10 | 45 | 0 | 4 | 80 | 121 | 194 | 11 | 4 | 5 | 14 | 648 |

The middle depths gonad staging schedule was used for all teleosts: 1, immature; 2, resting; 3, ripening; 4, ripe; 5, running ripe; 6, partially spent; 7, spent

**Table 9—continued.**

**b) Elasmobranchs**

**Spiny dogfish**

| | Male maturity stages | | | Female maturity stages | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | Total |
| Length (cm) | | | | | | | | | | |
| <31 | 6 | - | - | 7 | - | - | - | - | - | 13 |
| 31–40 | 28 | - | - | 28 | - | - | - | - | - | 56 |
| 41–50 | 53 | 10 | 1 | 70 | - | - | - | - | - | 134 |
| 51–60 | 20 | 38 | 102 | 77 | 25 | 2 | - | - | - | 264 |
| 61–70 | 1 | 42 | 180 | 14 | 24 | 41 | 19 | 42 | - | 363 |
| 71–80 | - | - | 2 | - | 6 | 8 | 19 | 70 | - | 105 |
| >80 | - | - | - | 1 | 1 | 1 | 6 | 10 | - | 19 |
| Total | 108 | 90 | 285 | 197 | 56 | 52 | 44 | 122 | - | 954 |

Maturity stages used were:

Males
1. Immature (Claspers shorter than the pelvic fins)
2. Maturing (Claspers at least as long as the pelvic fins but soft)
3. Mature (Claspers longer than the pelvic fins and hard and firm)

Females
1. Immature (No eggs visible in the ovary larger than about 2 mm in diameter)
2. Maturing (Ovary contains eggs greater than 2 mm in diameter but no yolk apparent)
3. Mature (Yolked eggs in the ovary, uterus small and firm)
4. Ripe ('Candle' of eggs in the uterus, no embryos visible)
5. Running Ripe (Embryos visible in the uterus)
6. Spent (No embryos in the ovary, ovary flabby and may be bloodshot. Yolked eggs may be present in the ovary)

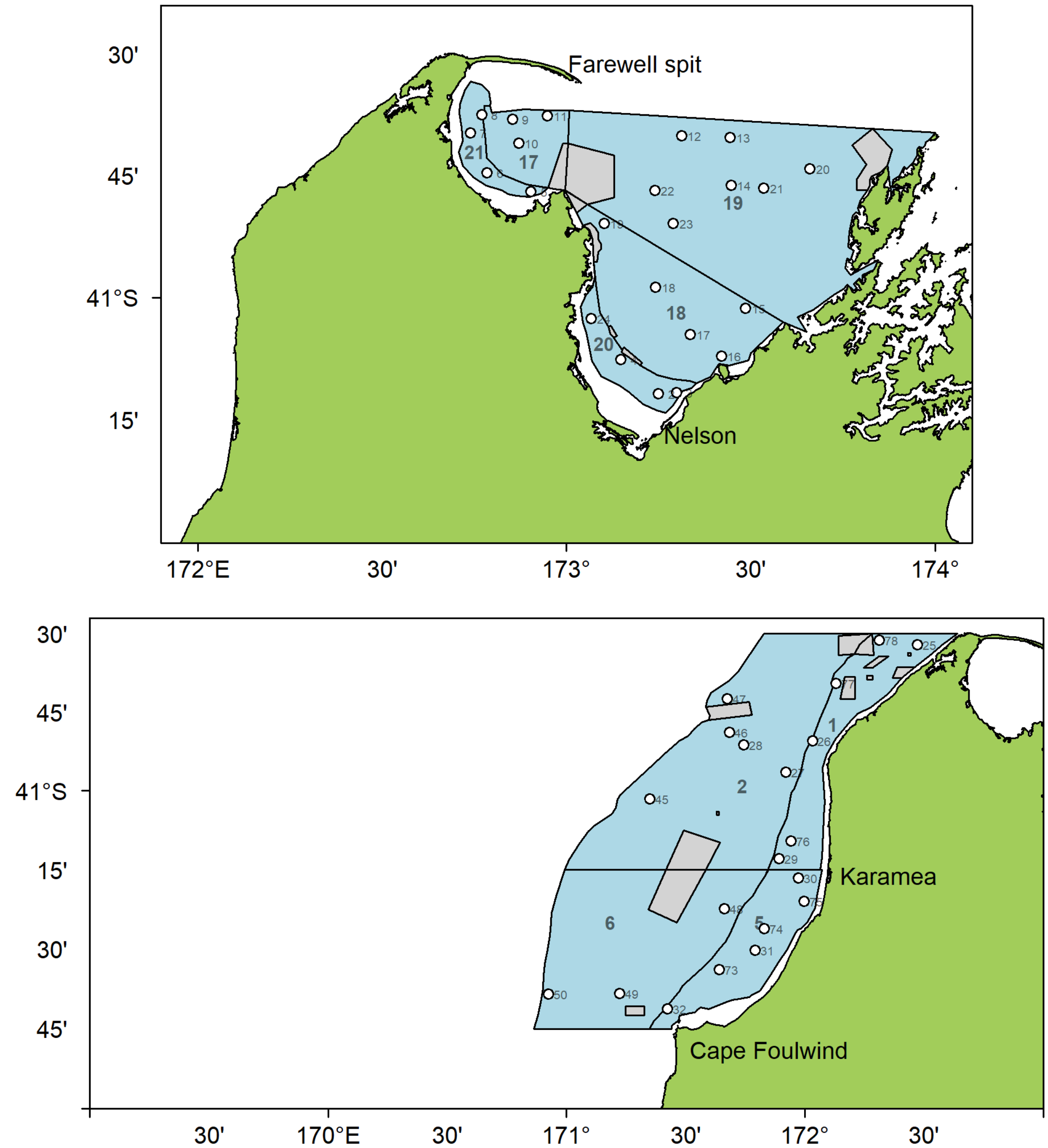



**Figure 1a: Survey area showing stratum boundaries and numbers (bold type) for Tasman and Golden Bays (top) and the west coast north of Cape Foulwind (bottom), with station positions (white circles) and station numbers.**

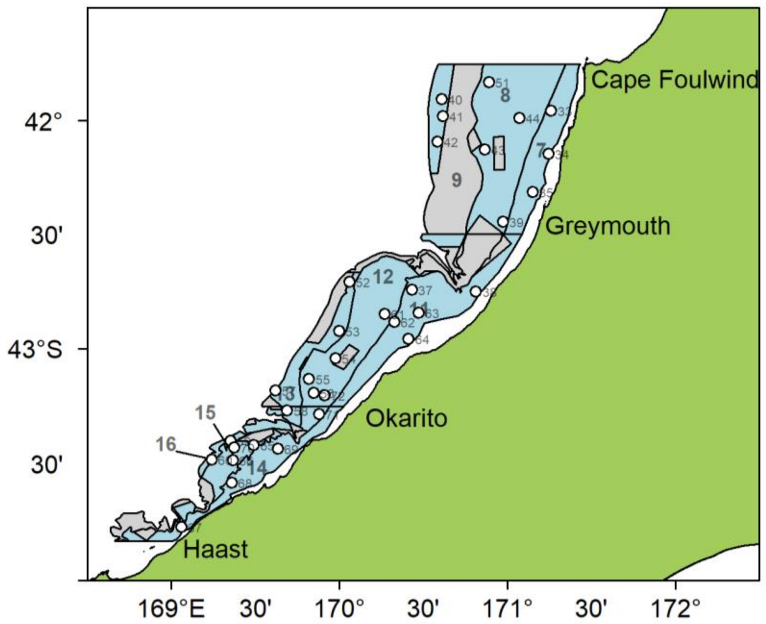



**Figure 1b: Stratum boundaries and numbers (bold type) south of Cape Foulwind with station positions (white circles) and station numbers.**

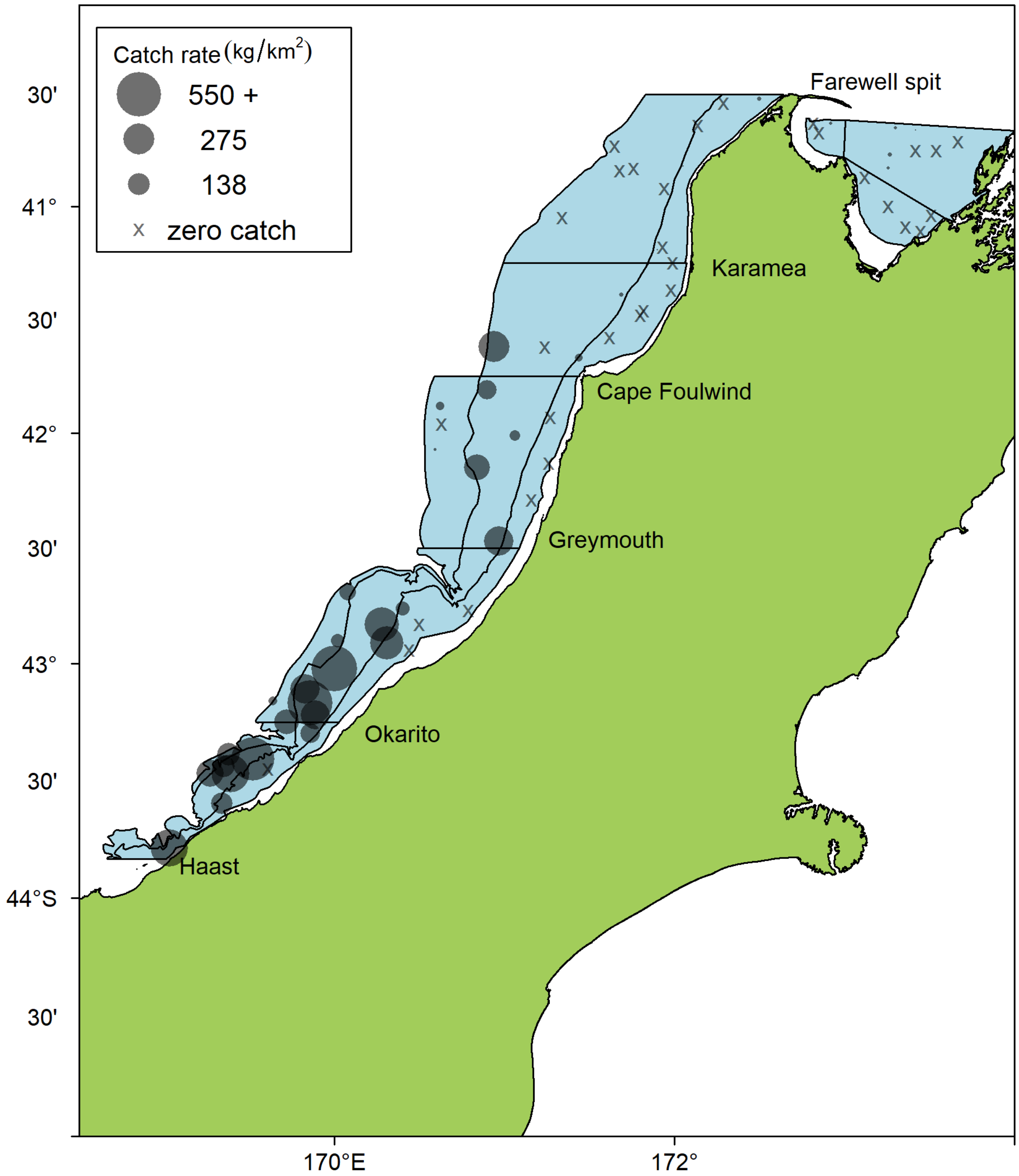
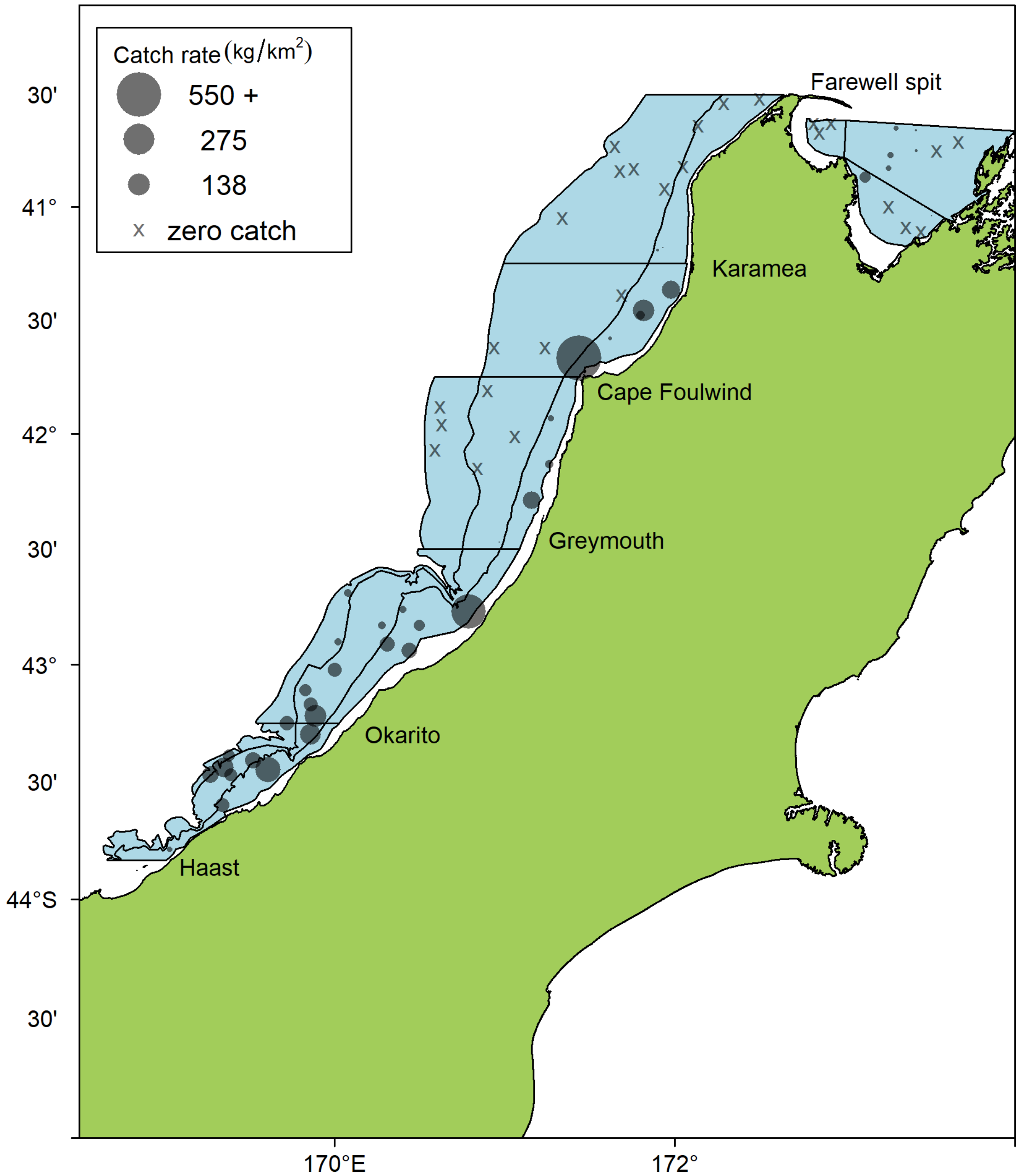
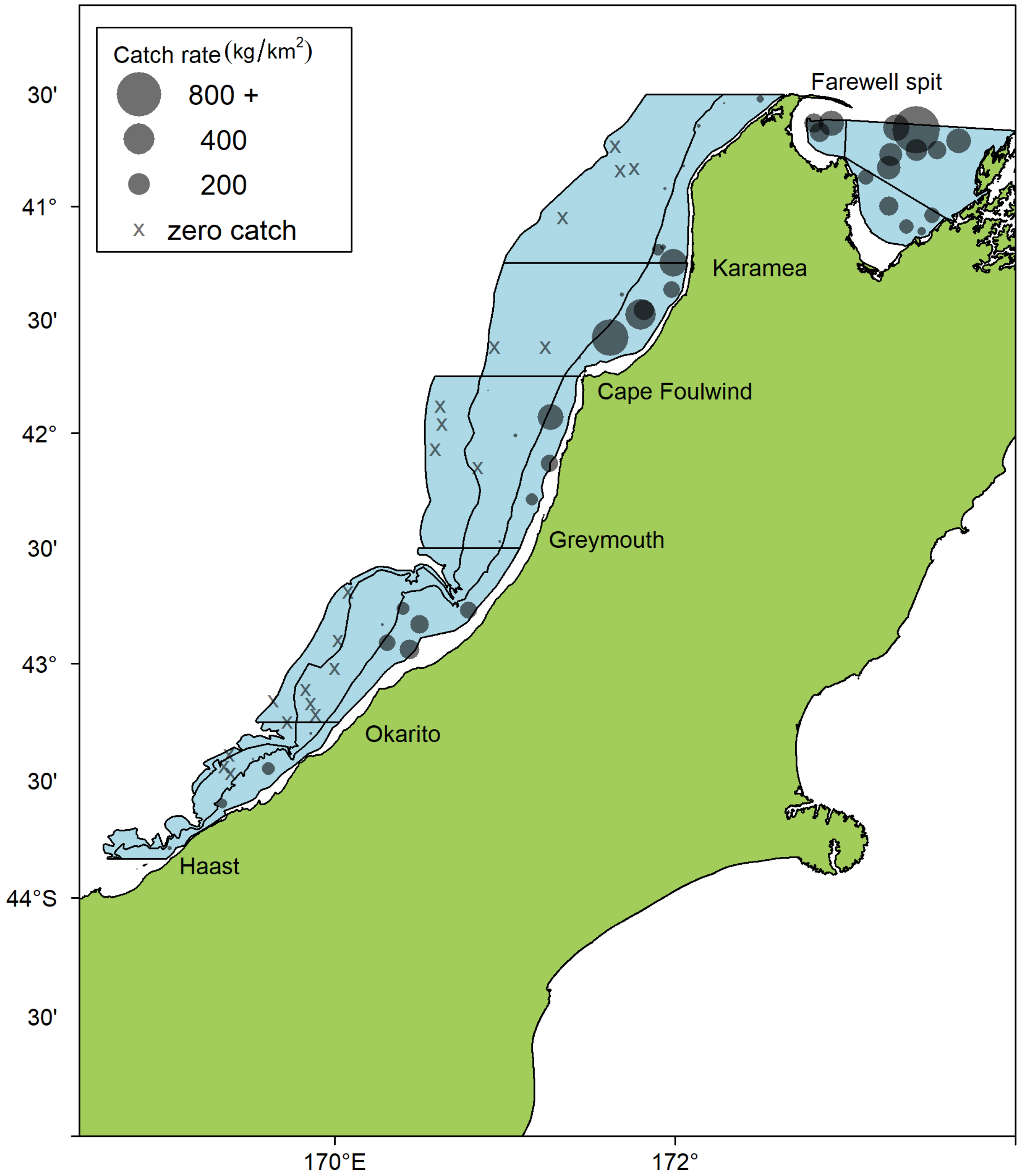



**Figure 2: Catch rates (kg km$^{-2}$) and distribution for the target species in alphabetical order by common name.**
**a: Giant stargazer**

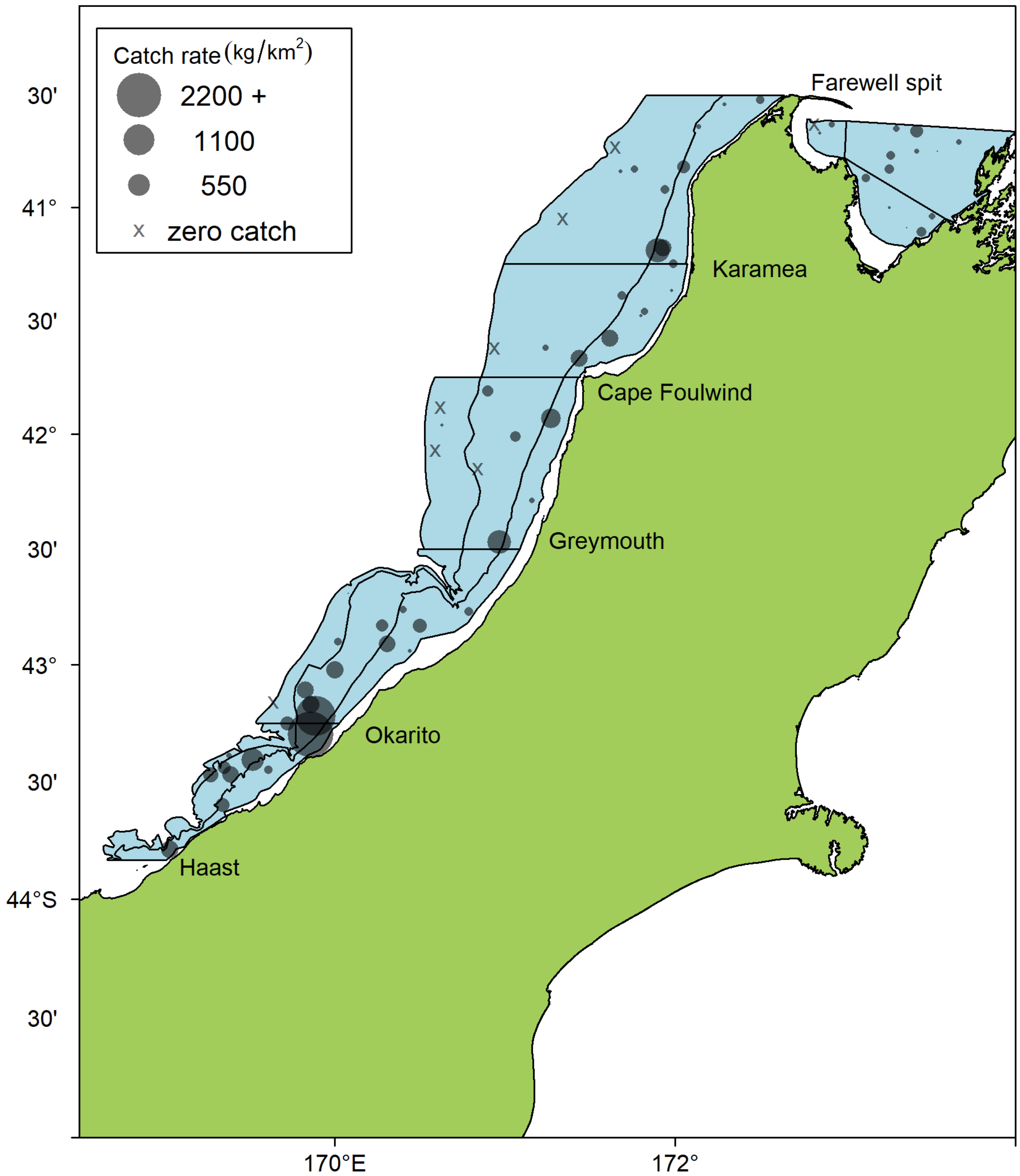


Catch rate (kg/km$^2$)
550 +
275
138
zero catch
Farewell spit
Karamea
Cape Foulwind
Greymouth
Okarito
Haast
30'
41°
30'
42°
30'
43°
30'
44°S
30'
170°E
172°

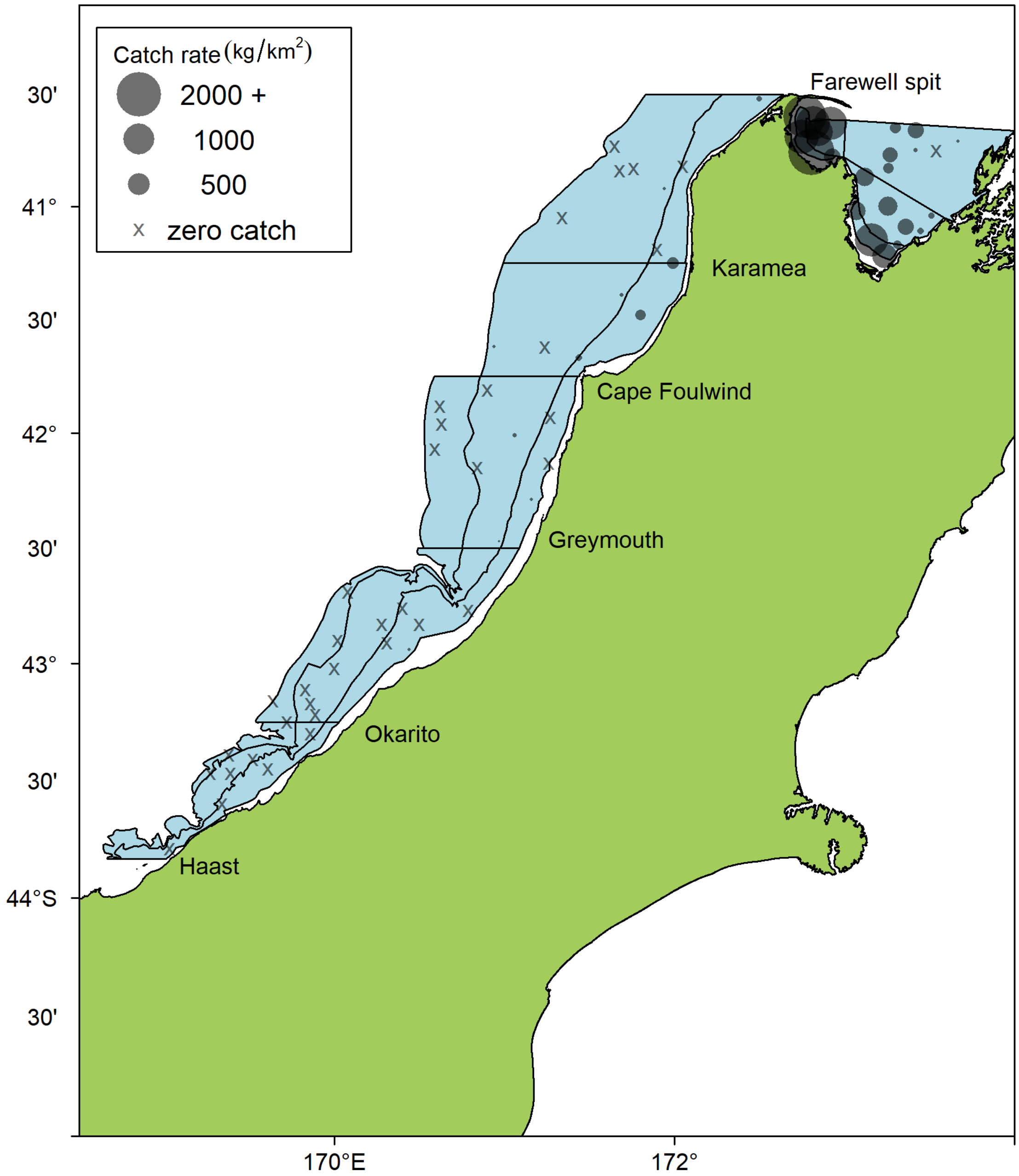

**b: Red cod**



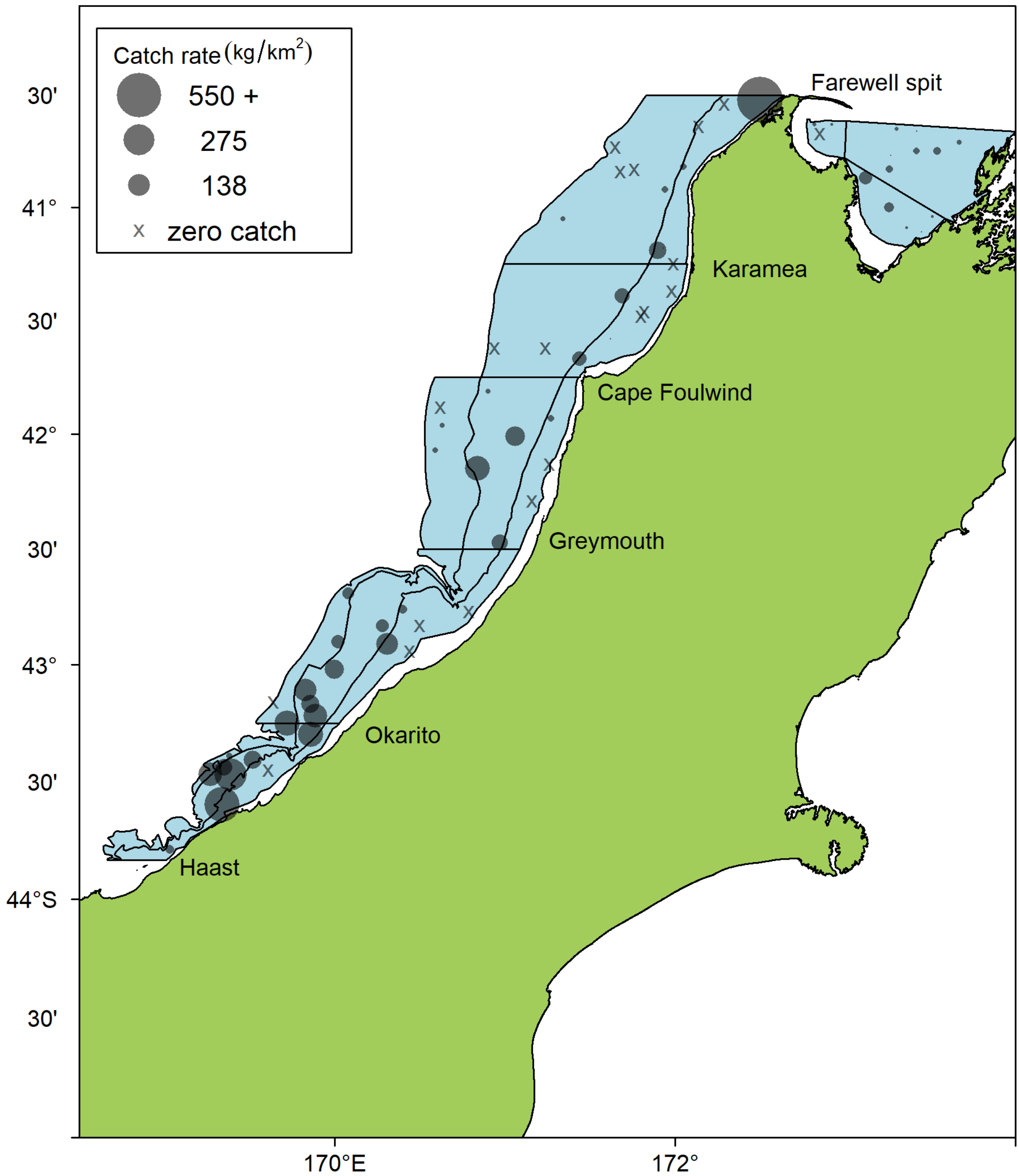

**c: Red gurnard**




**d: Spiny dogfish**


Catch rate (kg/km²)
2000 +
1000
500
zero catch
Farewell spit
Karamea
Cape Foulwind
Greymouth
Okarito
Haast
30'
41°
30'
42°
30'
43°
30'
44°S
30'
170°E
172°

**e. Snapper**


Catch rate (kg/km2)
550 +
275
138
zero catch
Farewell spit
Karamea
Cape Foulwind
Greymouth
Okarito
Haast
30'
41°
30'
42°
30'
43°
30'
44°S
30'
170°E
172°

**f: Tarakihi**

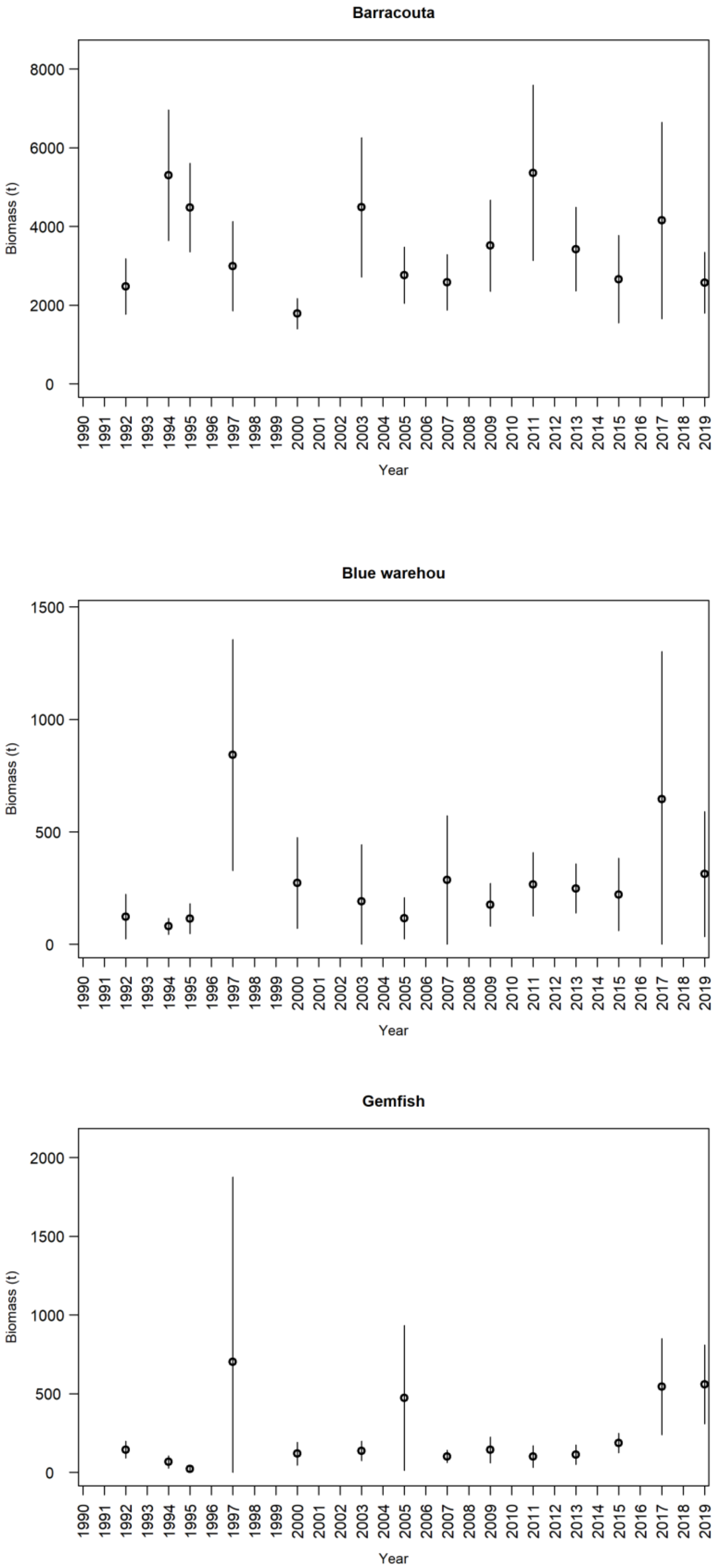
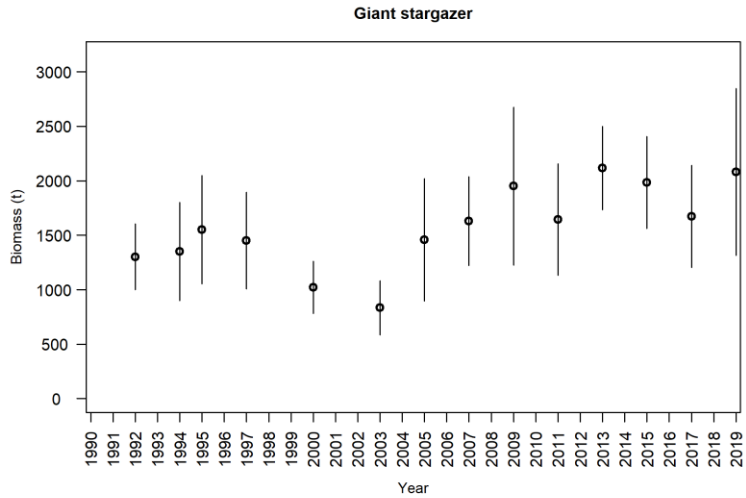
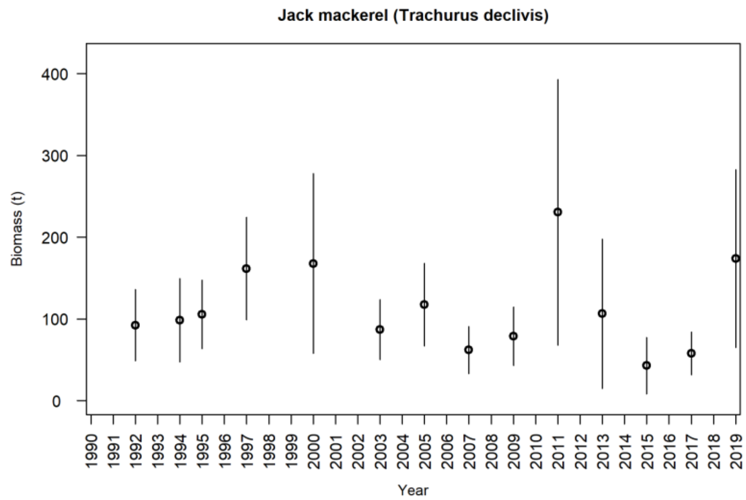



**Figure 3: Trends in total biomass from the core strata for the target species and other species reliably monitored by the survey time series. Species arranged in alphabetical order by common name. Error bars are +/- two standard deviations.**



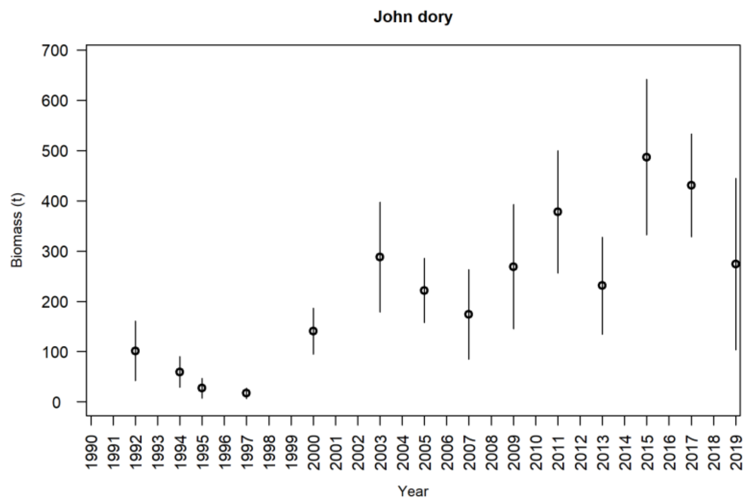
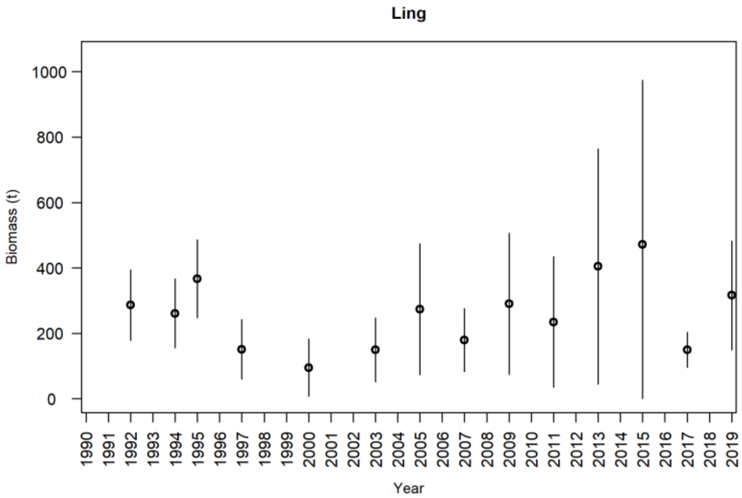
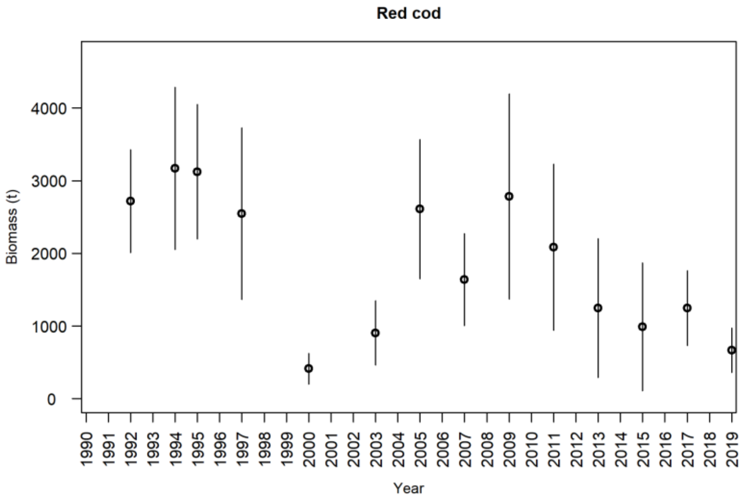




**Figure 3—continued.**



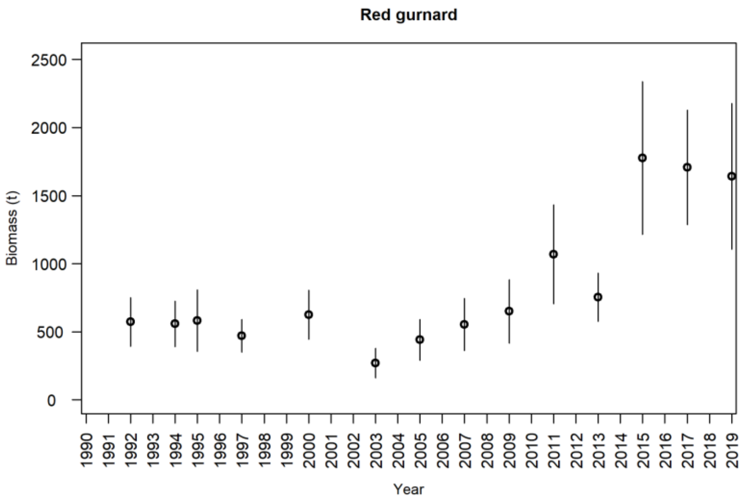




**Figure 3—continued.**

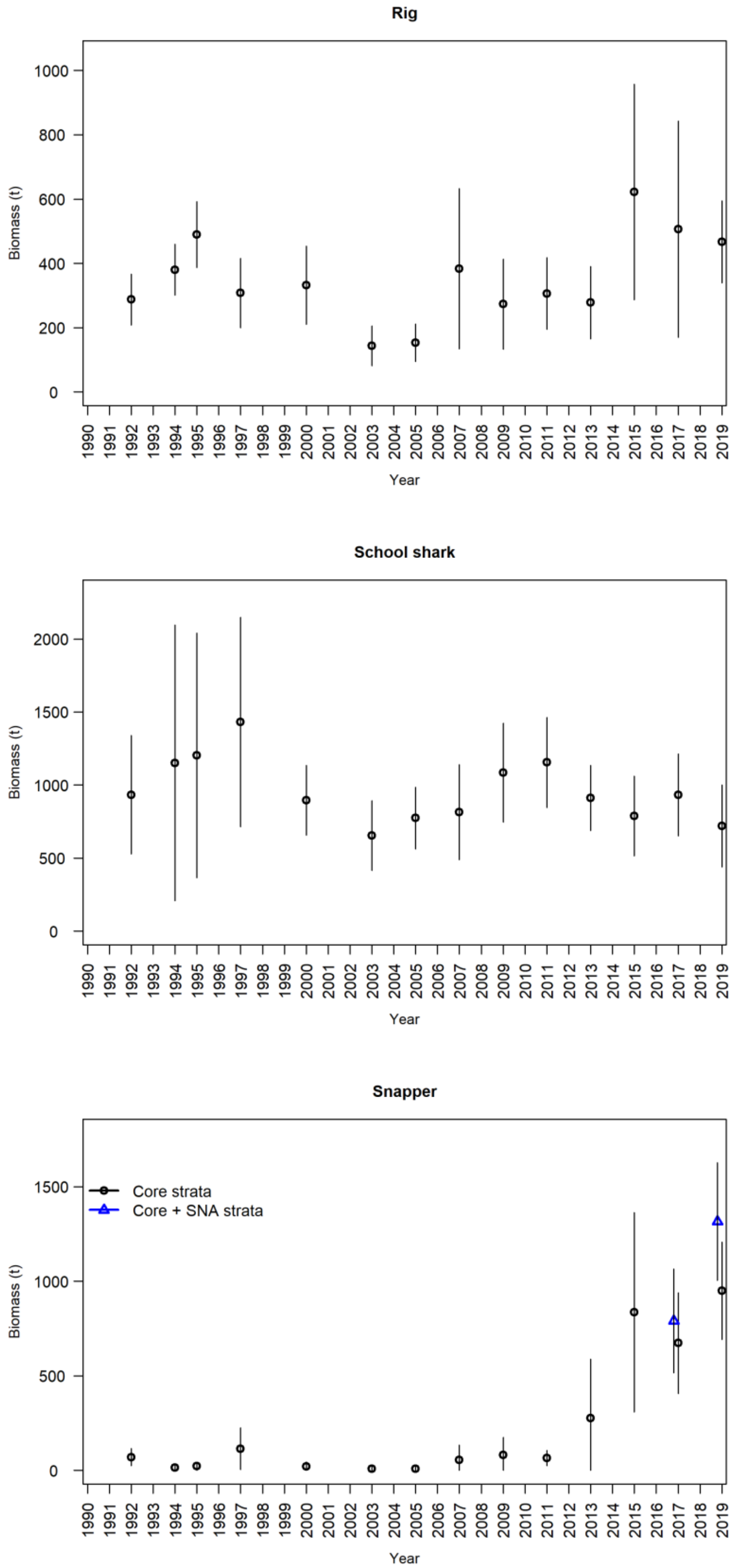
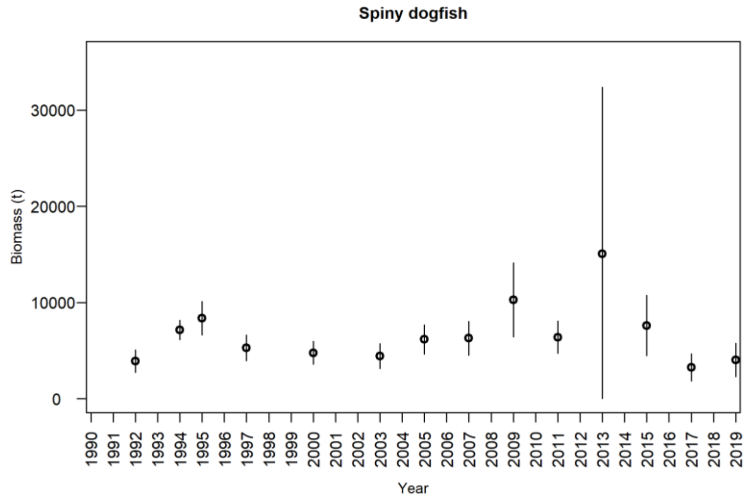



**Figure 3—continued.**



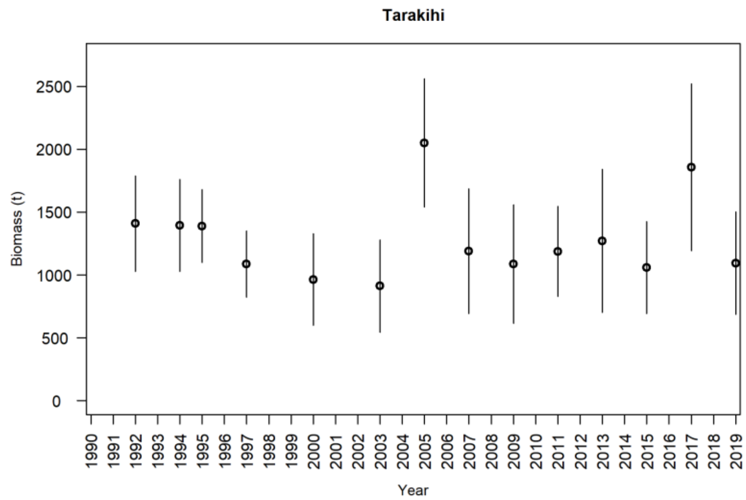




**Figure 3—continued.**

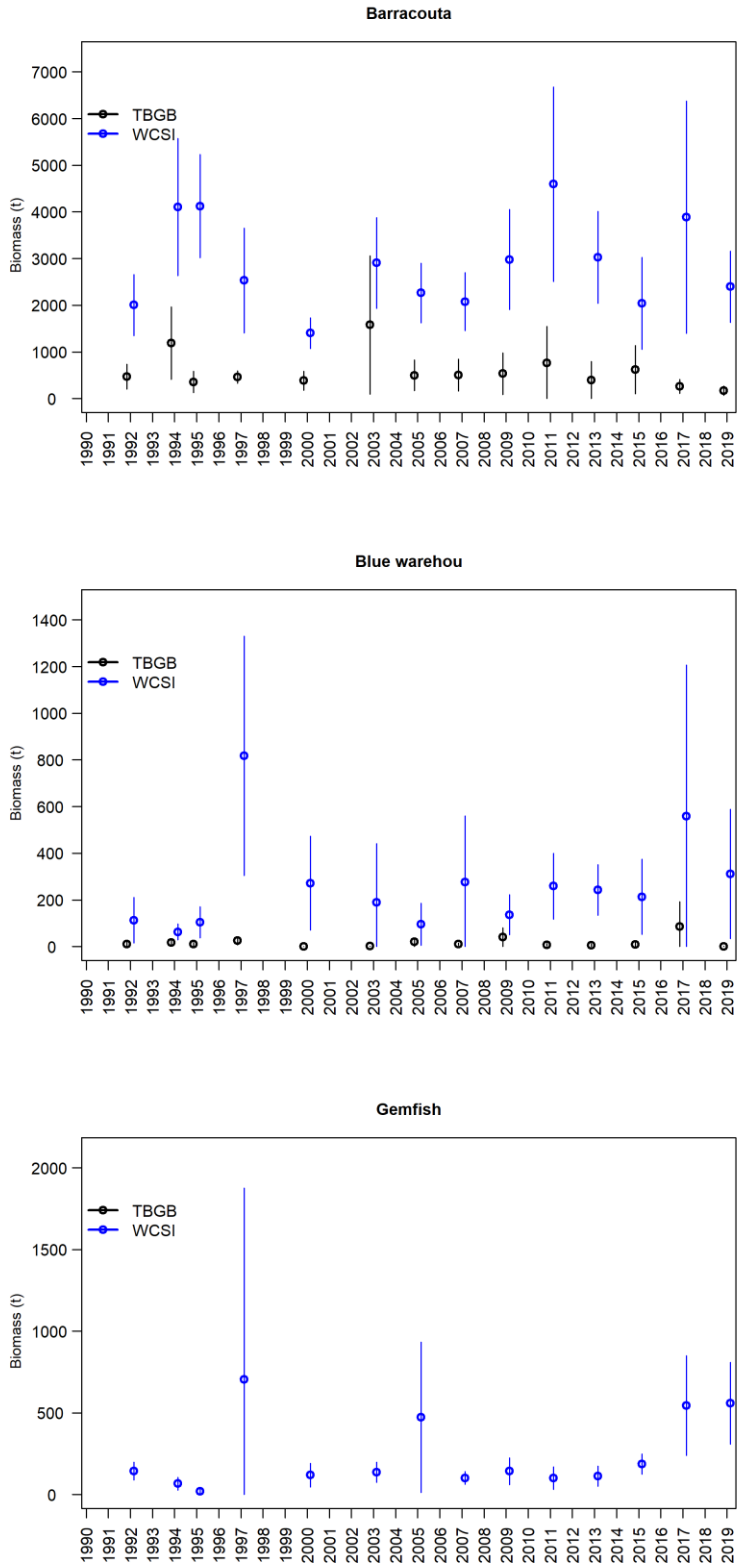



**Figure 4: Trends in total biomass (t) for the target species and other species for which the survey time series is likely to be monitoring adult or pre-recruit abundance, separated into Tasman and Golden Bays (TBGB), and the west coast South Island (WCSI). Species arranged in alphabetical order by common name. Error bars are +/- two standard deviations.**

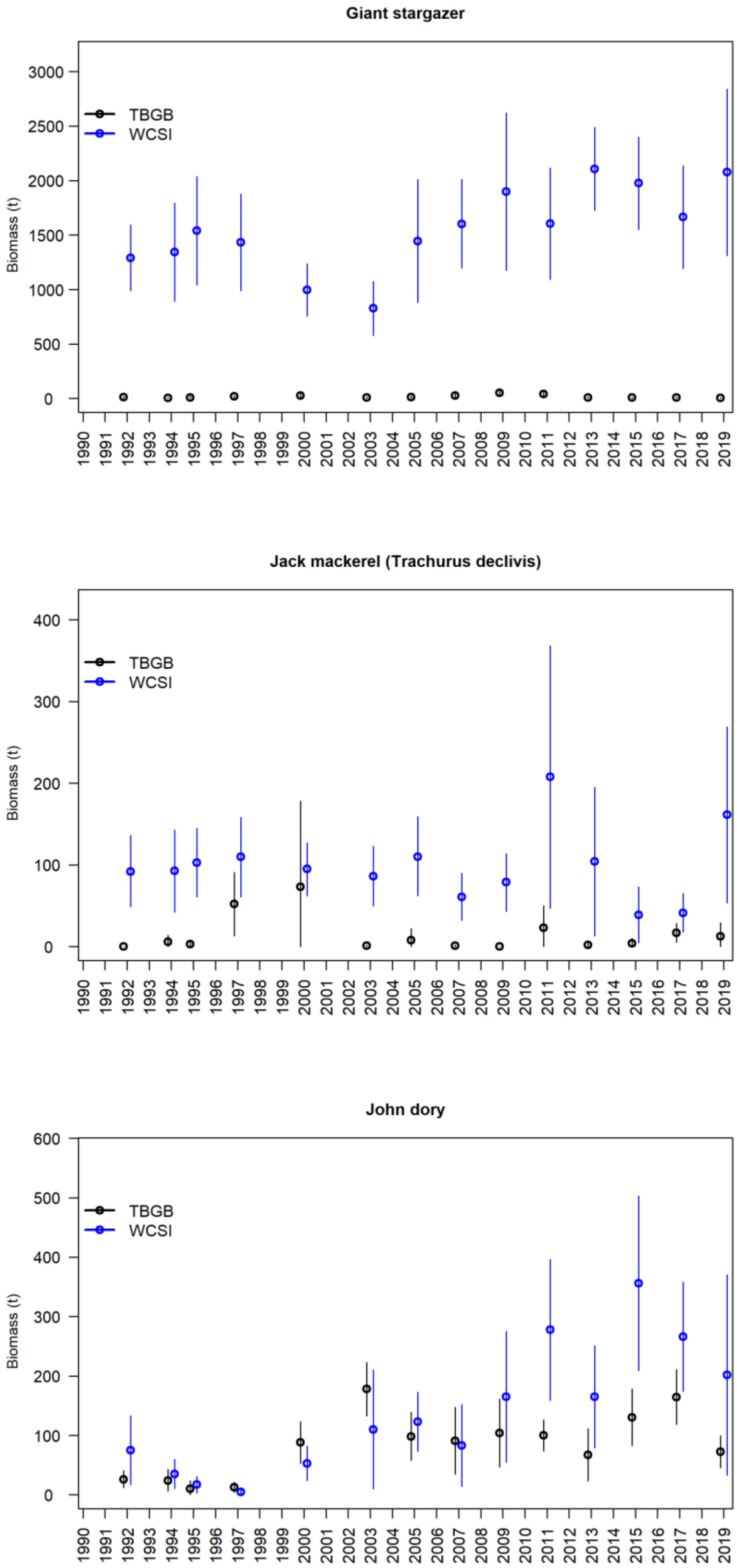



**Figure 4—continued.**

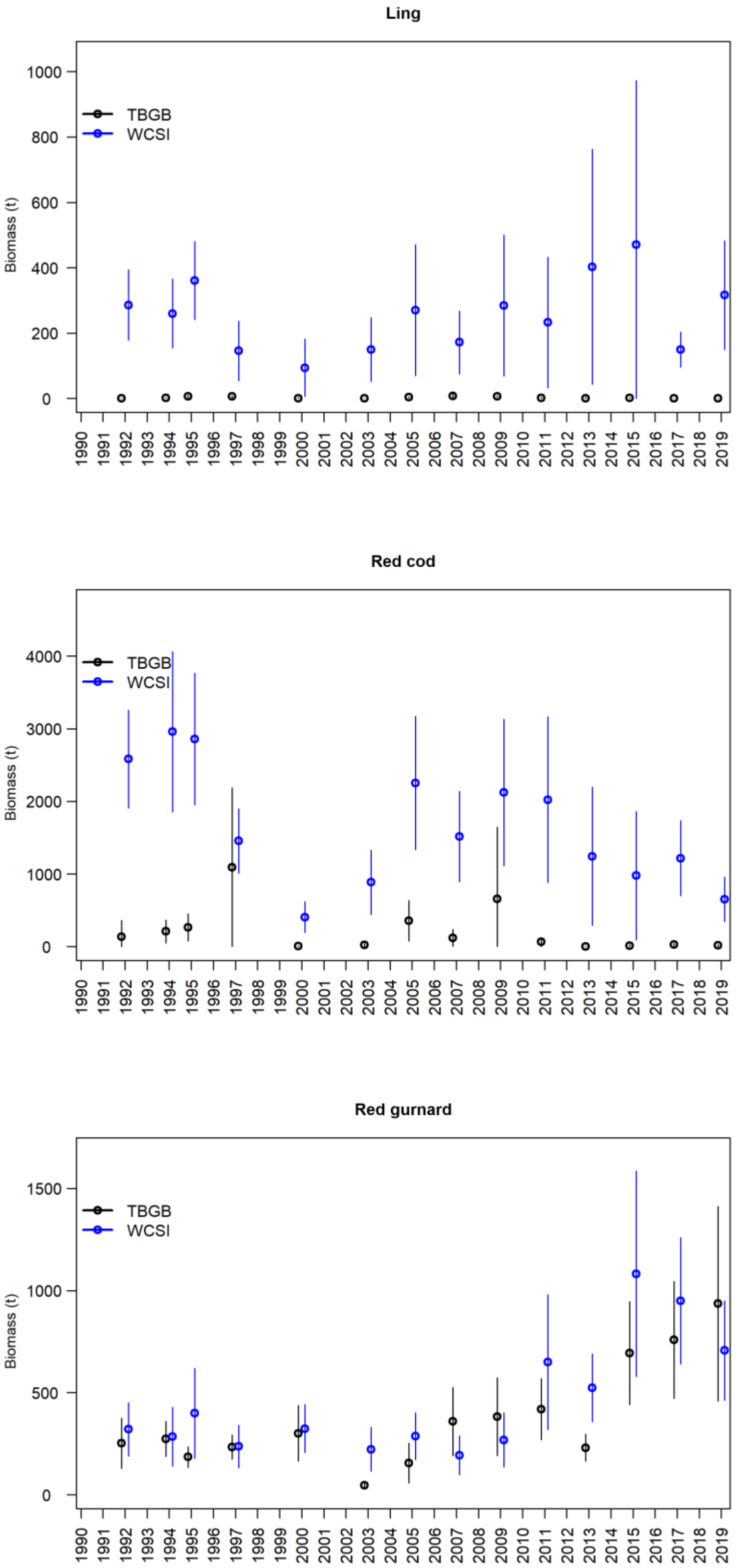



**Figure 4—continued.**

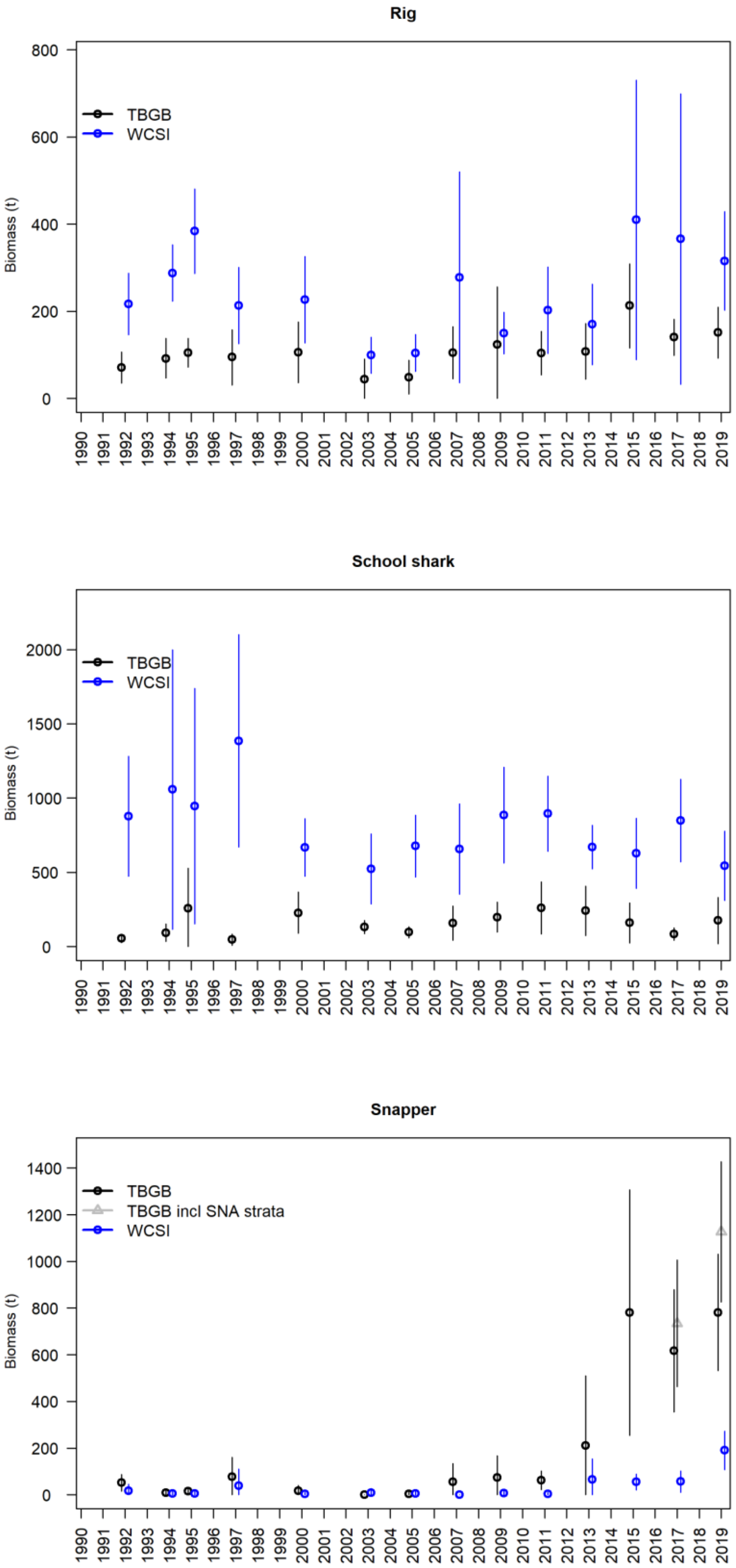
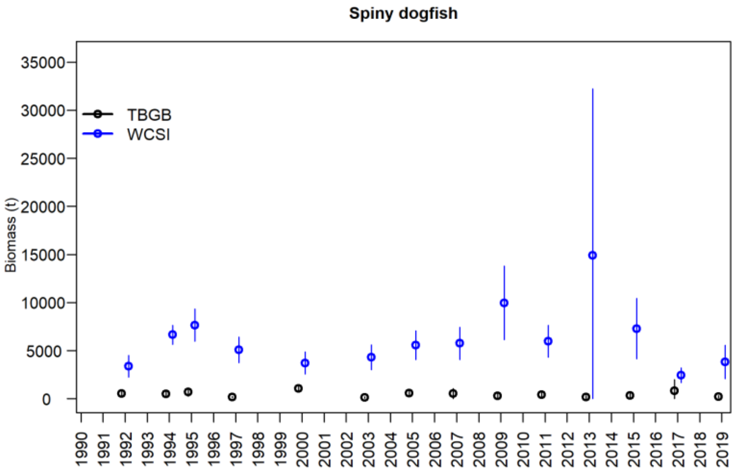



**Figure 4—continued.**



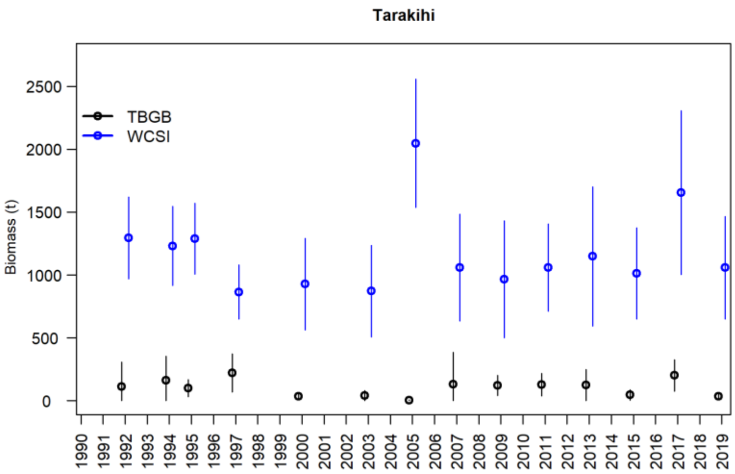




**Figure 4—continued.**

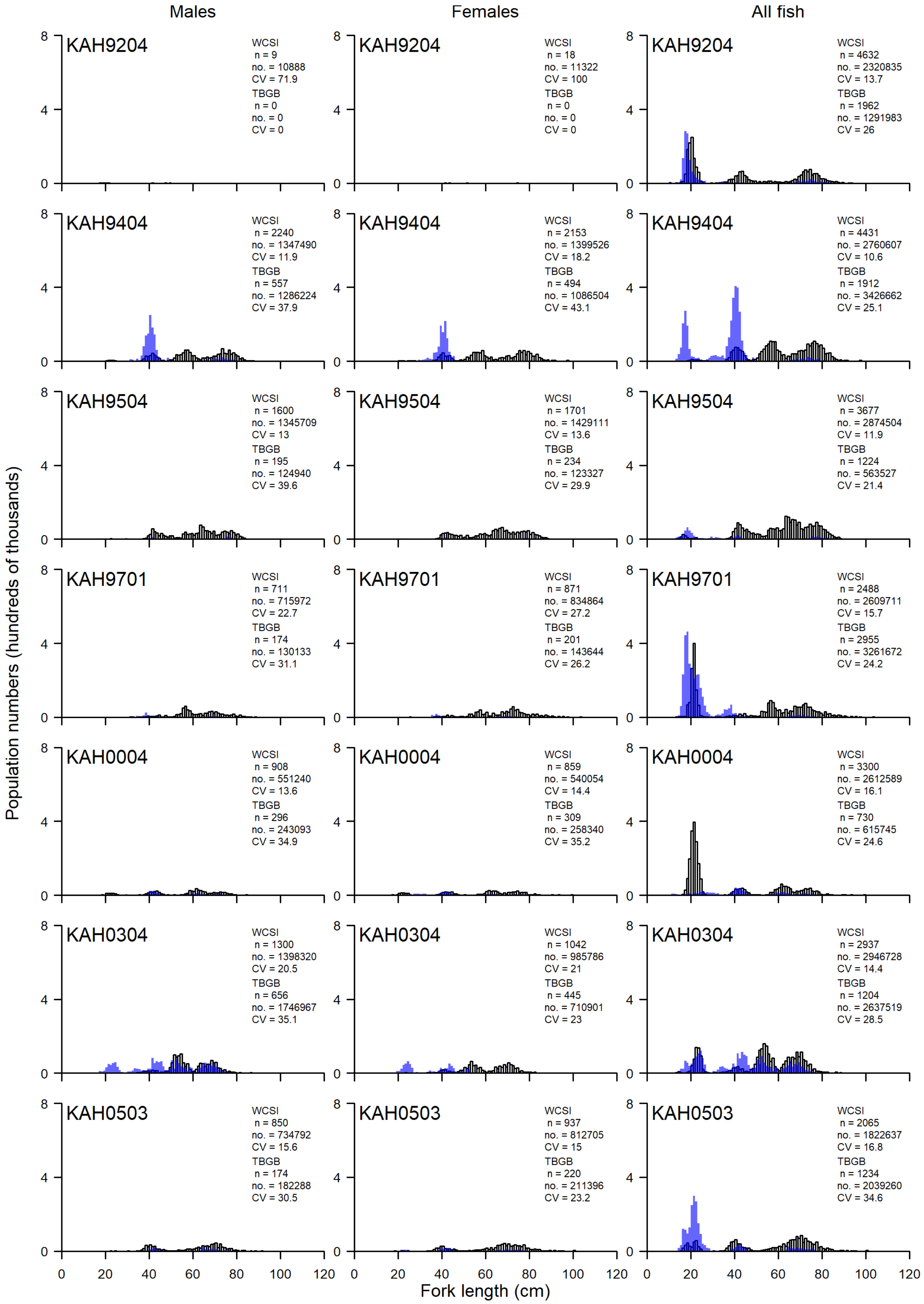



**Figure 5: Comparative scaled length frequency distributions with Tasman and Golden Bays (TBGB) and west coast South Island (WCSI) plotted separately for the target species and those species where the surveys are monitoring adult or pre-recruit abundance. n = number of fish measured, no. = scaled population number, CV = coefficient of variation. 'All fish' includes any unsexed fish. Blue bars = Tasman and Golden Bays, black bars = west coast South Island. a) Barracouta.**

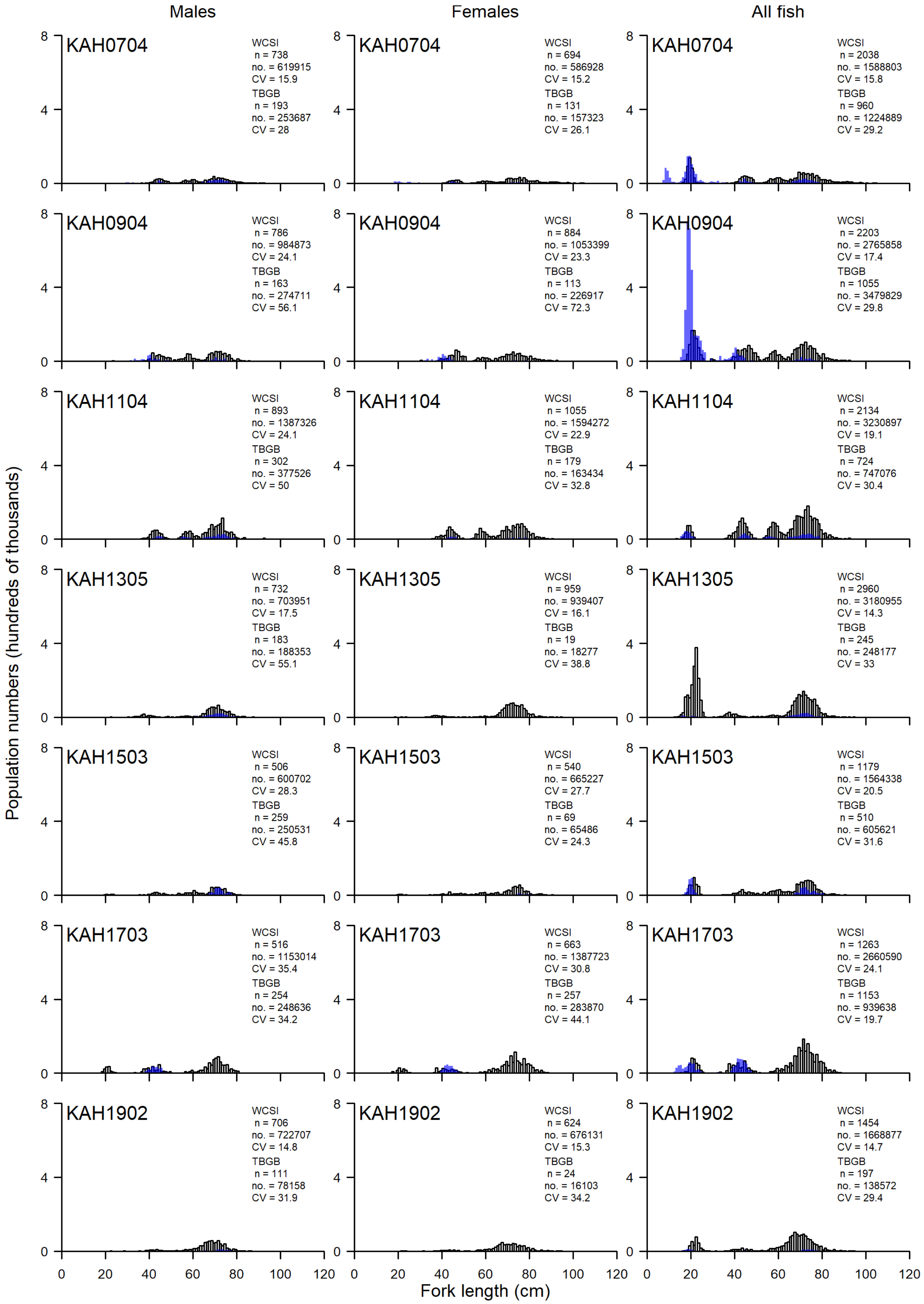



**Figure 5a—continued.**

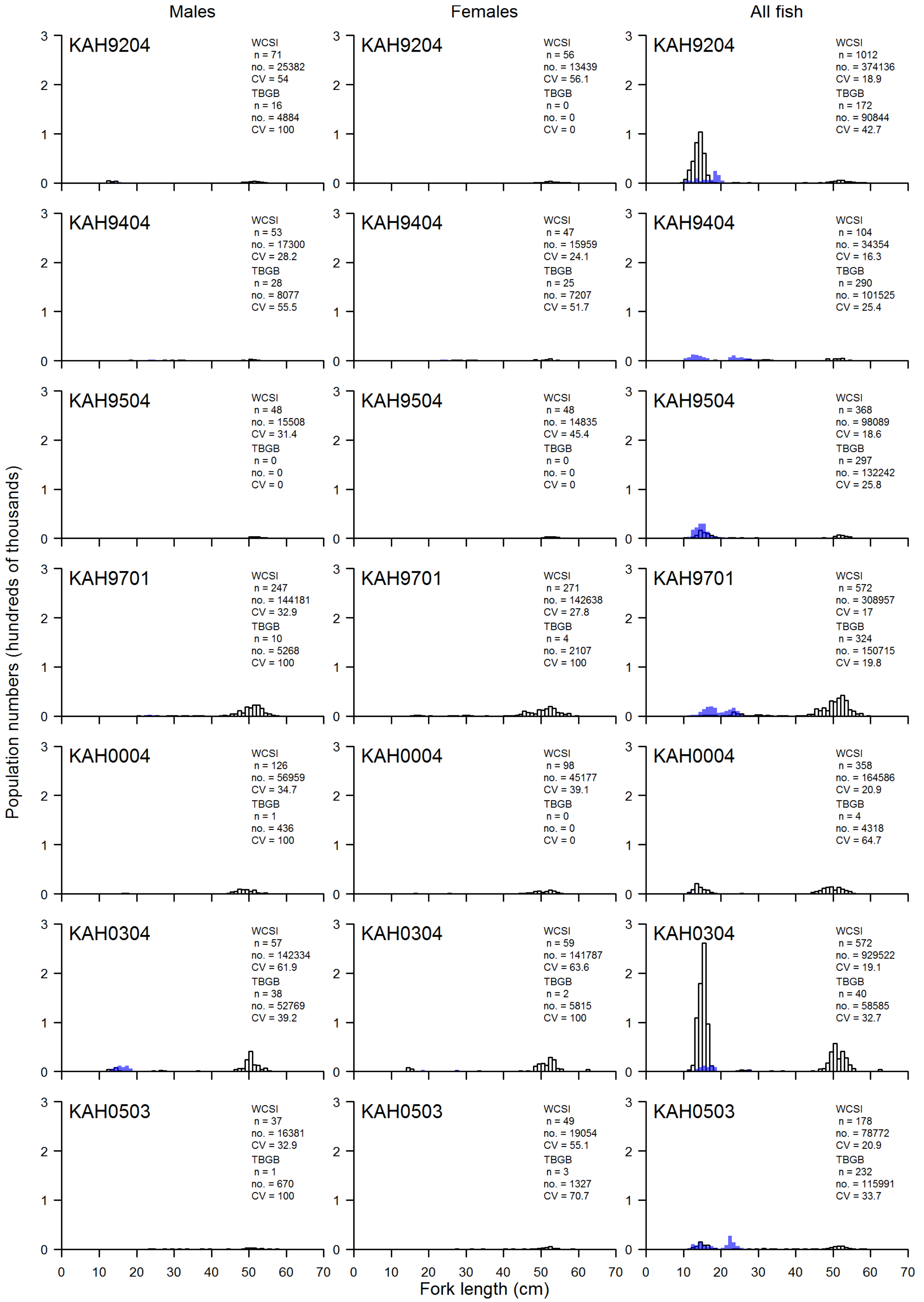



**Figure 5b: Blue warehou.**

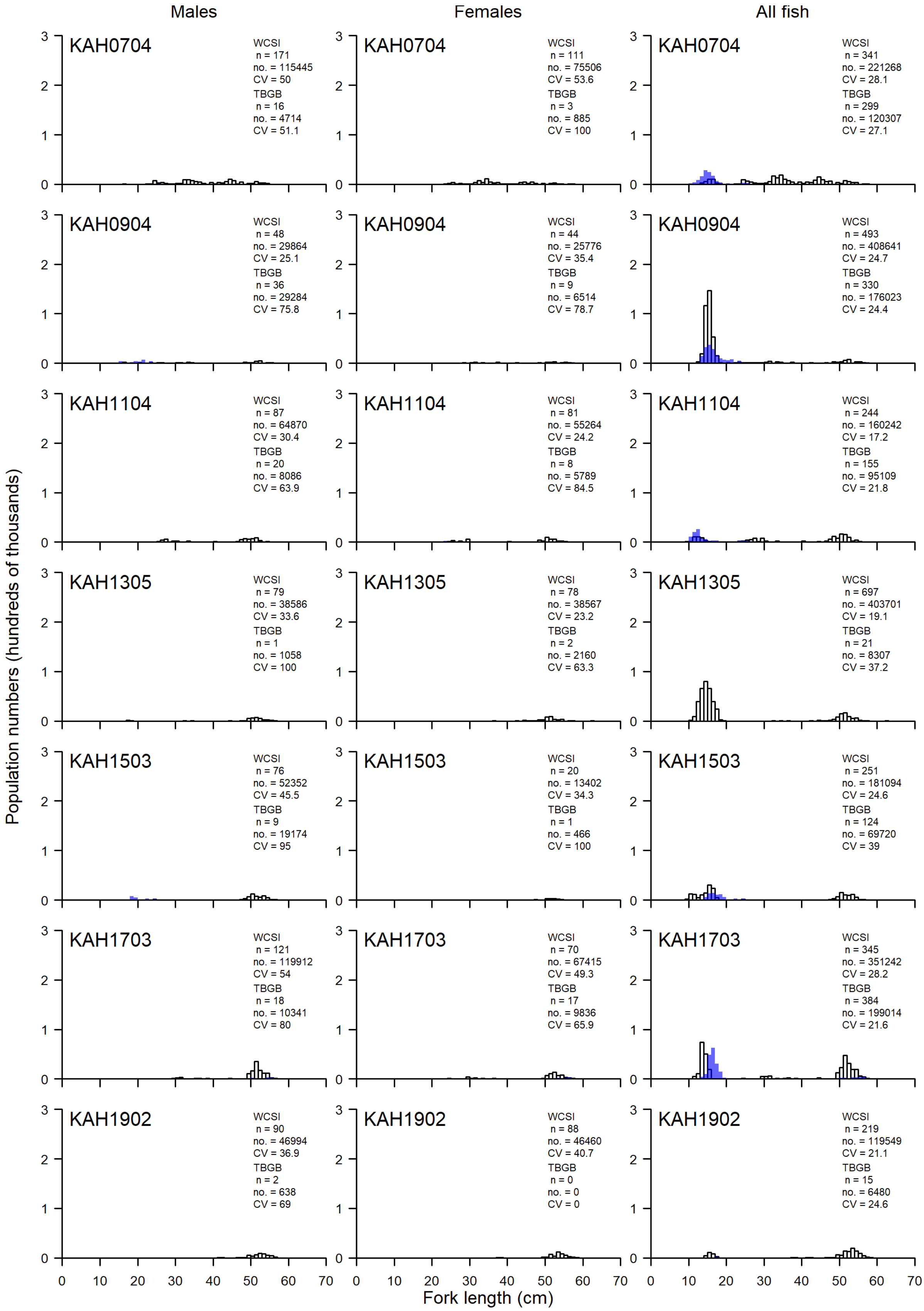



**Figure 5b—continued.**

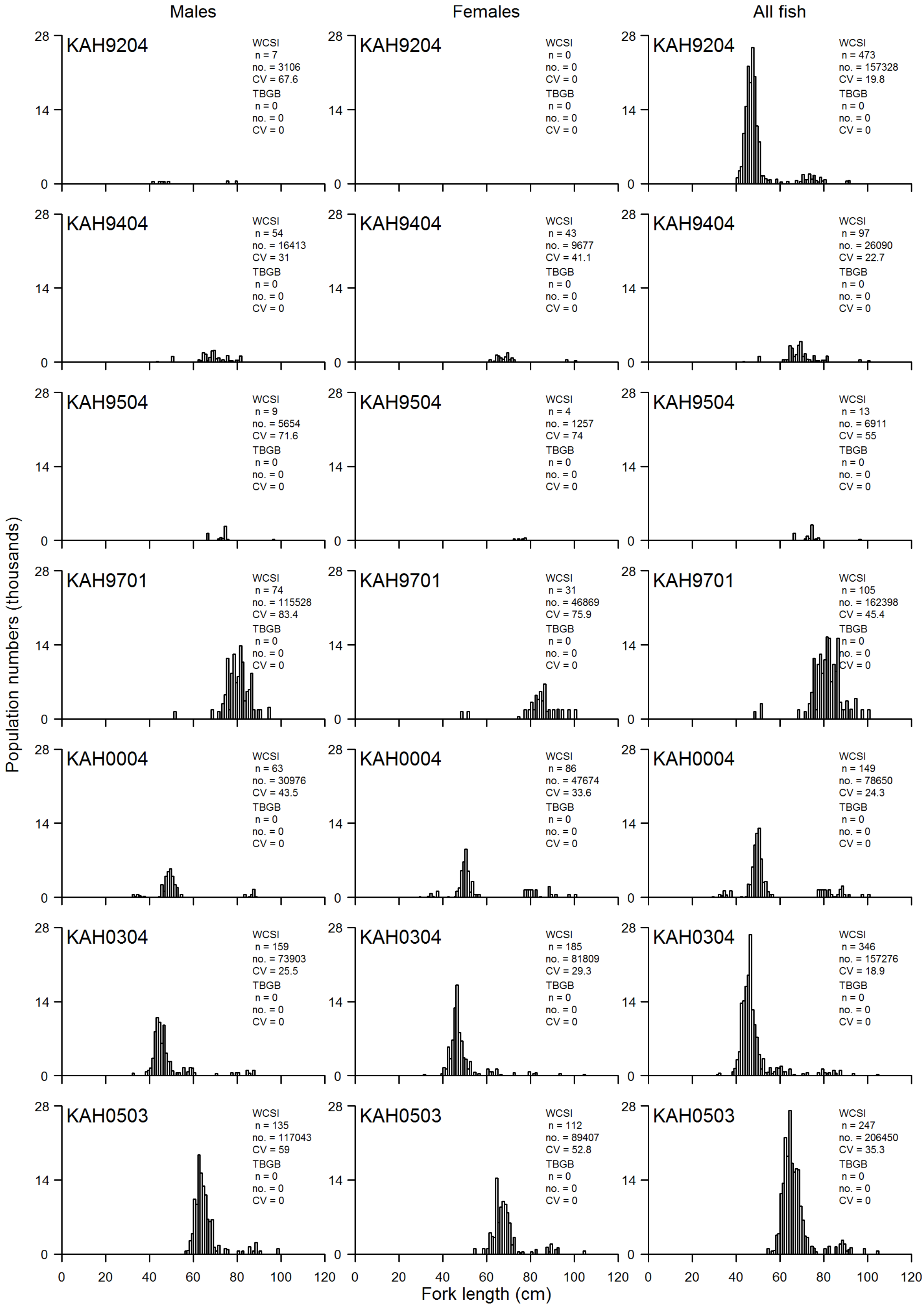



**Figure 5c: Gemfish (all fish were from the west coast).**

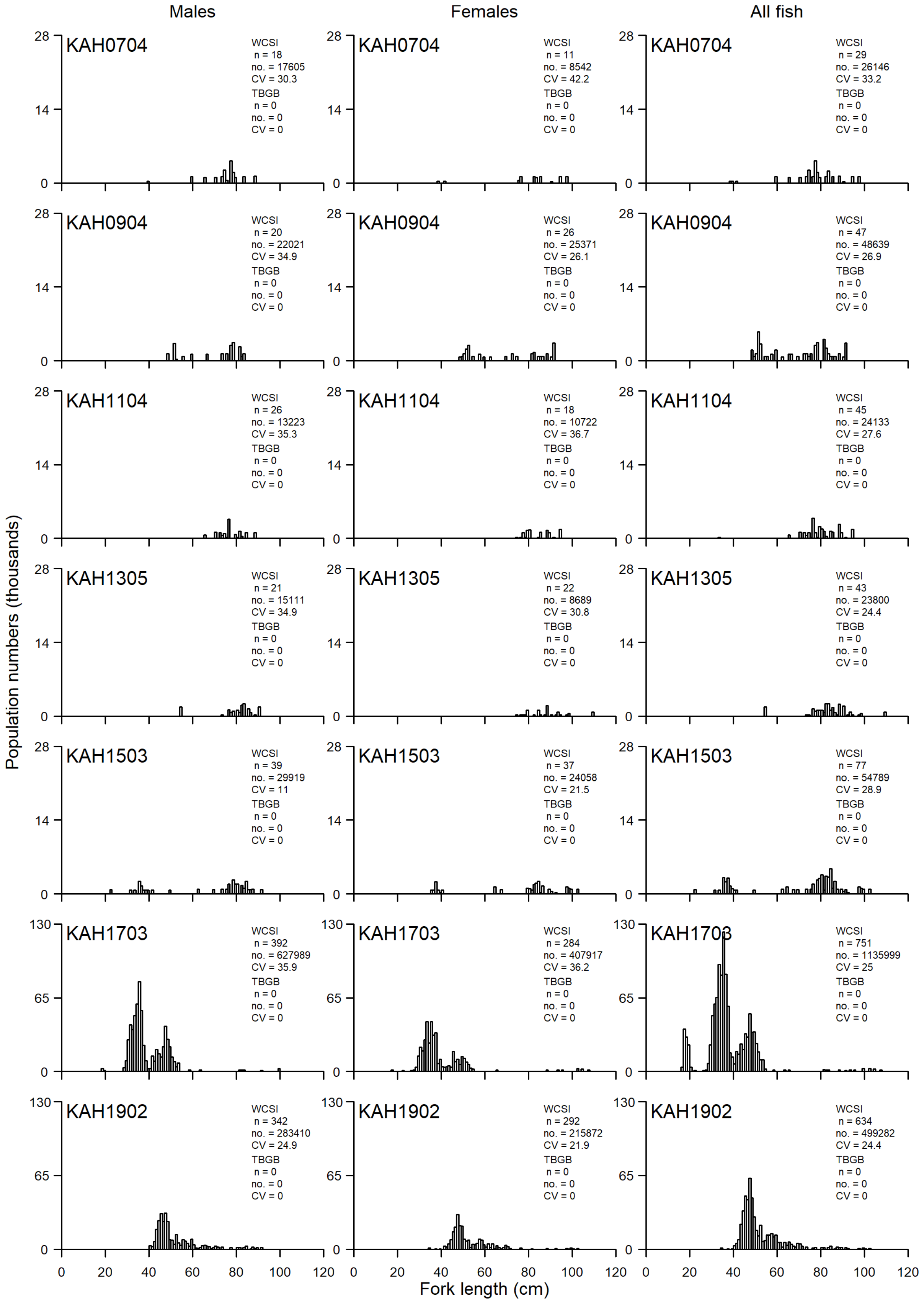



**Figure 5c—continued.**

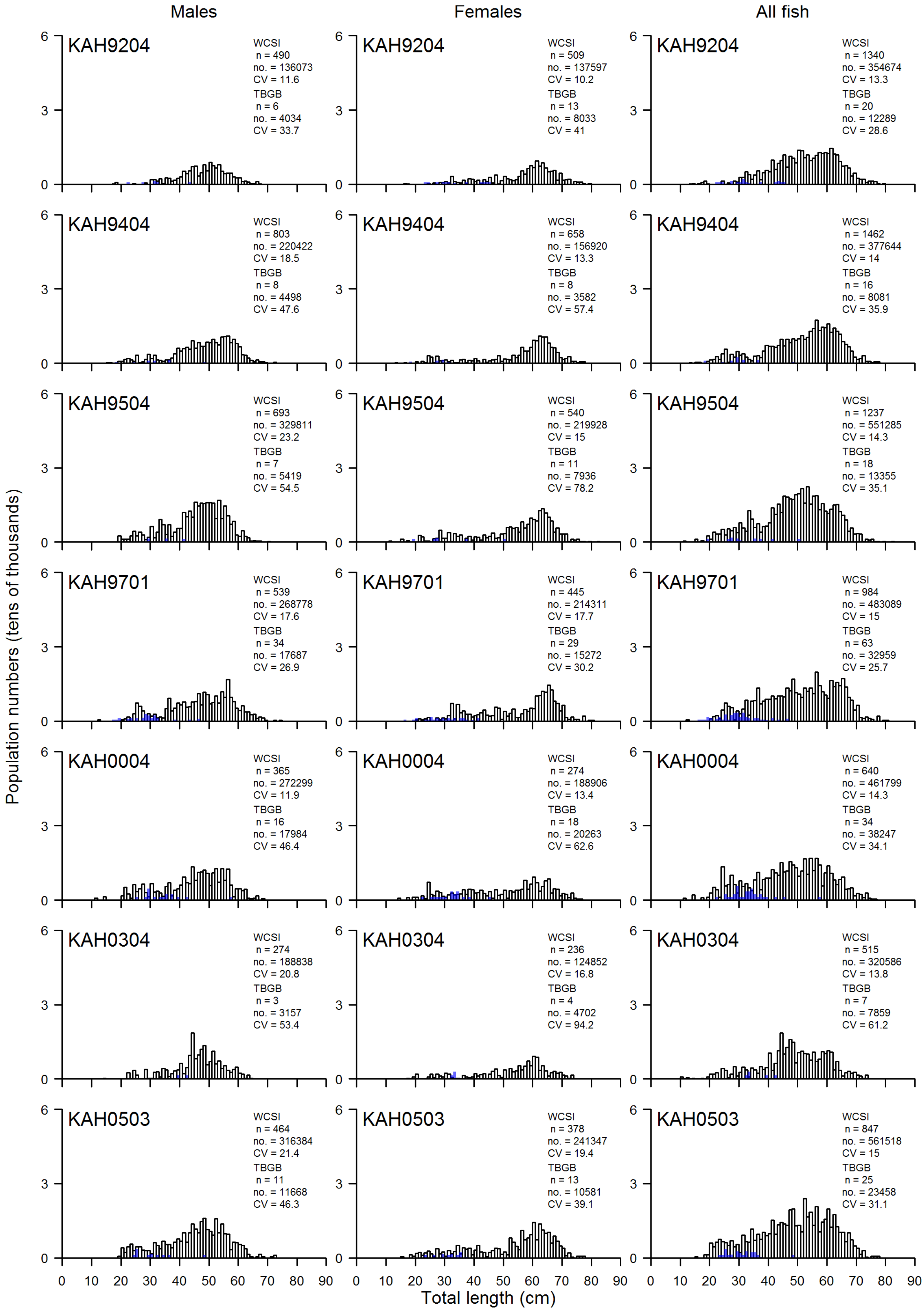



**Figure 5d: Giant stargazer.**

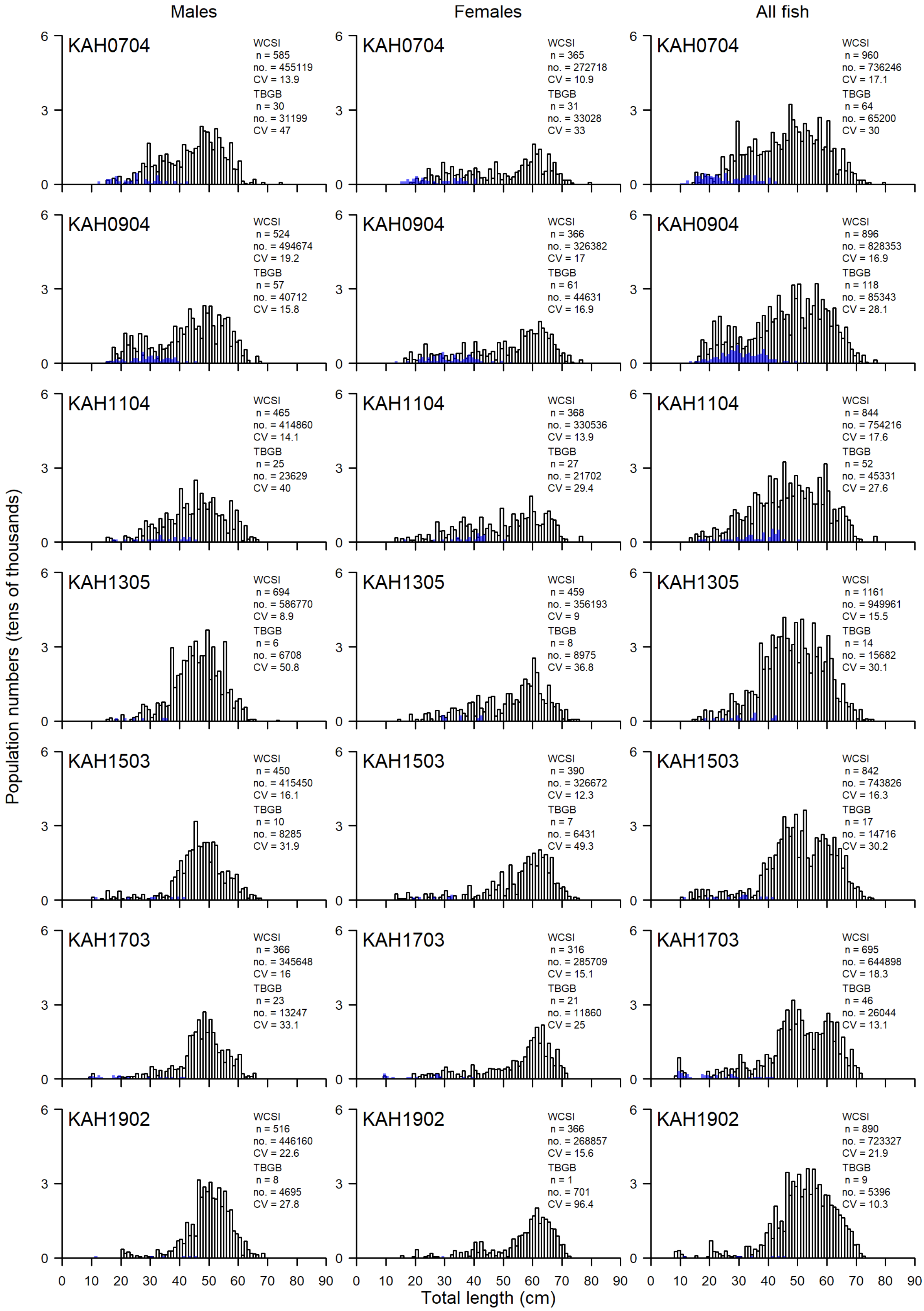



**Figure 5d—continued.**

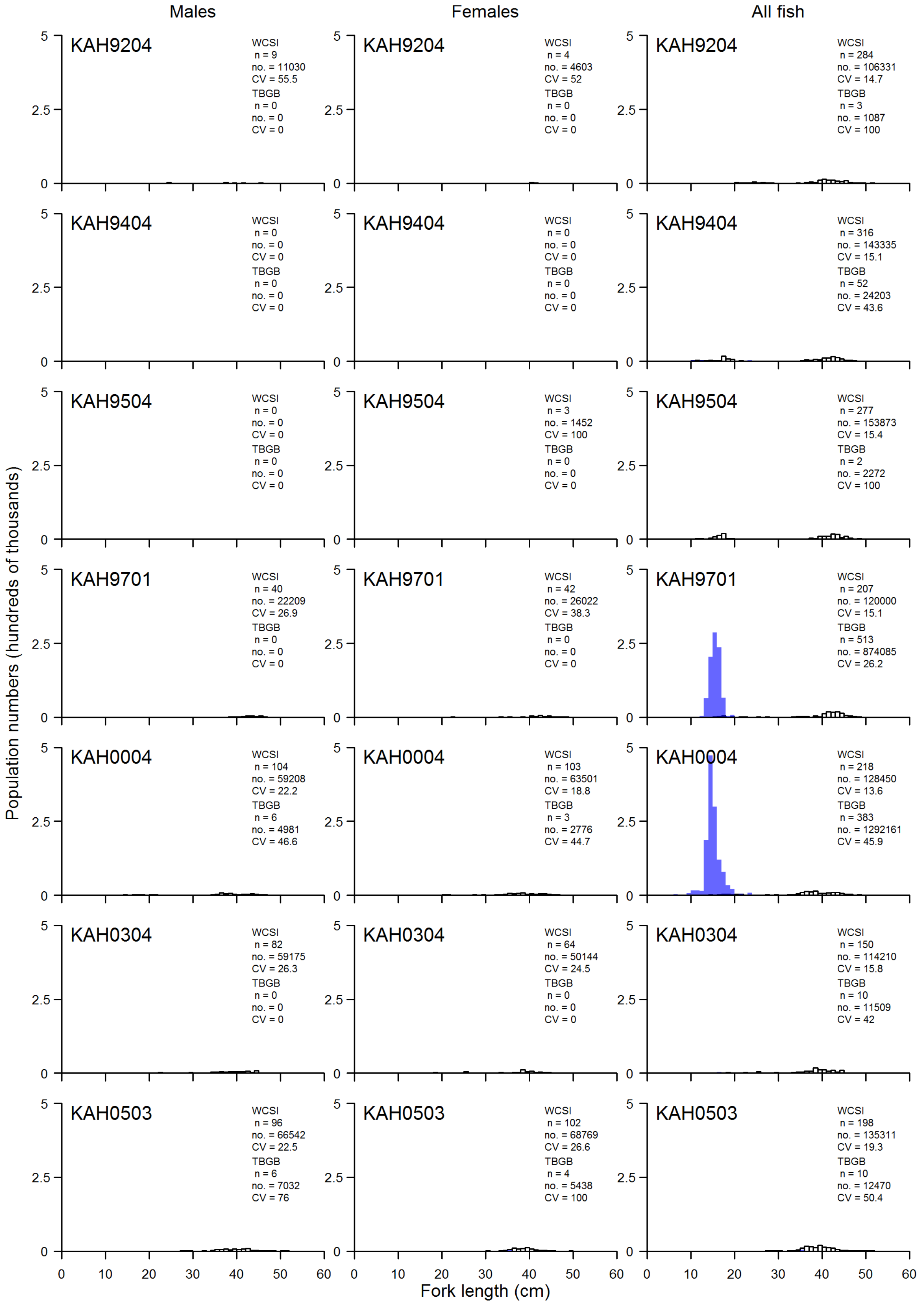



**Figure 5e: Jack mackerel (*Trachurus declivis*).**

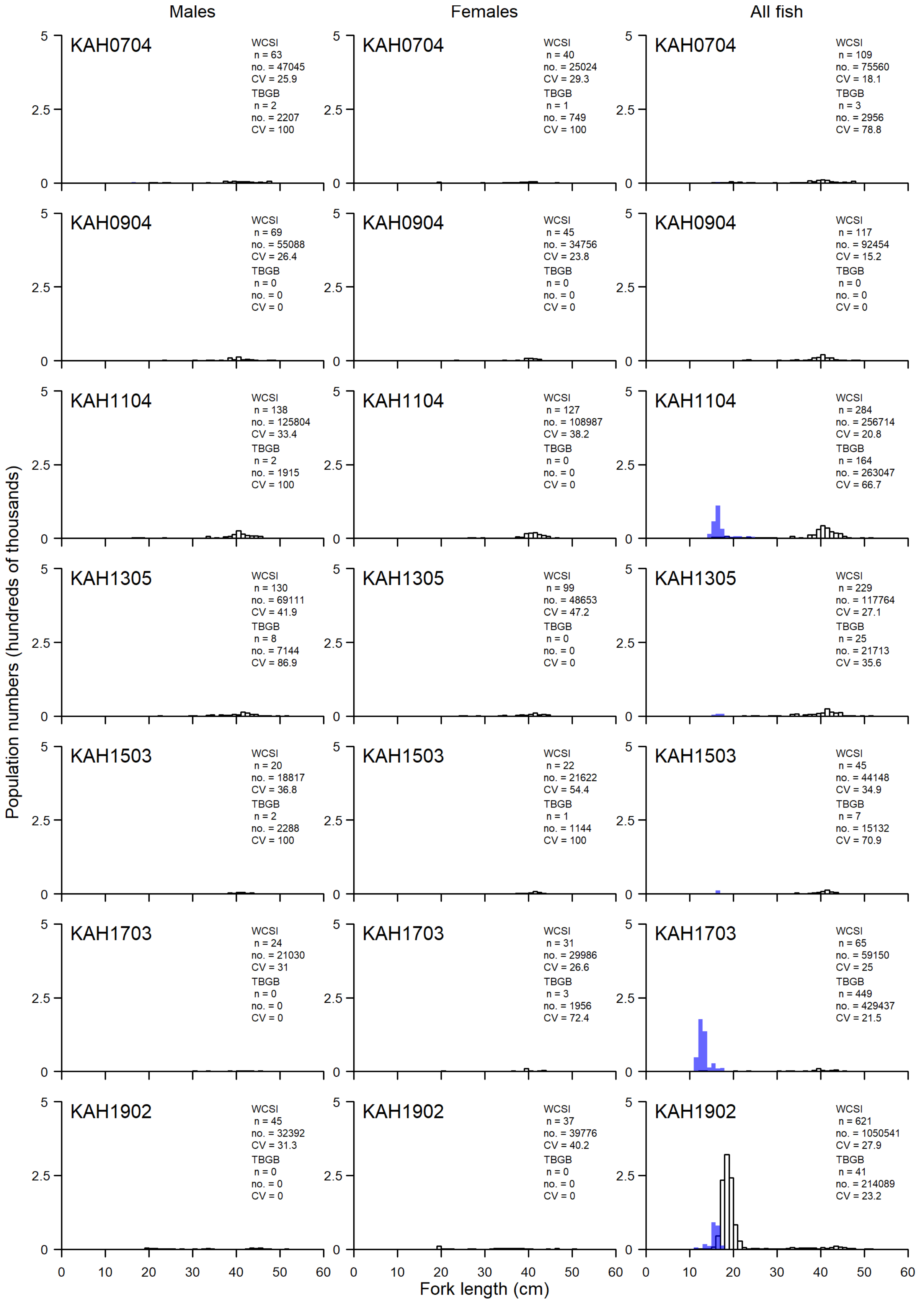



**Figure 5e—continued.**

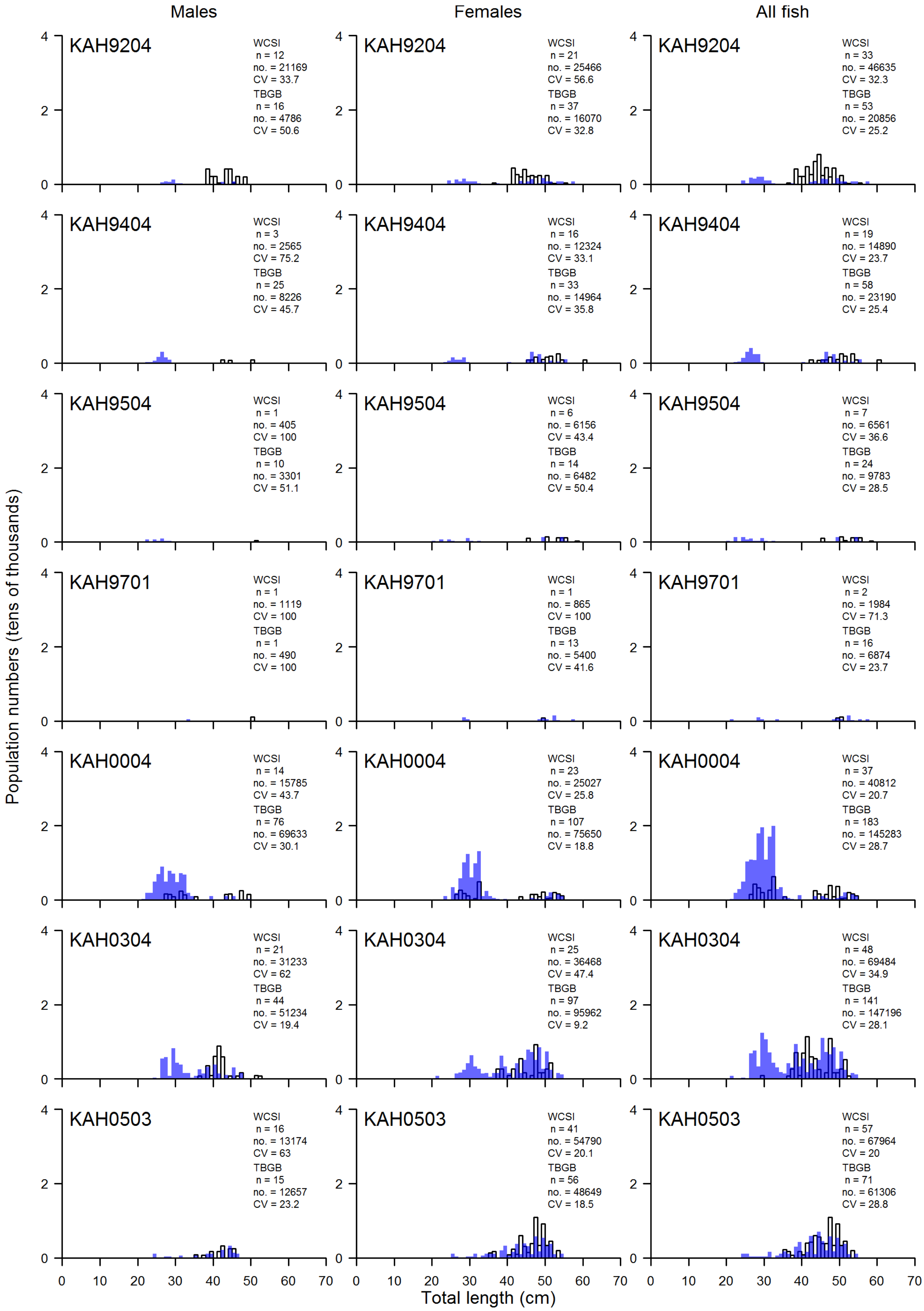



**Figure 5f: John dory.**

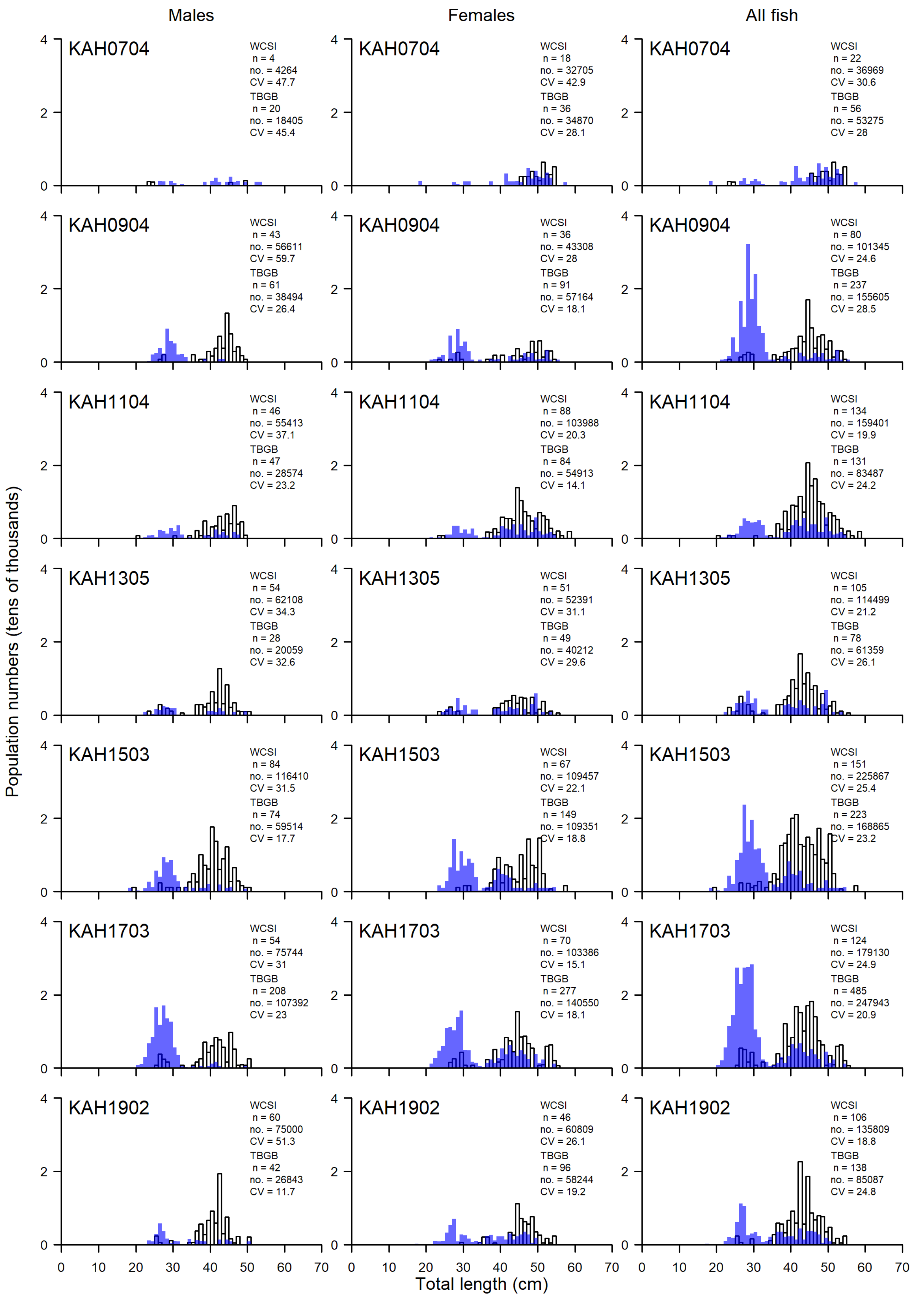



**Figure 5f—continued.**

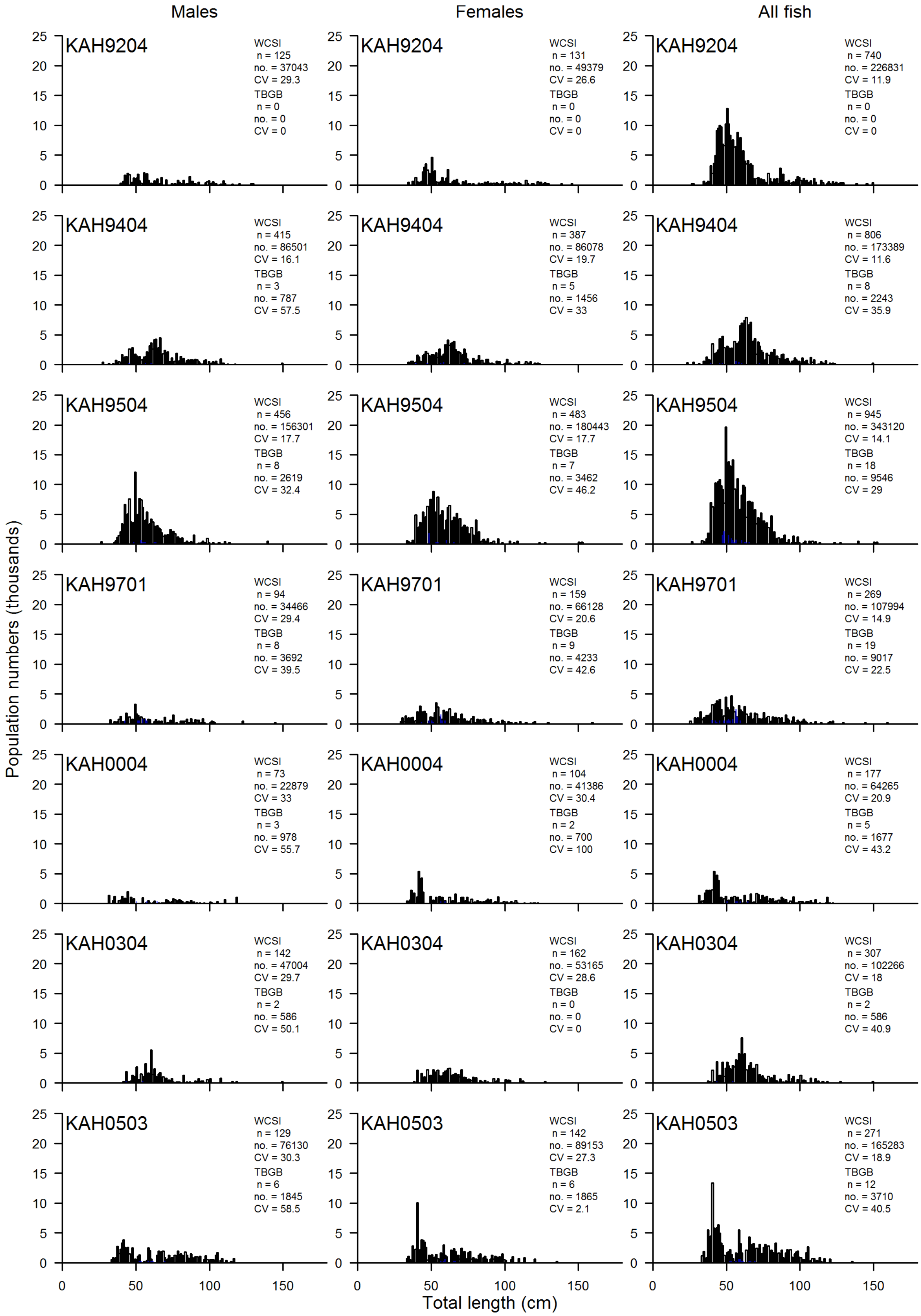



**Figure 5g: Ling.**

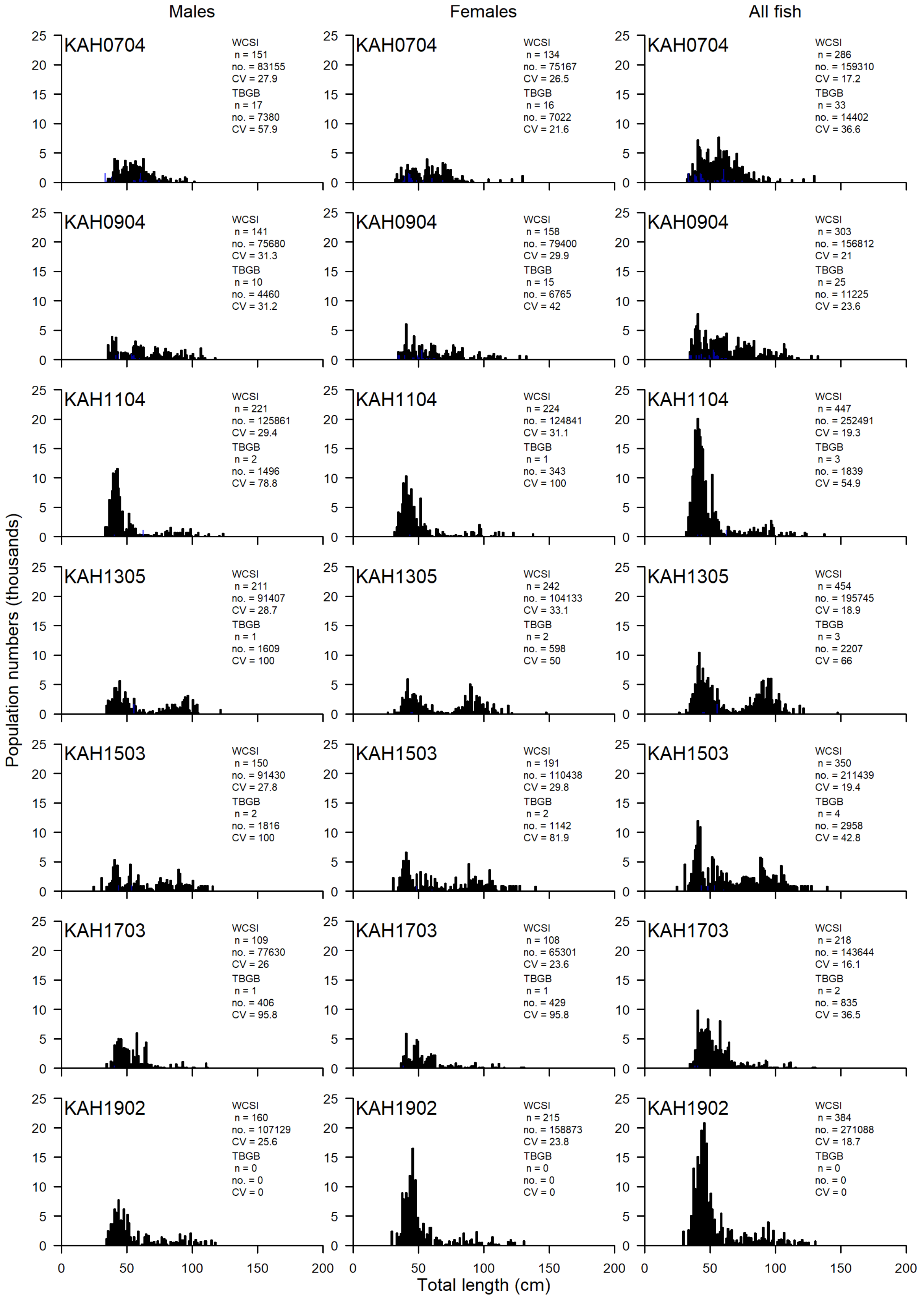



**Figure 5g—continued.**

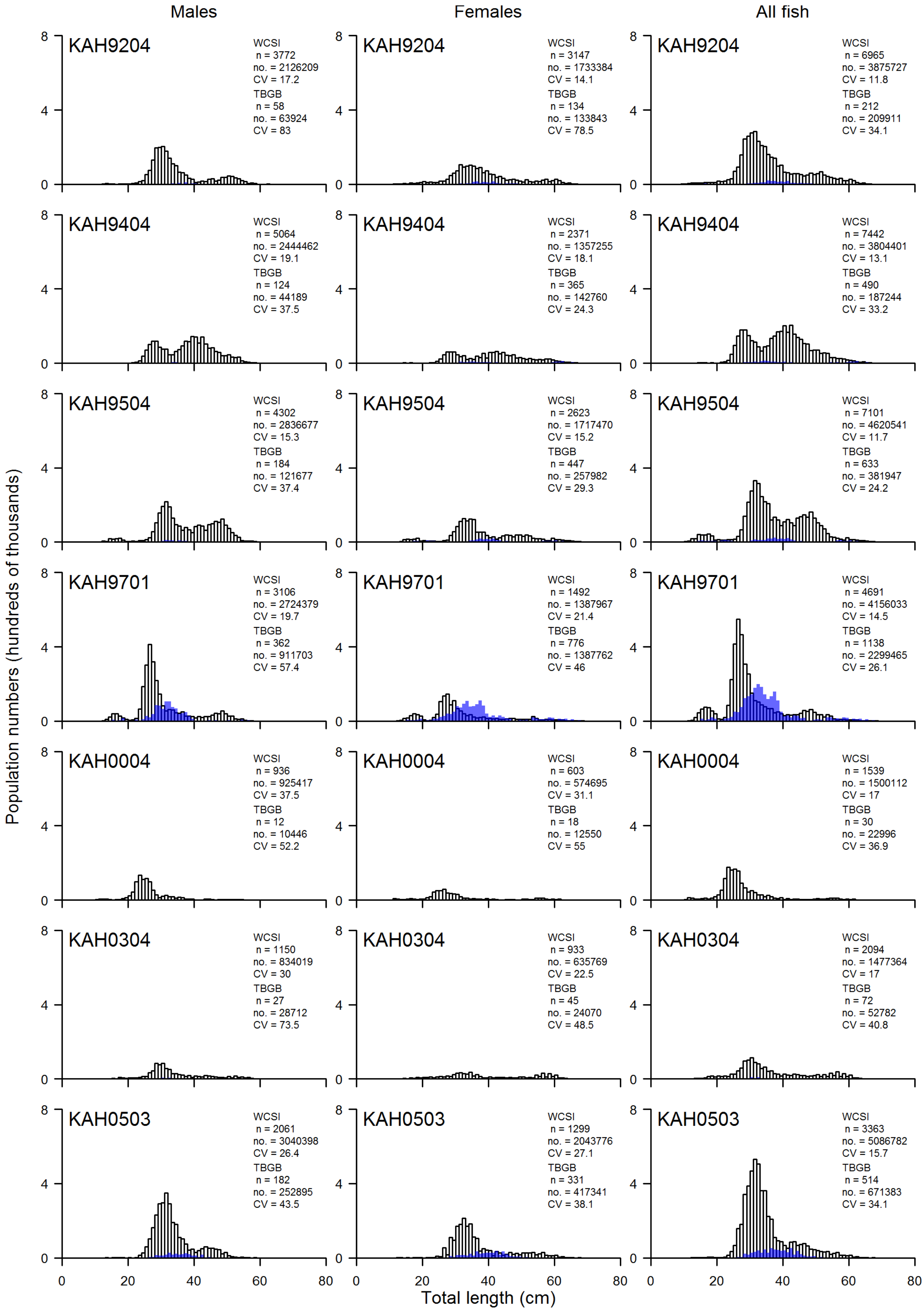



**Figure 5h: Red cod.**

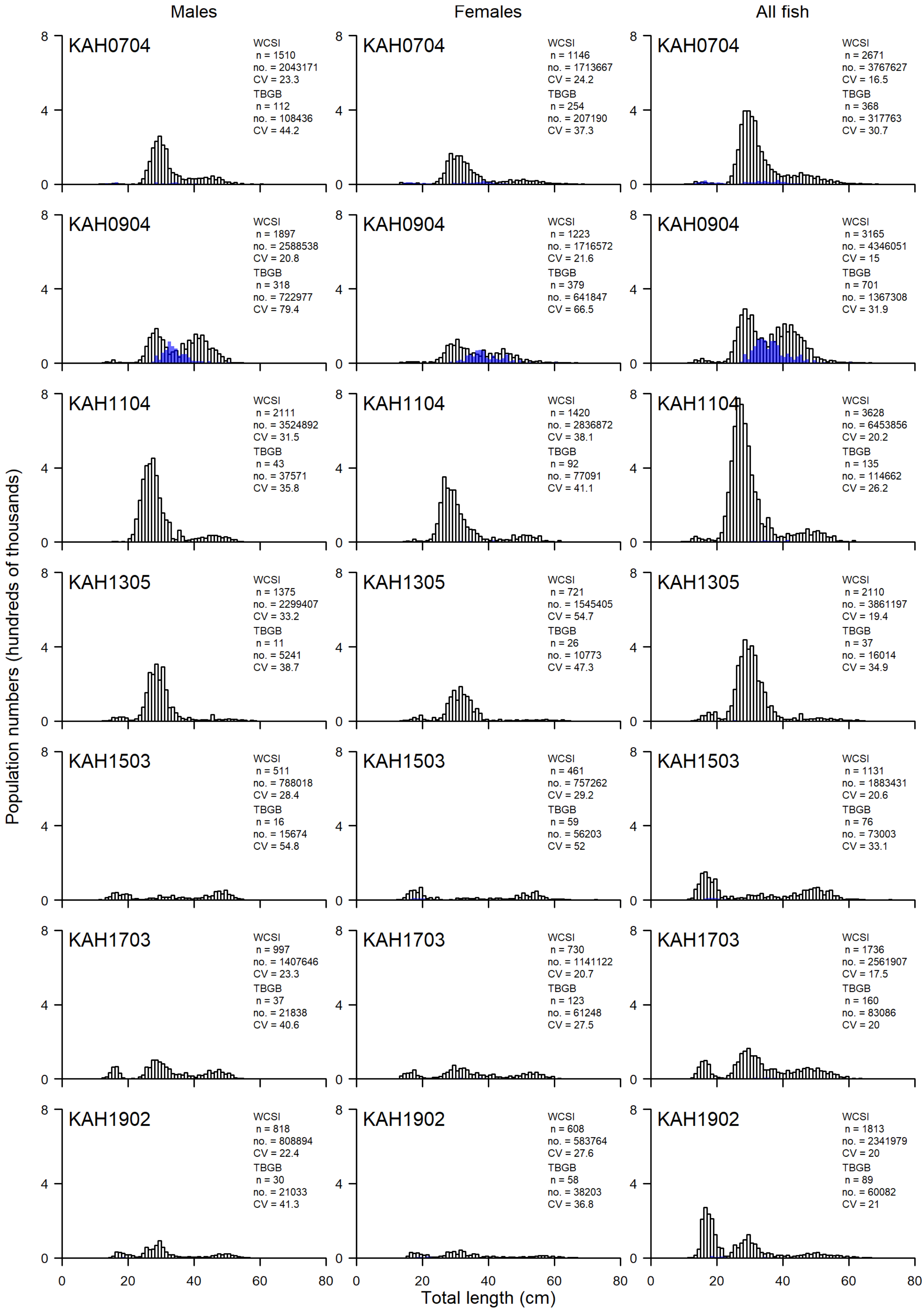



**Figure 5h—continued.**

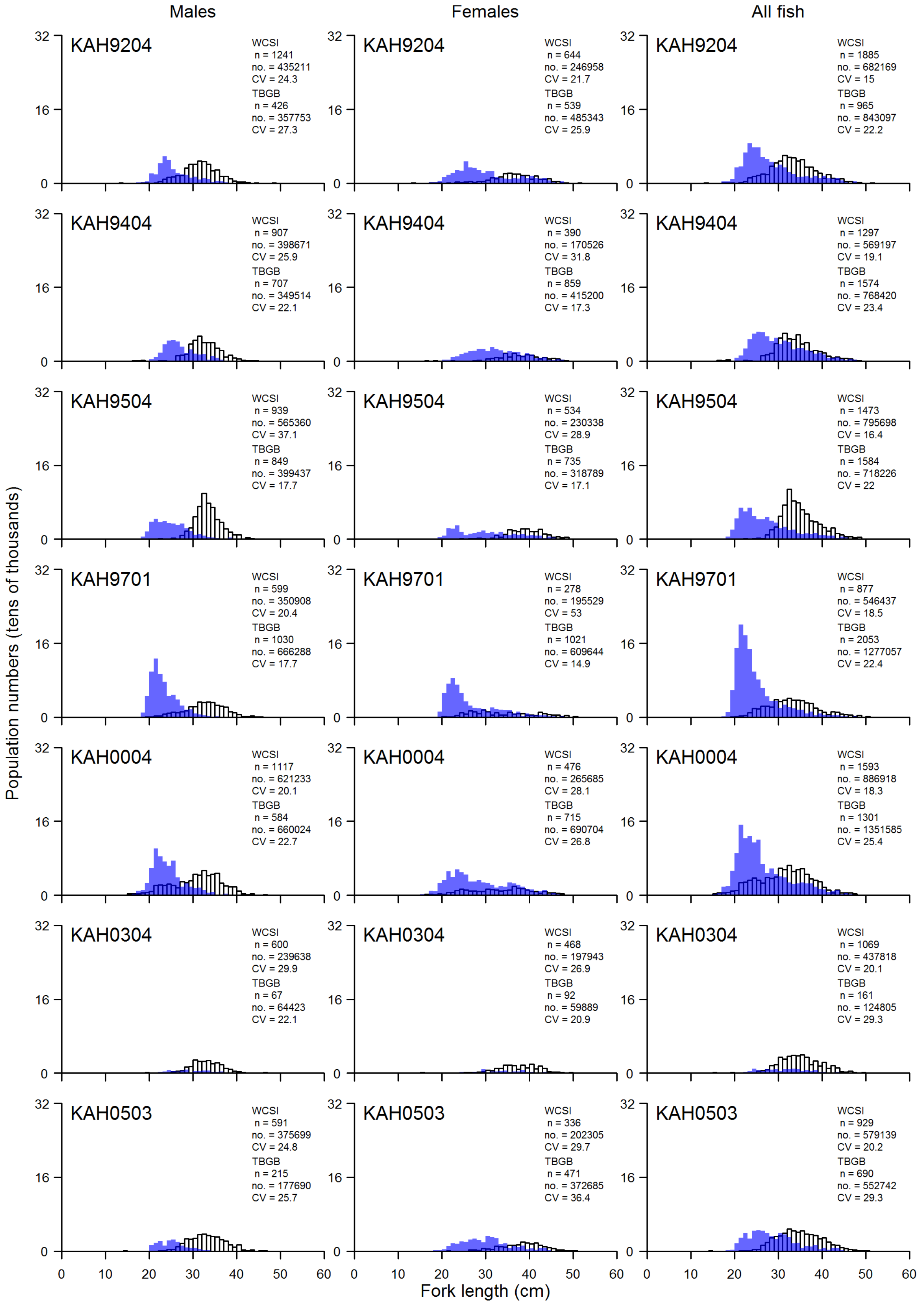



**Figure 5i: Red gurnard.**

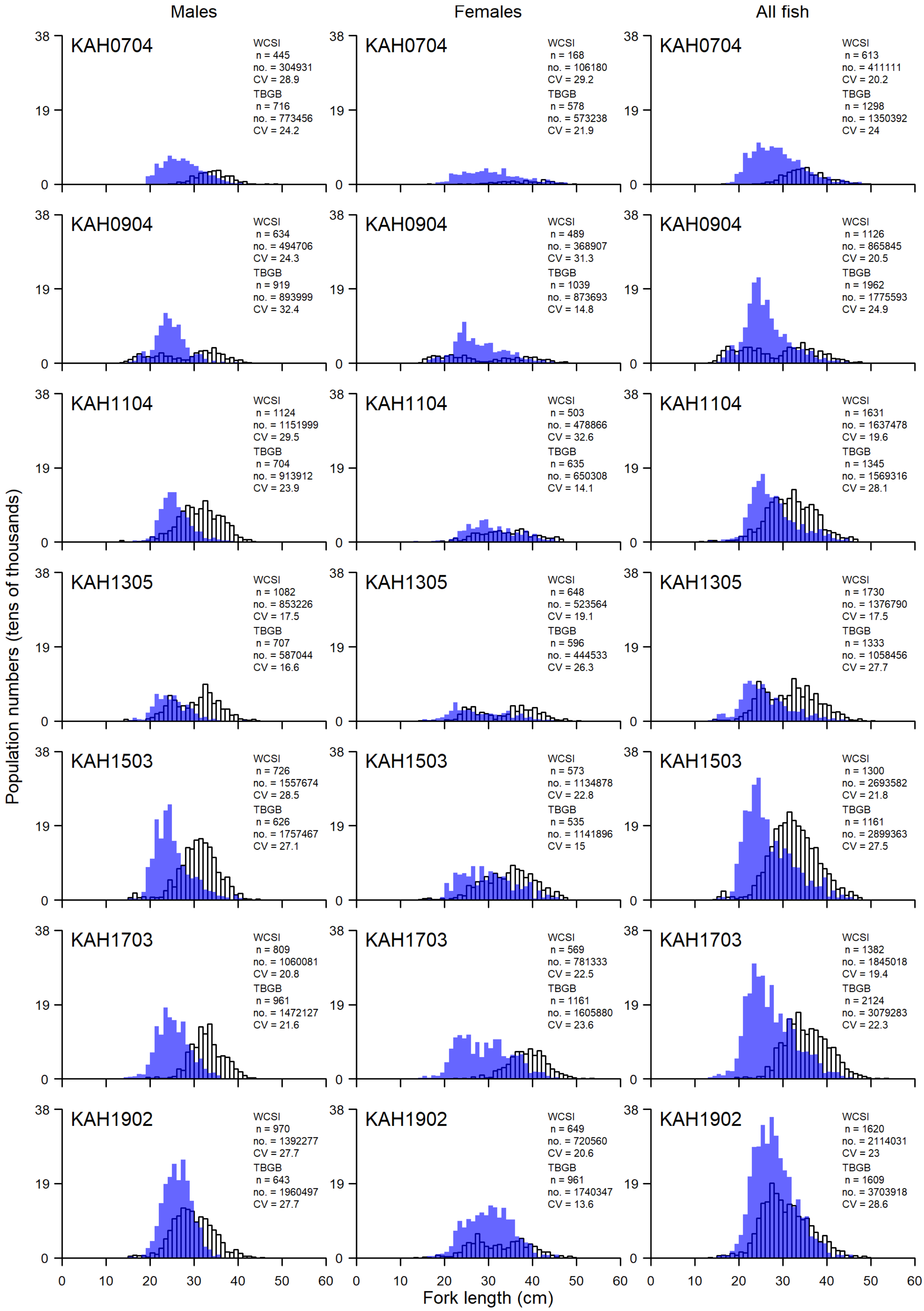



**Figure 5i—continued.**

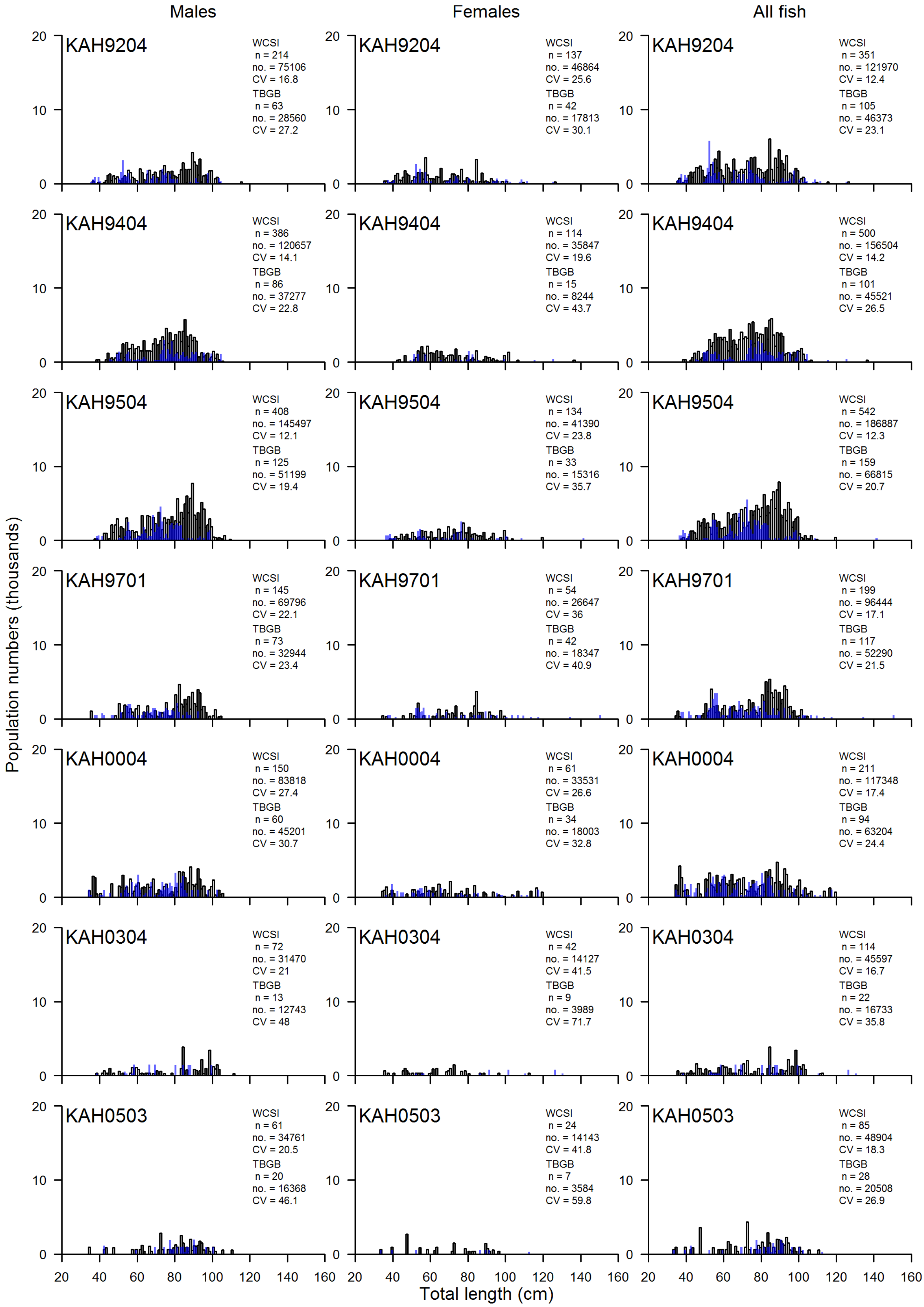



**Figure 5j: Rig.**

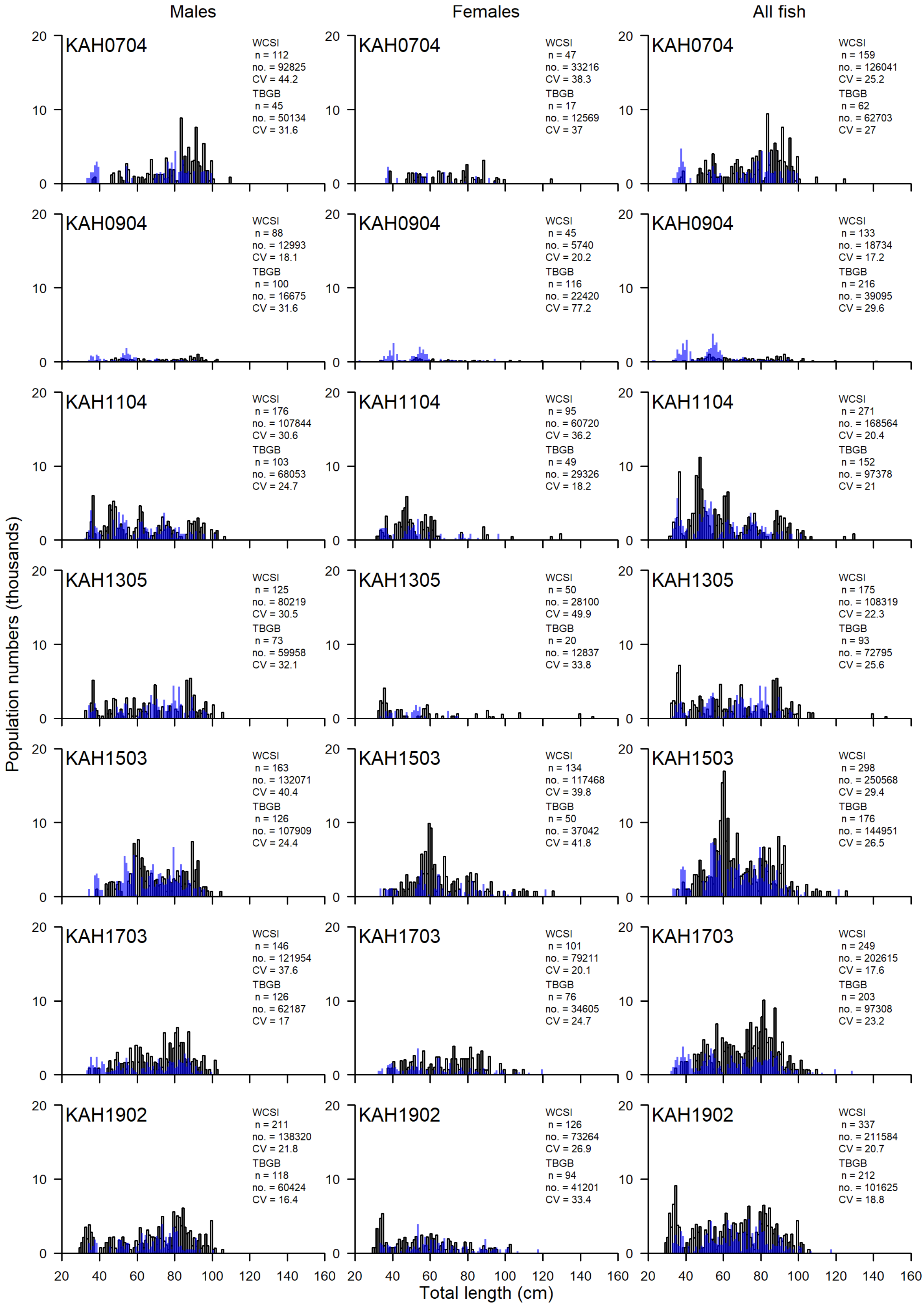



**Figure 5j—continued.**

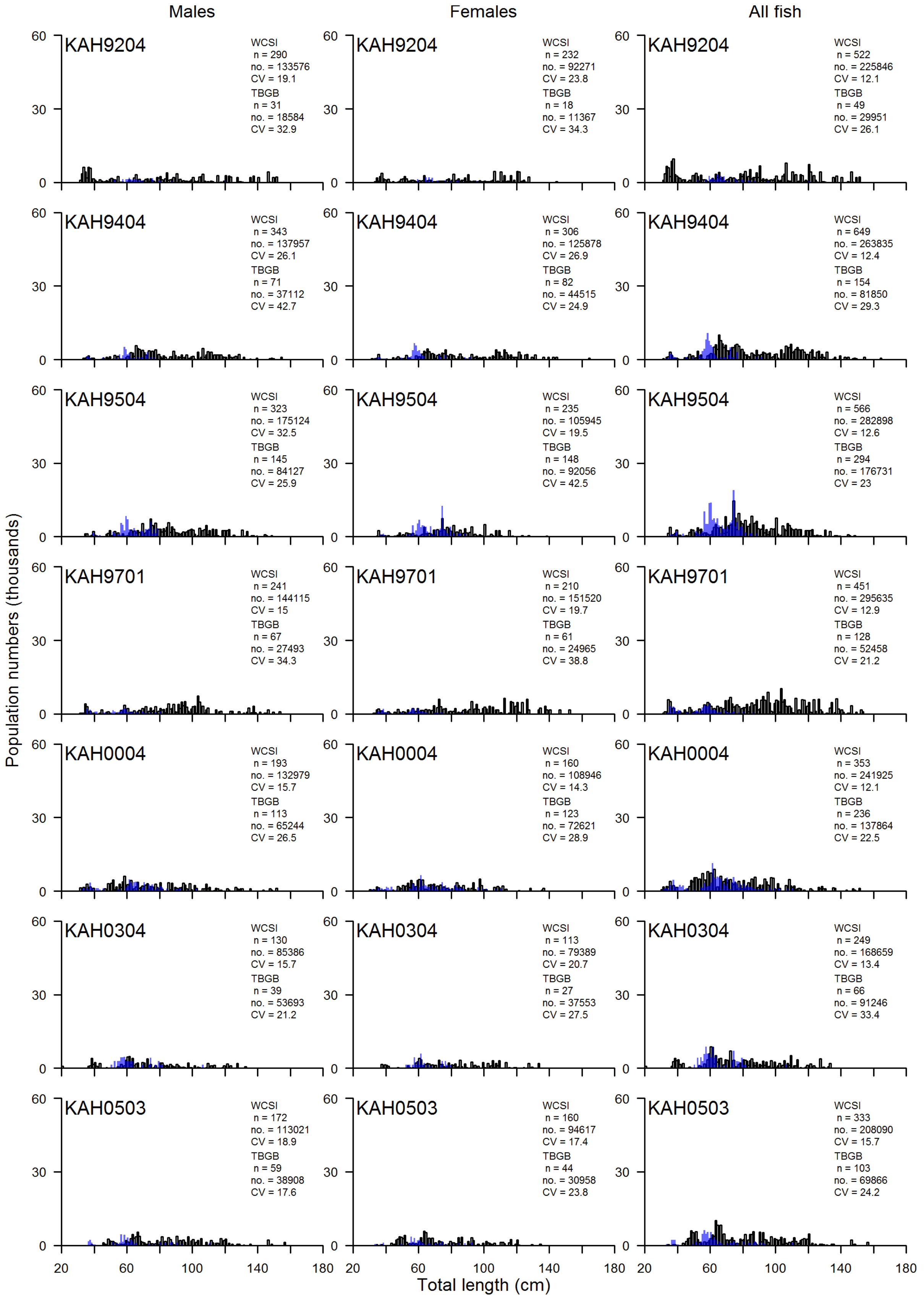



**Figure 5k: School shark.**

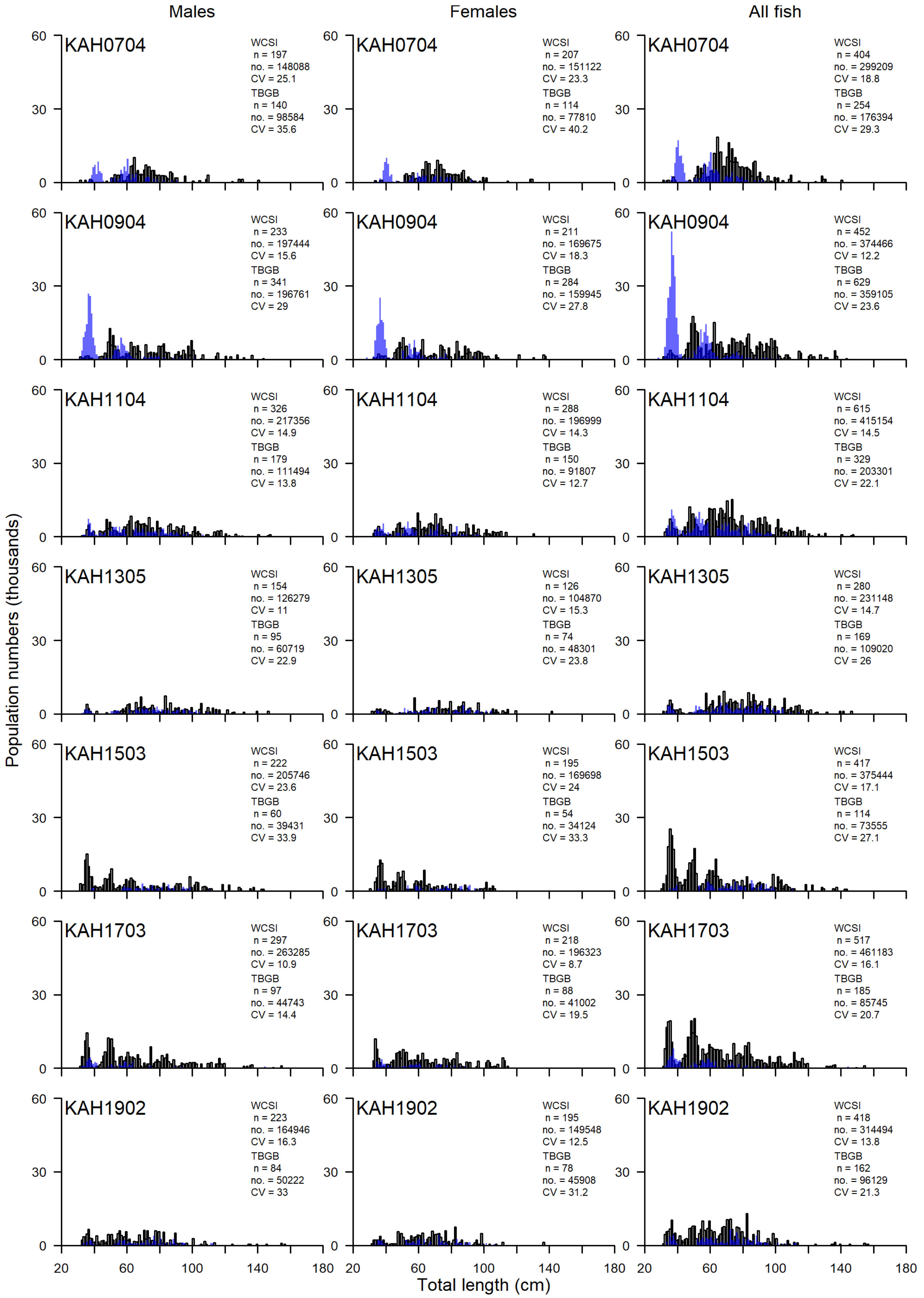



**Figure 5k—continued.**

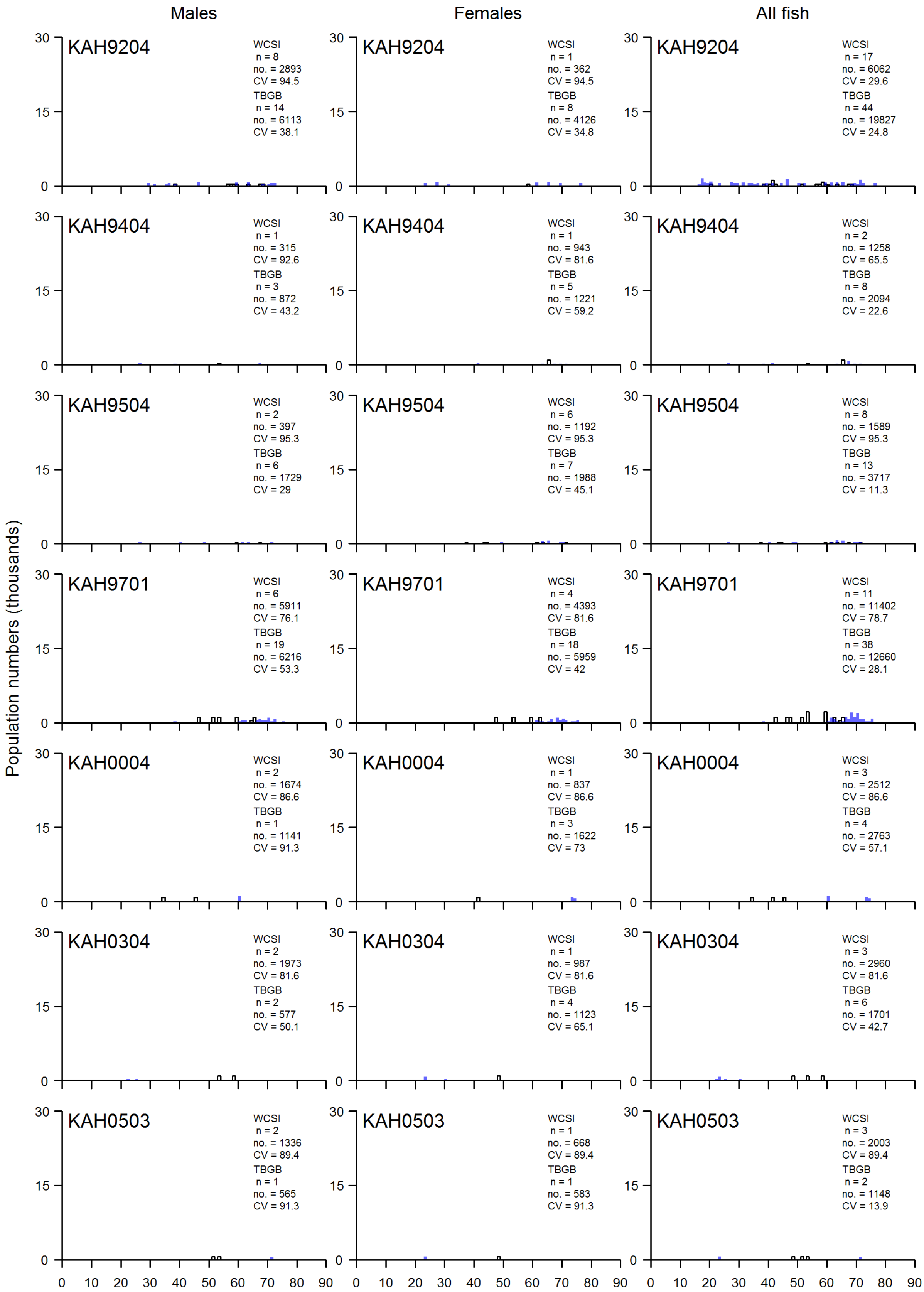



**Figure 5l: Snapper**

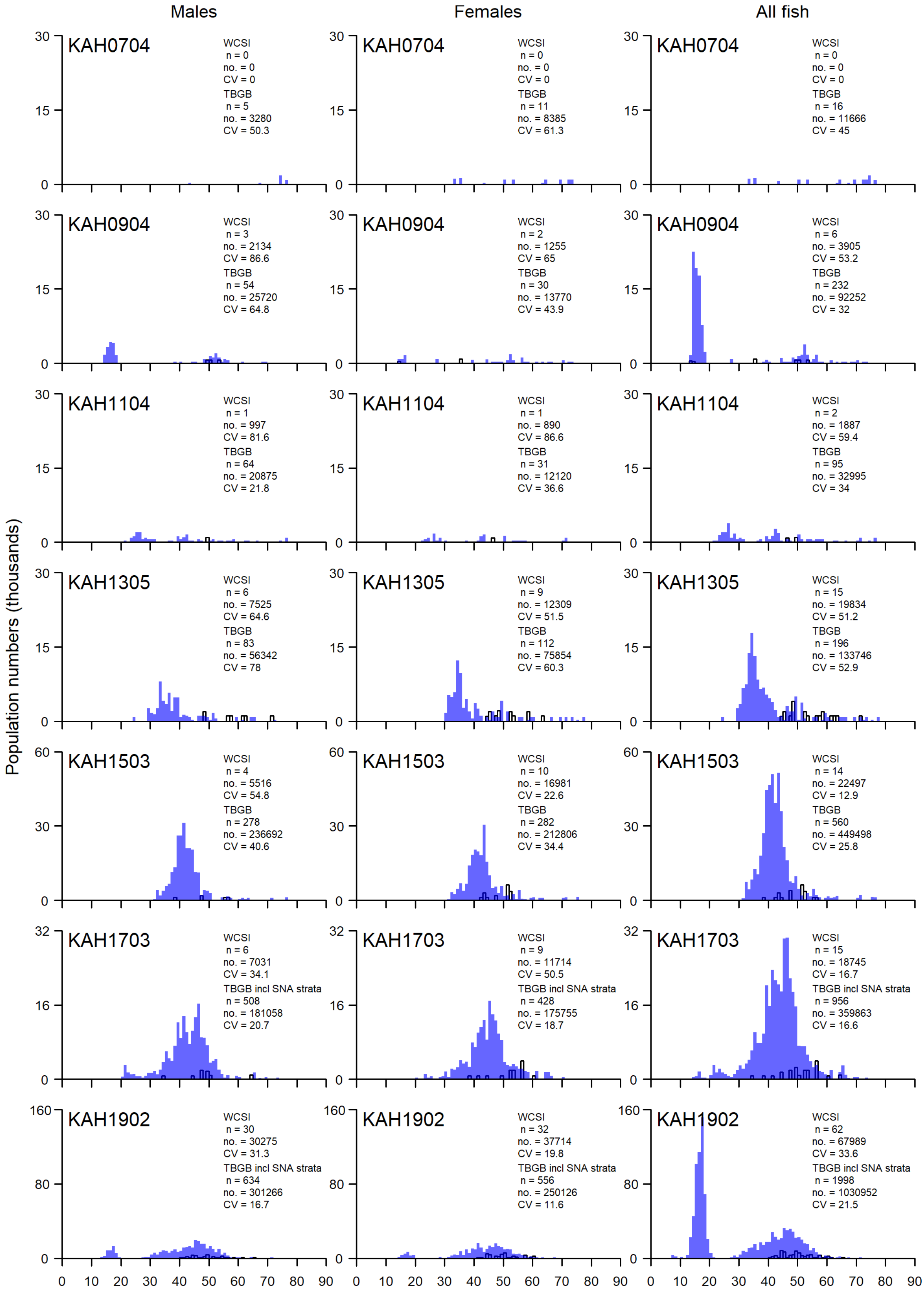



**Figure 5l—continued.**

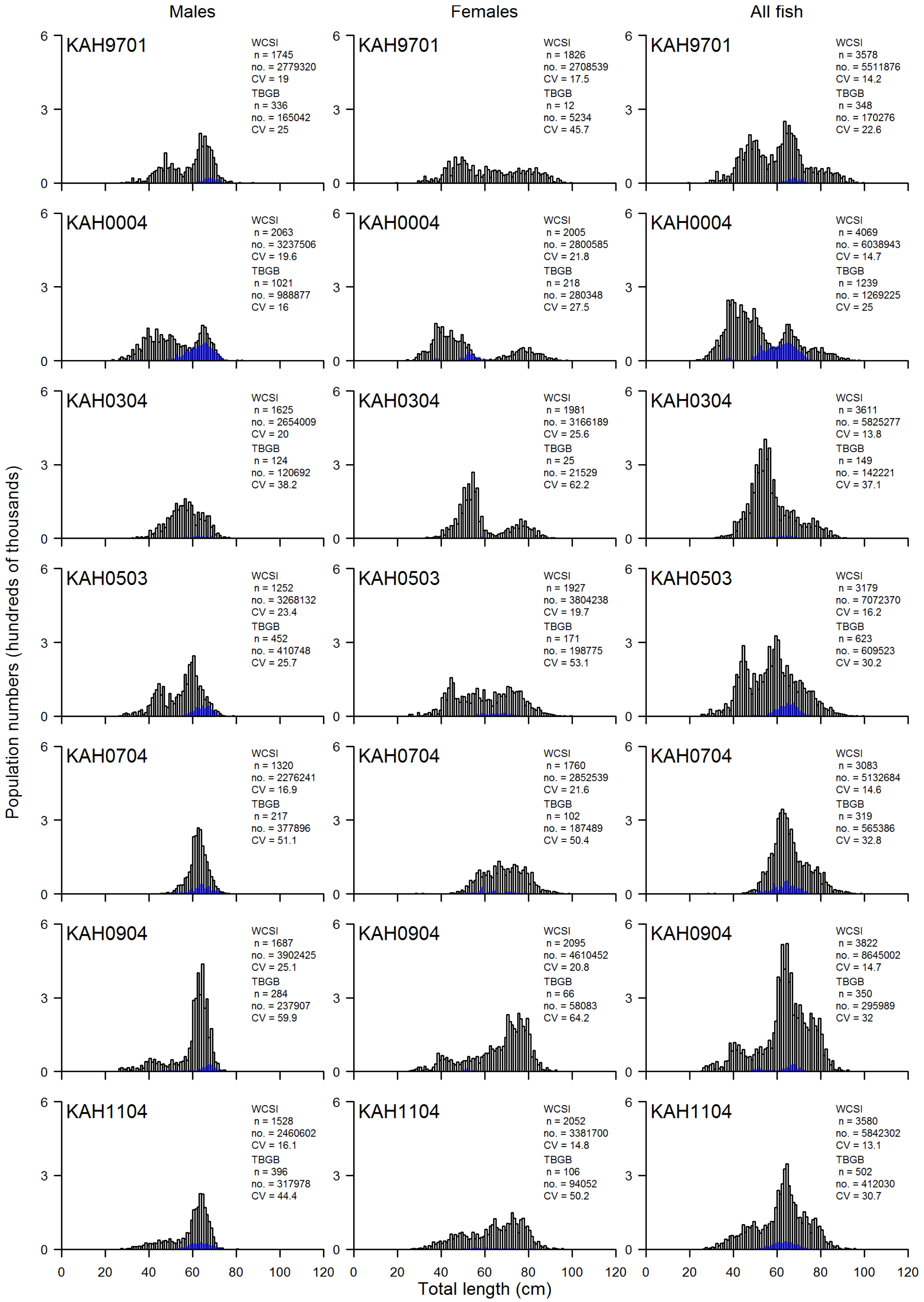



**Figure 5m: Spiny dogfish. NB: spiny dogfish were not measured before 1997.**

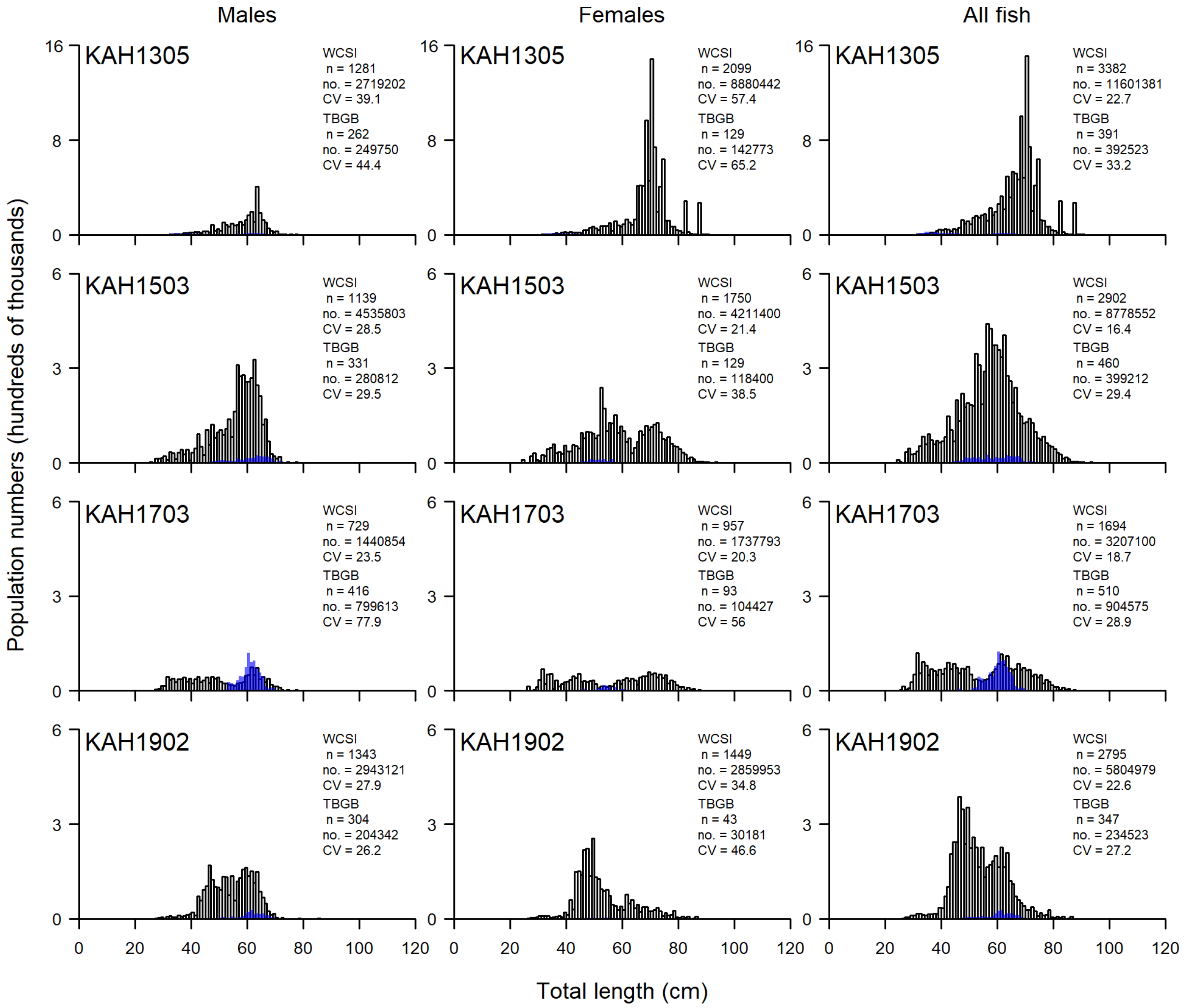



**Figure 5m—continued.**

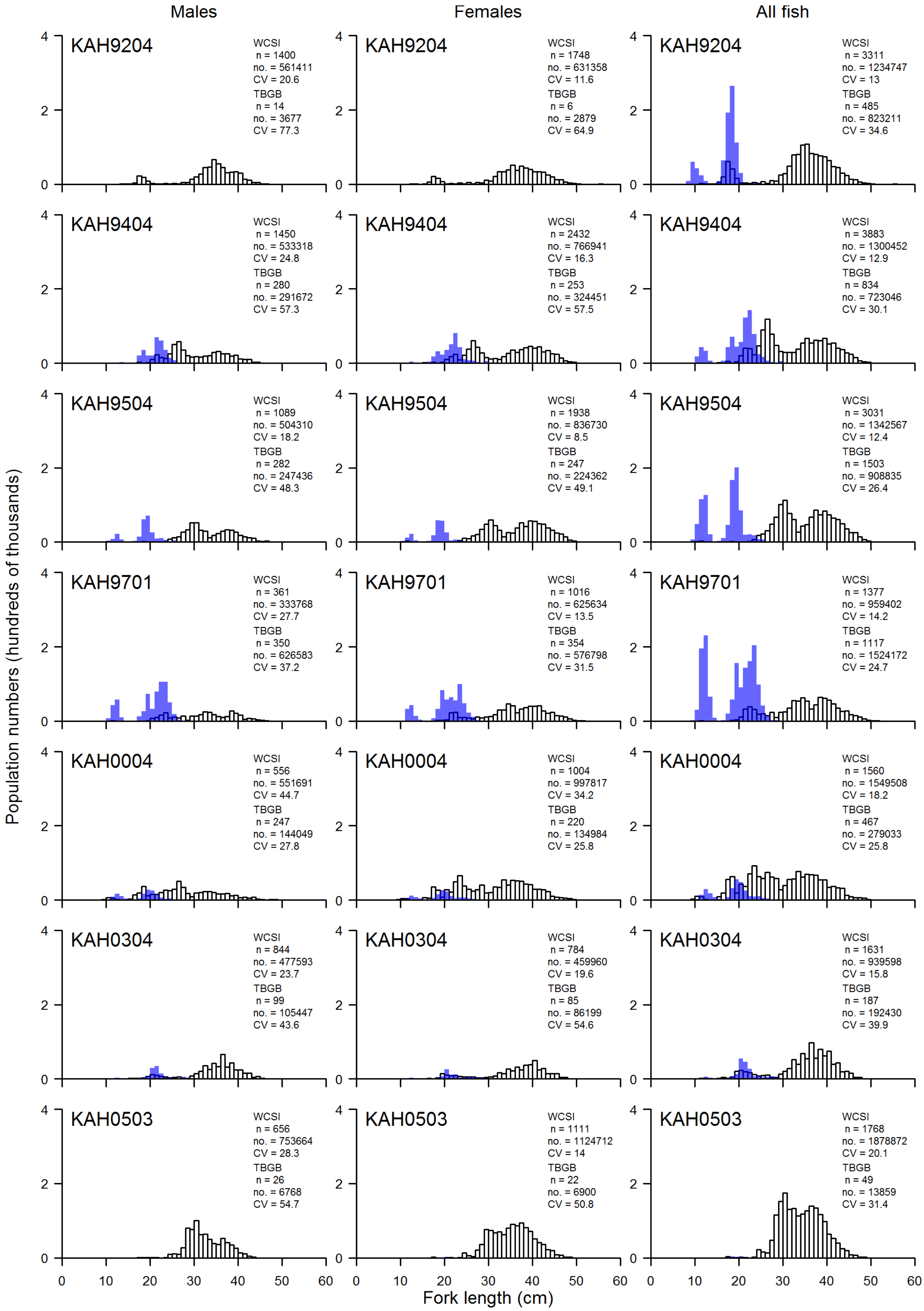



**Figure 5n: Tarakihi.**

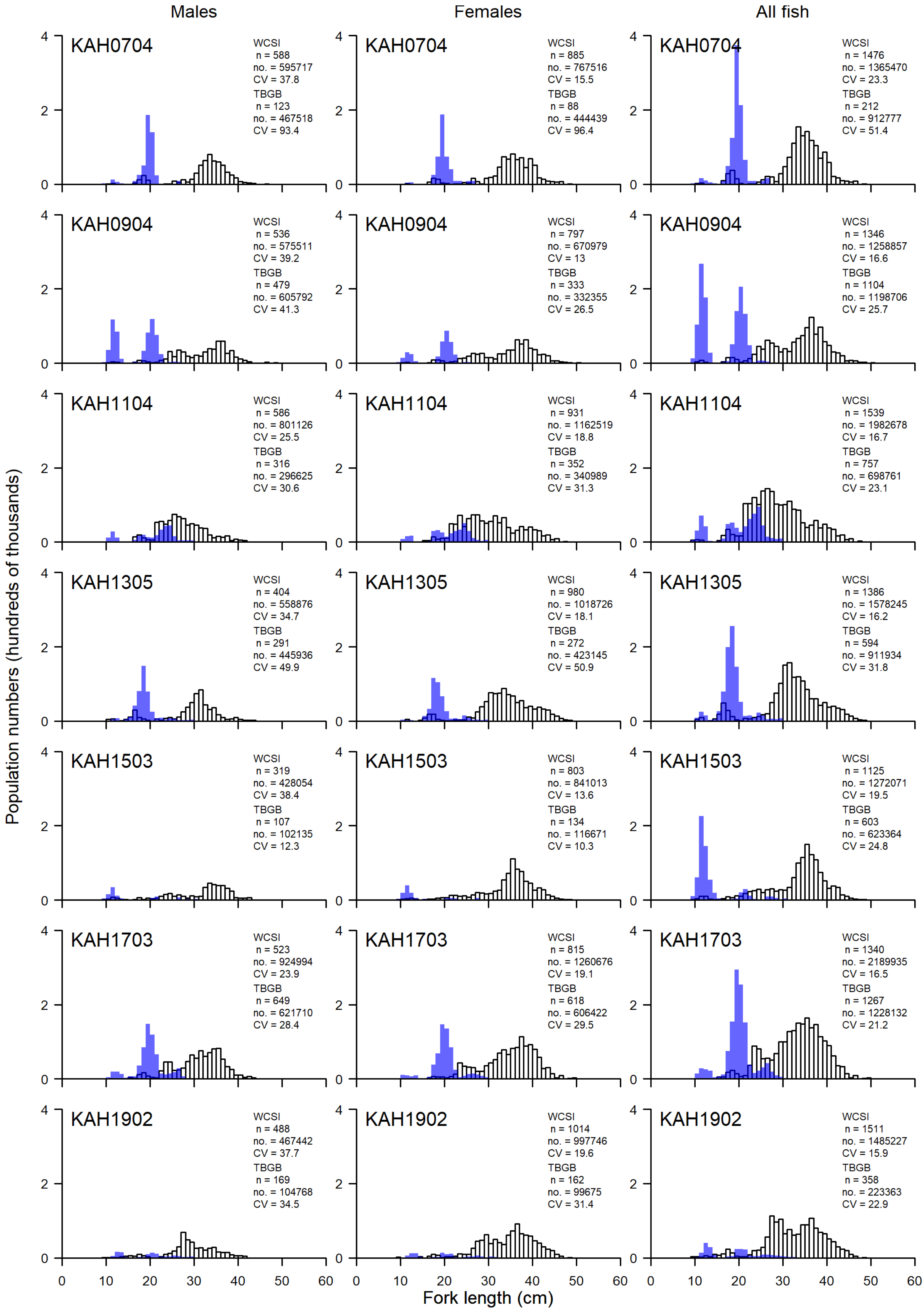
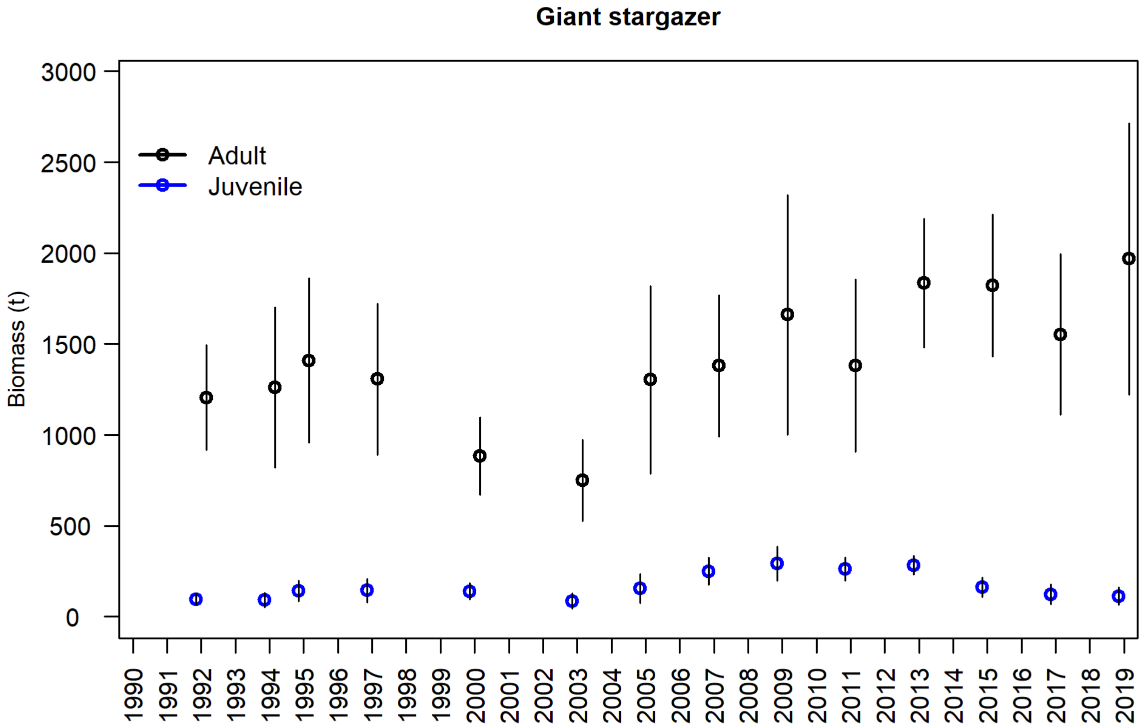



**Figure 5n—continued.**



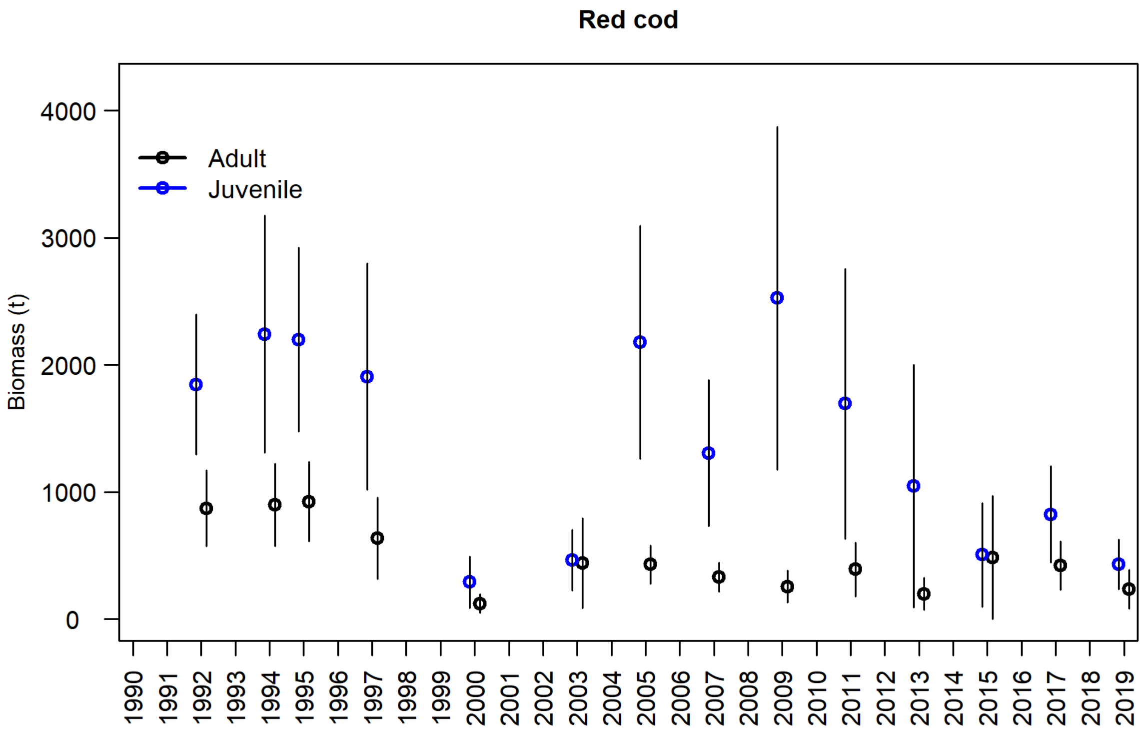
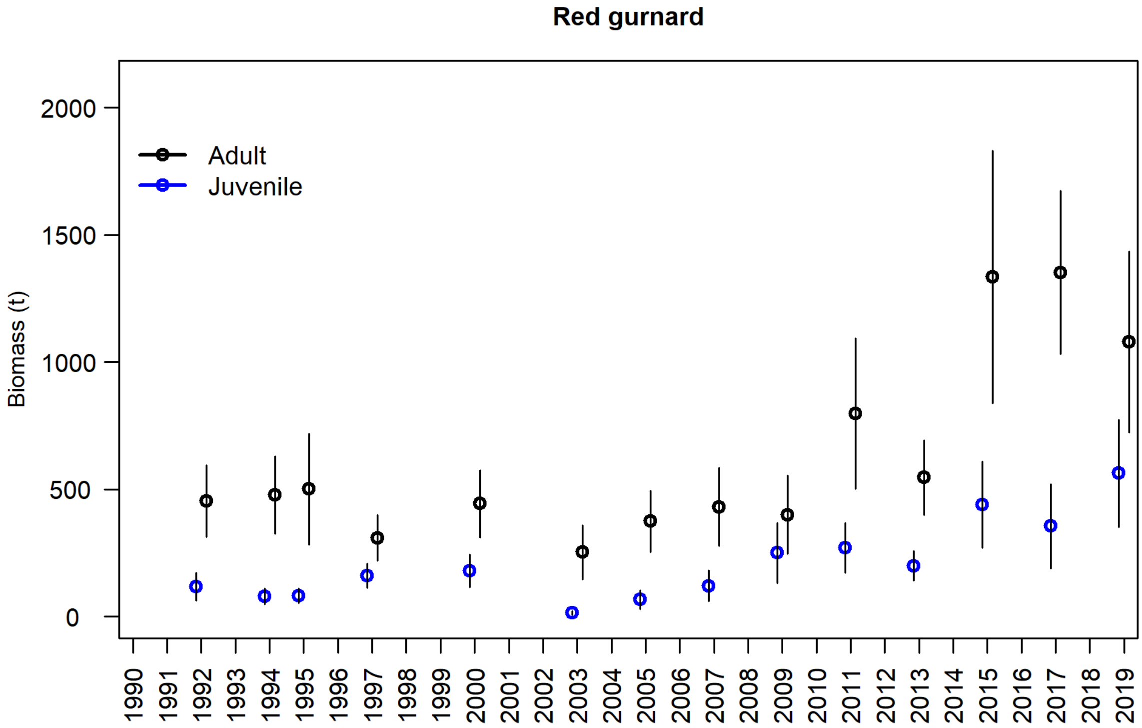




**Figure 6: Biomass trends with 95% confidence intervals for juveniles (dashed blue lines) and adults (solid black lines) for the target species (all sexes combined) from all surveys in the series. For 50% maturity lengths, see Table 5.**



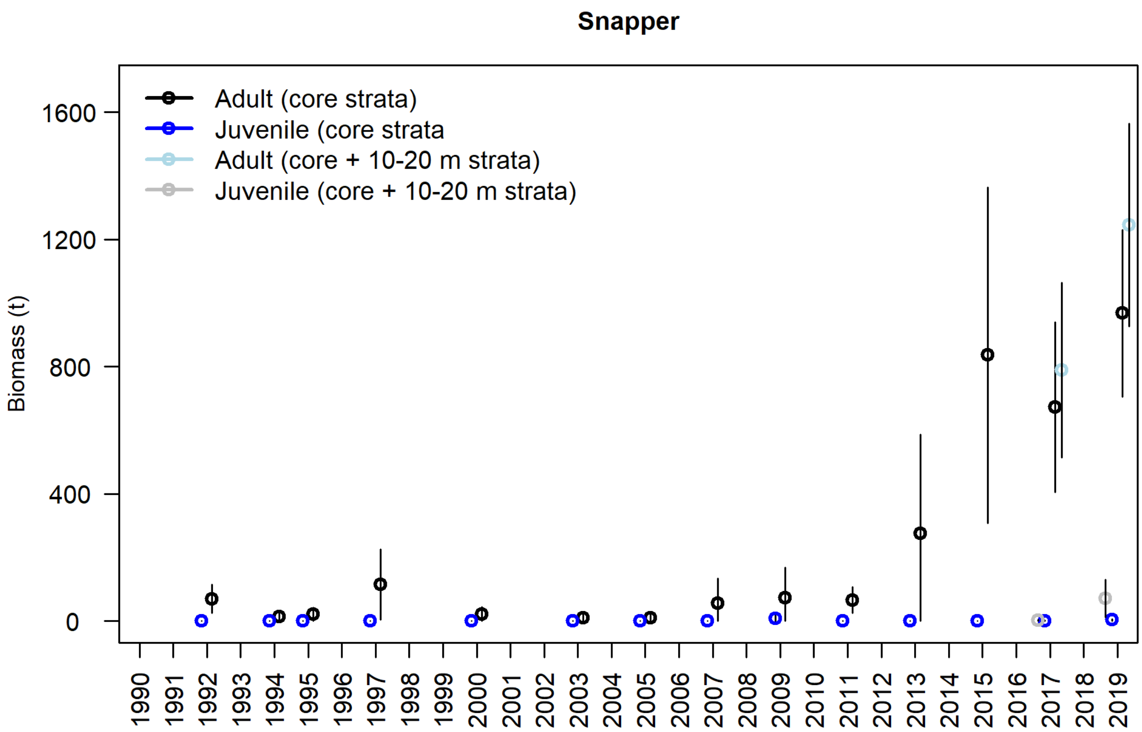
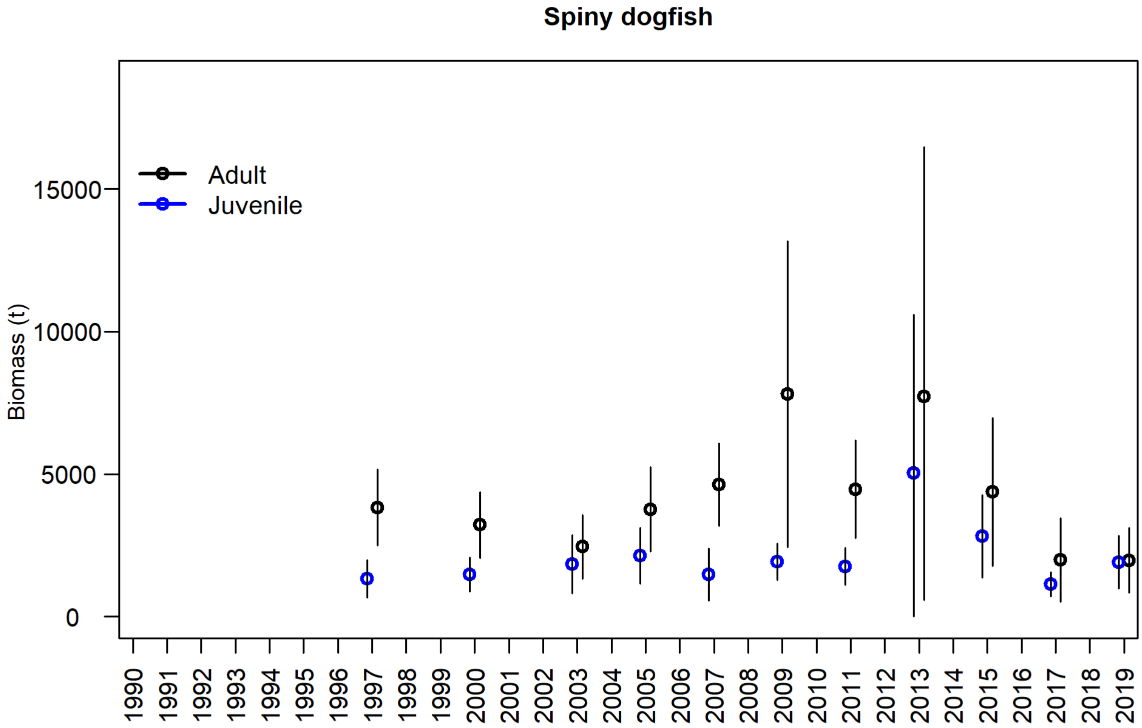




**Figure 6—continued.**



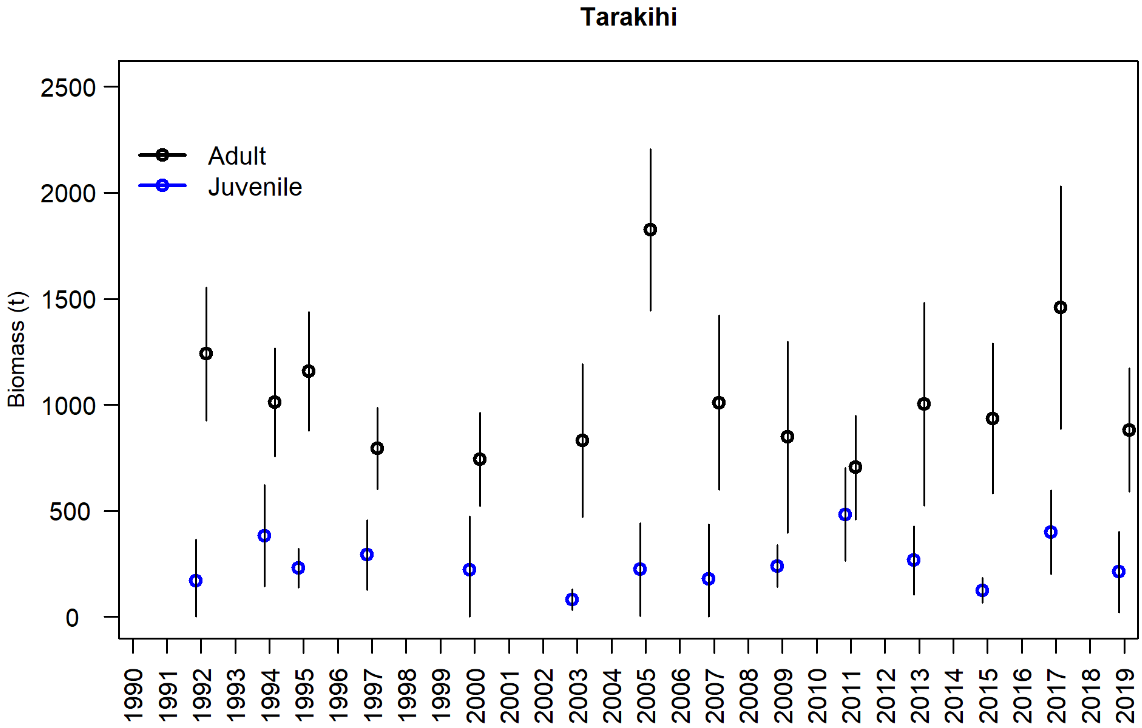




**Figure 6—continued.**

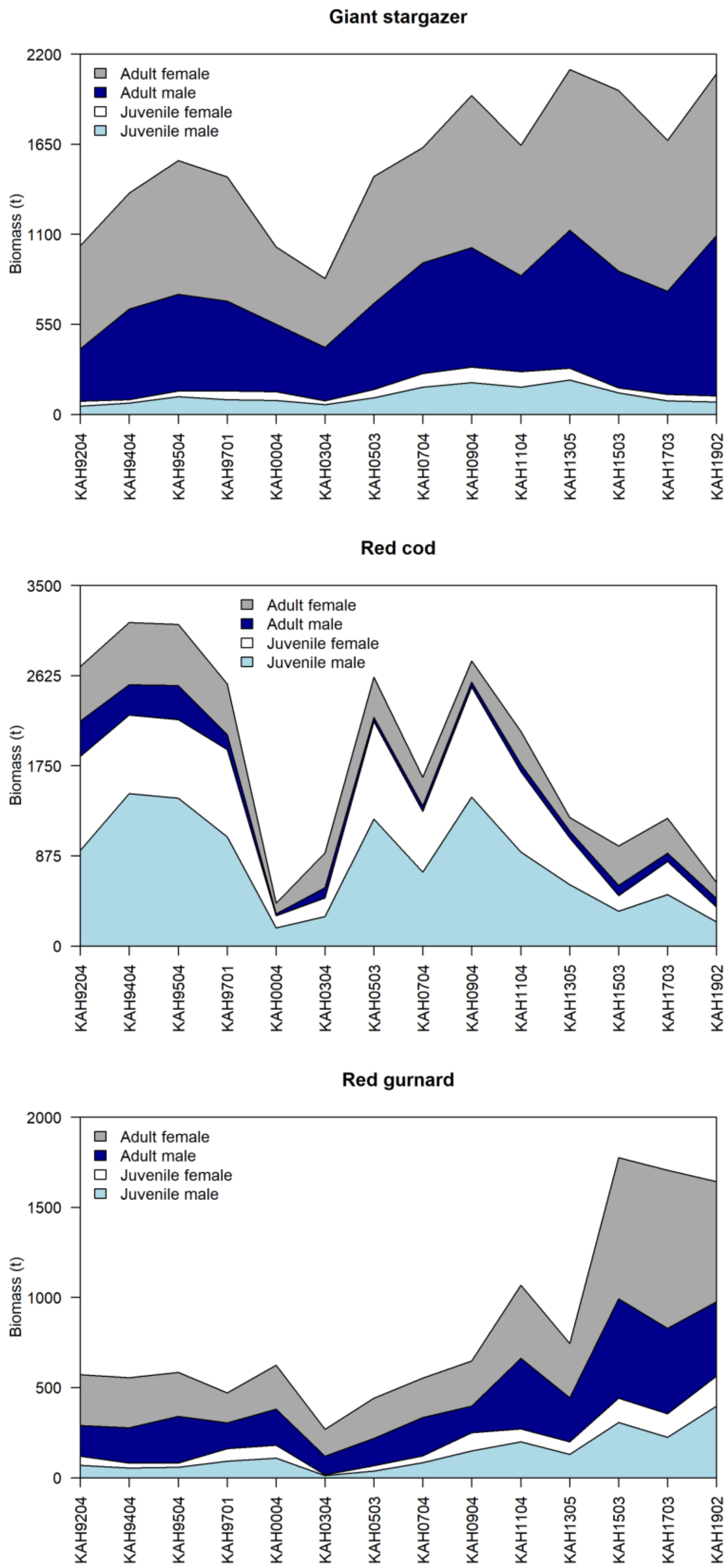



**Figure 7: Biomass trends for juveniles and adults by sex for the target species for all surveys in the series. For 50% maturity lengths, see Table 5.**

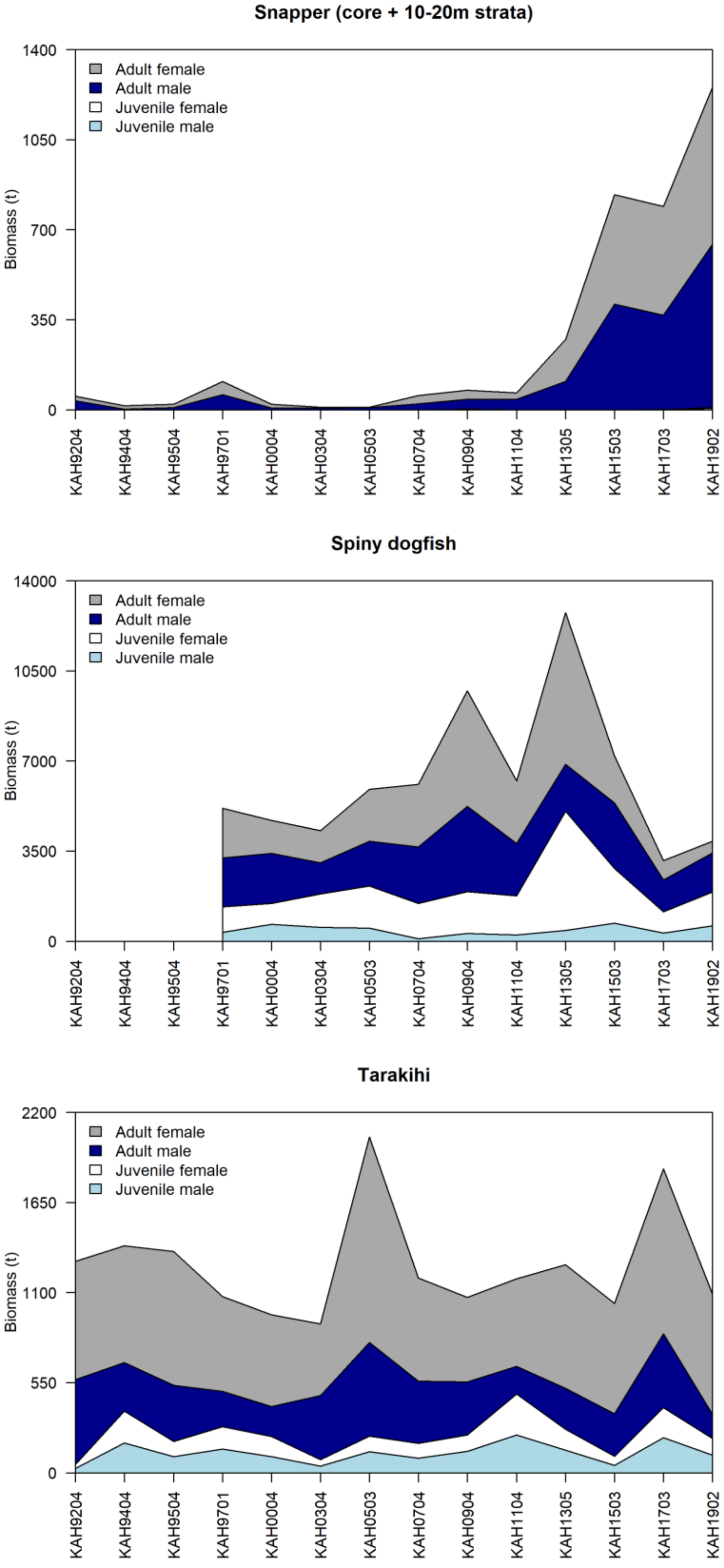



**Figure 7—continued.**

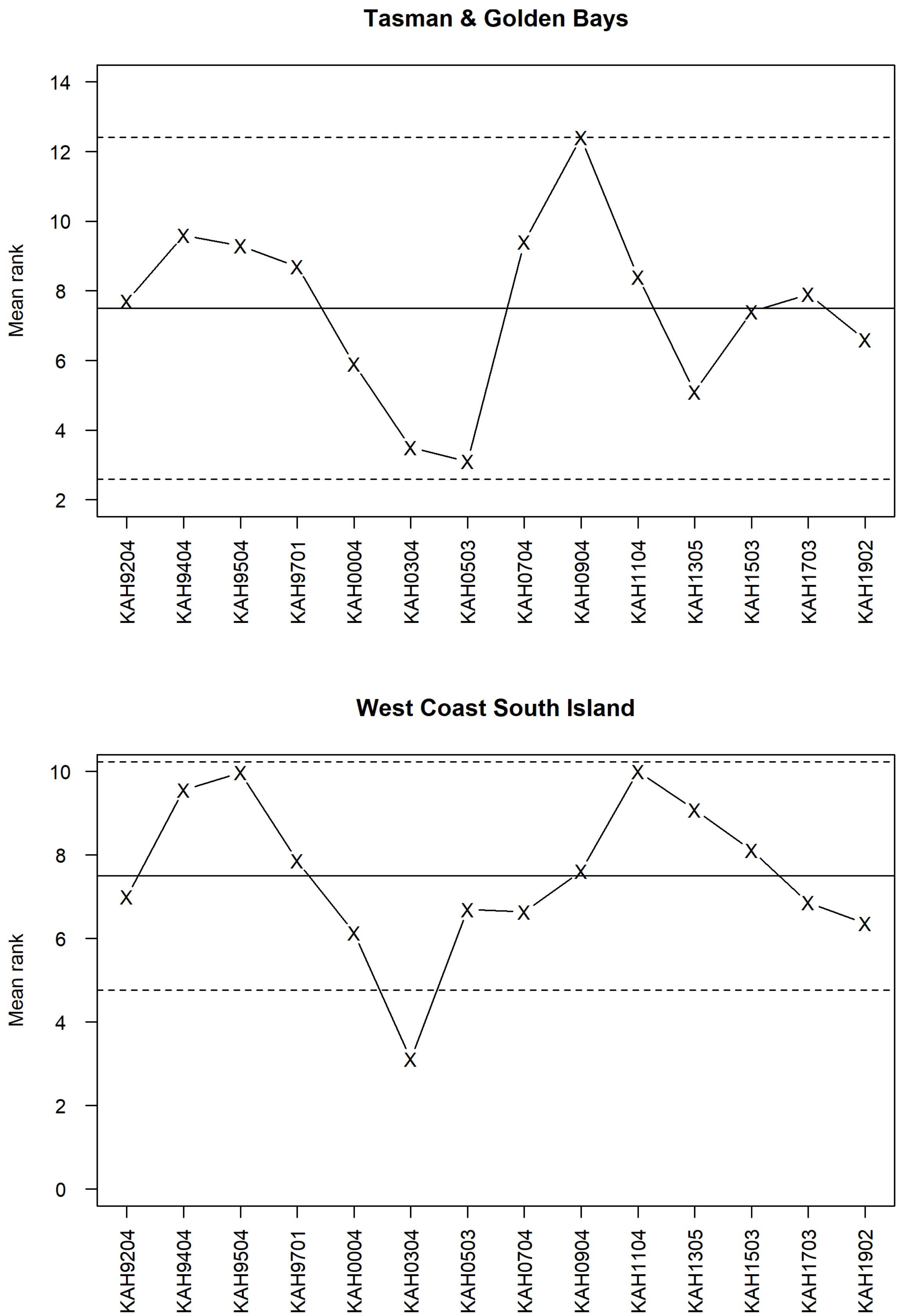



**Figure 8: Mean ranks for the WCSI inshore trawl surveys for Tasman and Golden Bays (upper plot) and the west coast South Island (lower plot). The solid line indicates the overall mean rank. Mean ranks outside the broken lines (95% confidence intervals) have extreme catchability.**

**Appendix 1: Length-weight relationship parameters used to scale length frequencies and calculate length class biomass estimates. (Fisheries New Zealand *rdb* database; n, sample size.)**

| | | | | Length range (cm) | | |
|---|---|---|---|---|---|---|
| Species | *a* | *b* | n | Min | Max | Data source |
| Barracouta | 0.0056 | 2.9766 | 408 | 13.2 | 91.4 | *rdb*, KAH1305 |
| Blue warehou | 0.0144 | 3.1050 | 338 | 27.4 | 69.6 | *rdb*, KAH9604 |
| Gemfish | 0.0017 | 3.3419 | 391 | 32 | 107 | *rdb*, KAH9602 |
| Giant stargazer | 0.0119 | 3.0972 | 411 | 9.3 | 72.1 | KAH1902 |
| Jack mackerel (*Trachurus declivis*) | 0.0165 | 2.9300 | 200 | 15 | 53 | *rdb*, COR9001 |
| John dory | 0.0186 | 2.9790 | 316 | 18.5 | 55.7 | KAH1902 |
| Ling | 0.0016 | 3.2477 | 232 | 27 | 122 | KAH1305 |
| Red cod | 0.0103 | 2.9626 | 628 | 15.8 | 67.8 | KAH1902 |
| Red gurnard | 0.0090 | 3.0326 | 821 | 14.6 | 51.4 | KAH1902 |
| Rig | 0.0040 | 3.0065 | 430 | 33.6 | 129 | KAH1703 |
| School shark | 0.0031 | 3.0963 | 494 | 32.3 | 155 | KAH1703 |
| Snapper | 0.0361 | 2.8644 | 498 | 8.9 | 71.7 | KAH1703 |
| Spiny dogfish | 0.0020 | 3.1566 | 972 | 27 | 87.7 | KAH1902 |
| Tarakihi | 0.0138 | 3.0698 | 674 | 10.4 | 49.1 | KAH1902 |

## Appendix 2: station details. '#' = not suitable for biomass estimation

| | | | Start of tow | | | End of tow | | Gear depth (m) | | Distance trawled | Headline | Doorspread | Surface temp | Bottom temp | Warp length |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station | Stratum | Date | Time | ° ' S | ° ' E | ° ' S | ° ' E | Min. | Max. | (n. miles) | height (m) | (m) | ° C | ° C | (m) |
| 1# | — | 23-Mar-19 | 554 | 41 07.80 | 173 19.99 | 41 08.24 | 173 19.30 | 25 | 26 | 0.68 | 4.5 | 74 | — | — | 200 |
| 2 | 20 | 23-Mar-19 | 1106 | 41 13.25 | 173 14.65 | 41 10.33 | 173 15.37 | 13 | 20 | 2.96 | 4.7 | 71.5 | 21.2 | 19.2 | 200 |
| 3 | 20 | 23-Mar-19 | 1253 | 41 10.36 | 173 18.77 | 41 13.00 | 173 17.05 | 13 | 20 | 2.94 | 4.5 | 73.7 | — | — | 200 |
| 4 | 20 | 23-Mar-19 | 1455 | 41 08.94 | 173 09.70 | 41 06.31 | 173 08.03 | 14 | 17 | 2.91 | 4.8 | 72 | 21 | 19.4 | 200 |
| 5 | 21 | 24-Mar-19 | 558 | 40 46.62 | 172 56.09 | 40 47.33 | 172 52.31 | 14 | 18 | 2.94 | 4.7 | 68.5 | 19.4 | 19 | 200 |
| 6 | 21 | 24-Mar-19 | 748 | 40 45.43 | 172 48.77 | 40 43.84 | 172 45.39 | 16 | 18 | 3.01 | 4.3 | 68.3 | 20 | 19.3 | 200 |
| 7 | 21 | 24-Mar-19 | 1010 | 40 41.13 | 172 45.09 | 40 38.37 | 172 43.64 | 15 | 18 | 2.97 | 4.8 | 67.4 | 20.1 | 19 | 200 |
| 8 | 21 | 24-Mar-19 | 1247 | 40 36.02 | 172 46.07 | 40 39.01 | 172 46.34 | 19 | 20 | 2.99 | 4.3 | 71.8 | 19.8 | 18.7 | 200 |
| 9 | 17 | 24-Mar-19 | 1504 | 40 38.07 | 172 49.21 | 40 38.09 | 172 53.21 | 27 | 29 | 3.03 | 4.7 | 74.8 | 20.1 | 17.8 | 200 |
| 10 | 17 | 25-Mar-19 | 603 | 40 40.02 | 172 50.73 | 40 41.97 | 172 53.74 | 27 | 28 | 3 | 4.4 | 74.6 | 19.7 | 17.4 | 200 |
| 11 | 17 | 25-Mar-19 | 758 | 40 37.65 | 172 54.98 | 40 37.65 | 172 58.84 | 29 | 33 | 2.92 | 4.2 | 77.1 | 19.9 | 17.8 | 200 |
| 12 | 19 | 25-Mar-19 | 1050 | 40 38.83 | 173 17.76 | 40 41.41 | 173 19.69 | 54 | 55 | 2.96 | 4.5 | 75.6 | 19.4 | 16.4 | 200 |
| 13 | 19 | 25-Mar-19 | 1244 | 40 39.37 | 173 25.13 | 40 41.28 | 173 28.16 | 56 | 58 | 2.98 | 4.5 | 75.1 | 19.4 | 16.7 | 200 |
| 14 | 19 | 25-Mar-19 | 1440 | 40 45.10 | 173 25.46 | 40 47.32 | 173 28.13 | 52 | 53 | 3 | 4.4 | 77.3 | 19.5 | 16.8 | 200 |
| 15 | 18 | 28-Mar-19 | 602 | 41 02.50 | 173 30.41 | 41 00.20 | 173 27.95 | 38 | 43 | 2.95 | 4.6 | 79.7 | 19.5 | 17.3 | 200 |
| 16 | 18 | 28-Mar-19 | 804 | 41 06.51 | 173 26.94 | 41 07.93 | 173 23.49 | 28 | 29 | 2.96 | 4.6 | 76.2 | 19.5 | 18 | 200 |
| 17 | 18 | 28-Mar-19 | 946 | 41 05.61 | 173 21.52 | 41 03.43 | 173 18.83 | 32 | 37 | 2.97 | 4.5 | 76.7 | 19.6 | 17.3 | 200 |
| 18 | 18 | 28-Mar-19 | 1136 | 41 00.11 | 173 15.34 | 40 57.42 | 173 13.66 | 36 | 38 | 2.97 | 4.5 | 77 | 18.8 | 17 | 200 |
| 19 | 18 | 28-Mar-19 | 1336 | 40 52.24 | 173 07.01 | 40 49.56 | 173 05.27 | 35 | 37 | 2.98 | 4.6 | 76.4 | 18.7 | 17 | 200 |
| 20 | 19 | 29-Mar-19 | 604 | 40 42.73 | 173 40.15 | 40 45.59 | 173 39.09 | 54 | 58 | 2.97 | 4.4 | 74.2 | 18.7 | 17.2 | 200 |
| 21 | 19 | 29-Mar-19 | 807 | 40 45.15 | 173 32.70 | 40 48.00 | 173 31.55 | 51 | 53 | 2.98 | 4.4 | 76.4 | 18.9 | 16.9 | 200 |
| 22 | 19 | 29-Mar-19 | 1040 | 40 45.99 | 173 16.00 | 40 47.68 | 173 12.74 | 4 | 47 | 2.99 | 4.6 | 75.9 | 18.9 | 16.7 | 200 |
| 23 | 19 | 29-Mar-19 | 1220 | 40 49.92 | 173 15.88 | 40 51.90 | 173 18.84 | 44 | 45 | 2.98 | 4.7 | 77 | 18.9 | 16.7 | 200 |
| 24 | 20 | 29-Mar-19 | 1508 | 41 01.30 | 173 03.96 | 41 03.84 | 173 04.05 | 16 | 18 | 2.54 | 4.4 | 74.7 | 19.4 | 19.2 | 200 |
| 25 | 1 | 30-Mar-19 | 604 | 40 31.32 | 172 30.01 | 40 33.00 | 172 26.72 | 75 | 80 | 3.01 | 4.6 | 78.8 | 18.7 | 14.1 | 230 |
| 26 | 1 | 30-Mar-19 | 1011 | 40 49.14 | 172 02.73 | 40 51.87 | 172 01.12 | 97 | 98 | 2.98 | 4.1 | 83.3 | 19.2 | 14.1 | 280 |
| 27 | 2 | 30-Mar-19 | 1205 | 40 55.18 | 171 56.18 | 40 57.73 | 171 54.25 | 108 | 111 | 2.93 | 4.5 | 78.7 | 19.2 | 13.9 | 300 |
| 28 | 2 | 30-Mar-19 | 1446 | 40 49.92 | 171 45.64 | 40 52.56 | 171 43.77 | 139 | 146 | 2.99 | 4.4 | 89.8 | 20.1 | 13.8 | 400 |
| 29 | 1 | 31-Mar-19 | 604 | 41 11.47 | 171 53.96 | 41 14.40 | 171 53.23 | 90 | 95 | 2.98 | 4.6 | 78 | 19.6 | 14.4 | 260 |
| 30 | 5 | 31-Mar-19 | 801 | 41 15.24 | 171 59.26 | 41 17.96 | 171 57.68 | 49 | 51 | 2.96 | 4.7 | 76.8 | 19.1 | 15.6 | 200 |
| 31 | 5 | 31-Mar-19 | 1035 | 41 28.80 | 171 48.23 | 41 31.60 | 171 46.94 | 41 | 44 | 2.96 | 4.5 | 74.3 | 19.1 | 16 | 200 |
| 32 | 5 | 31-Mar-19 | 1339 | 41 40.16 | 171 26.70 | 41 42.44 | 171 24.19 | 85 | 92 | 2.95 | 4.5 | 81.6 | 19.5 | 13.8 | 270 |
| 33 | 7 | 1-Apr-19 | 842 | 41 56.02 | 171 16.46 | 41 58.74 | 171 14.92 | 77 | 77 | 2.95 | 4.7 | 75.7 | 19 | 14.3 | 220 |
| 34 | 7 | 1-Apr-19 | 1059 | 42 07.50 | 171 15.42 | 42 10.28 | 171 13.84 | 34 | 36 | 3.01 | 4.7 | 73.6 | 19.1 | 19.2 | 200 |
| 35 | 7 | 1-Apr-19 | 1304 | 42 17.57 | 171 09.89 | 42 20.31 | 171 08.39 | 34 | 35 | 2.95 | 4.5 | 76.9 | 18.6 | 18.4 | 200 |
| 36# | 12 | 2-Apr-19 | 651 | 42 42.64 | 170 17.51 | 42 42.04 | 170 21.39 | 119 | 134 | 2.91 | 4.5 | 89.2 | 18.4 | 13.5 | 360 |
| 37 | 11 | 2-Apr-19 | 928 | 42 45.30 | 170 24.26 | 42 43.86 | 170 27.74 | 78 | 94 | 2.93 | 4.6 | 79.3 | 18.3 | 13.9 | 250 |
| 38 | 11 | 2-Apr-19 | 1221 | 42 46.06 | 170 47.27 | 42 44.03 | 170 50.40 | 39 | 42 | 3.06 | 4.9 | 74.2 | 18.1 | 17.7 | 200 |
| 39 | 8 | 2-Apr-19 | 1520 | 42 28.27 | 170 58.18 | 42 25.26 | 170 58.73 | 114 | 116 | 3.03 | 4.5 | 89 | 18.6 | 13.6 | 330 |

## Appendix 2 continued

| | | | Start of tow | | | End of tow | | Gear depth (m) | | Distance trawled | Headline | Doorspread | Surface temp | Bottom temp | Warp length |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station | Stratum | Date | Time | ° ' S | ° ' E | ° ' S | ° ' E | Min. | Max. | (n. miles) | height (m) | (m) | ° C | ° C | (m) |
| 40 | 9 | 3-Apr-19 | 611 | 41 52.96 | 170 37.09 | 41 55.77 | 170 36.08 | 363 | 377 | 2.9 | 4.5 | 98.1 | 19.4 | 11.2 | 900 |
| 41 | 9 | 3-Apr-19 | 816 | 41 57.39 | 170 37.62 | 42 00.23 | 170 36.57 | 310 | 314 | 2.94 | 4.6 | 97.7 | 19.4 | 12 | 790 |
| 42 | 9 | 3-Apr-19 | 1014 | 42 04.20 | 170 35.11 | 42 07.14 | 170 35.18 | 333 | 338 | 2.94 | 4.6 | 99.2 | 19.2 | 11.7 | 840 |
| 43 | 8 | 3-Apr-19 | 1255 | 42 08.76 | 170 50.43 | 42 06.72 | 170 53.40 | 193 | 200 | 3 | 4.5 | 85.9 | — | — | 530 |
| 44 | 8 | 3-Apr-19 | 1513 | 42 00.73 | 171 03.50 | 41 58.02 | 171 05.24 | 153 | 156 | 3 | 4.5 | 92.9 | 19.5 | 13.1 | 430 |
| 45 | 2 | 4-Apr-19 | 616 | 41 02.94 | 171 20.21 | 41 00.24 | 171 21.84 | 166 | 168 | 2.96 | 4.3 | 91.1 | 19.6 | 13.8 | 460 |
| 46 | 2 | 4-Apr-19 | 921 | 40 50.36 | 171 40.58 | 40 47.45 | 171 41.41 | 156 | 161 | 2.97 | 4.3 | 89.4 | 19.7 | 13.8 | 440 |
| 47 | 2 | 4-Apr-19 | 1126 | 40 43.56 | 171 39.25 | 40 41.34 | 171 41.87 | 190 | 191 | 2.97 | 4.3 | 89.3 | 19.8 | 13.9 | 510 |
| 48 | 6 | 6-Apr-19 | 611 | 41 23.30 | 171 41.34 | 41 21.41 | 171 38.33 | 111 | 123 | 2.94 | 4.5 | 87.3 | 18.3 | 13.3 | 350 |
| 49 | 6 | 6-Apr-19 | 1013 | 41 36.98 | 171 14.17 | 41 39.78 | 171 12.77 | 148 | 153 | 2.98 | 4.7 | 94.4 | 18.8 | 13.1 | 420 |
| 50 | 6 | 6-Apr-19 | 1309 | 41 37.15 | 170 56.16 | 41 39.91 | 170 54.72 | 197 | 197 | 2.96 | 4.7 | 93.3 | 19.5 | 13.4 | 530 |
| 51 | 8 | 6-Apr-19 | 1520 | 41 48.41 | 170 53.82 | 41 51.39 | 170 53.05 | 180 | 181 | 3.03 | 4.4 | 91.4 | 19.2 | 13.2 | 500 |
| 52 | 13 | 7-Apr-19 | 633 | 42 41.26 | 170 04.69 | 42 43.80 | 170 02.58 | 271 | 283 | 2.97 | 4.3 | 95.7 | 18.5 | 12.9 | 720 |
| 53 | 13 | 7-Apr-19 | 906 | 42 54.18 | 170 00.96 | 42 56.74 | 169 59.02 | 233 | 246 | 2.92 | 4.6 | 90.2 | 17.9 | 12.8 | 610 |
| 54 | 12 | 7-Apr-19 | 1102 | 43 01.32 | 169 59.81 | 43 03.88 | 169 57.61 | 164 | 166 | 3.02 | 4.5 | 90.2 | 17.7 | 13.2 | 450 |
| 55 | 12 | 7-Apr-19 | 1324 | 43 06.49 | 169 49.91 | 43 09.35 | 169 48.63 | 190 | 193 | 3 | 4.6 | 91.1 | 18.4 | 13.1 | 520 |
| 56 | 12 | 7-Apr-19 | 1527 | 43 10.23 | 169 51.69 | 43 12.90 | 169 49.91 | 175 | 179 | 2.96 | 4.7 | 90.2 | 16.5 | 13.1 | 470 |
| 57 | 13 | 8-Apr-19 | 649 | 43 09.79 | 169 38.41 | 43 12.19 | 169 35.93 | 370 | 386 | 3 | 4.4 | 97.1 | 18.4 | 11.9 | 920 |
| 58 | 16 | 8-Apr-19 | 921 | 43 15.17 | 169 43.02 | 43 17.10 | 169 39.86 | 219 | 227 | 3 | 4.3 | 90.8 | 17.4 | 13.1 | 600 |
| 59 | 16 | 8-Apr-19 | 1206 | 43 23.35 | 169 23.03 | 43 24.84 | 169 19.34 | 249 | 281 | 3.06 | 4.6 | 94.7 | 18 | 12.8 | 660 |
| 60 | 16 | 8-Apr-19 | 1416 | 43 27.92 | 169 15.95 | 43 30.03 | 169 12.95 | 205 | 220 | 3.03 | 4.8 | 98.3 | 17.6 | 13.2 | 560 |
| 61 | 12 | 9-Apr-19 | 634 | 42 49.57 | 170 16.97 | 42 52.38 | 170 15.40 | 122 | 123 | 3.03 | 4.5 | 86.8 | 17.2 | 14 | 350 |
| 62 | 11 | 9-Apr-19 | 824 | 42 54.38 | 170 18.62 | 42 51.90 | 170 20.94 | 91 | 92 | 3 | 4.9 | 79.9 | 17.6 | 14.9 | 270 |
| 63 | 11 | 9-Apr-19 | 1033 | 42 49.52 | 170 29.71 | 42 51.98 | 170 27.12 | 43 | 47 | 3.1 | 4.7 | 76.6 | 17.3 | 17.5 | 200 |
| 64 | 11 | 9-Apr-19 | 1232 | 42 56.56 | 170 26.31 | 42 58.60 | 170 23.26 | 31 | 32 | 3.02 | 4.6 | 73.9 | 17 | 17.4 | 200 |
| 65 | 15 | 10-Apr-19 | 753 | 43 24.43 | 169 31.26 | 43 26.01 | 169 27.84 | 103 | 104 | 2.94 | 4.4 | 84.8 | 17.8 | 14.9 | 300 |
| 66 | 15 | 10-Apr-19 | 1106 | 43 27.96 | 169 23.29 | 43 30.24 | 169 20.67 | 118 | 124 | 2.96 | 4.6 | 88.3 | 17.5 | 13.8 | 340 |
| 67 | 14 | 12-Apr-19 | 933 | 43 47.17 | 169 01.96 | 43 45.57 | 169 05.52 | 63 | 67 | 3.02 | 4.4 | 77.2 | 17.1 | 13.5 | 200 |
| 68 | 14 | 12-Apr-19 | 1221 | 43 35.96 | 169 20.14 | 43 33.90 | 169 23.11 | 86 | 89 | 2.97 | 4.6 | 79.4 | 17.4 | 14.5 | 250 |
| 69 | 14 | 12-Apr-19 | 1454 | 43 27.07 | 169 36.54 | 43 25.11 | 169 39.69 | 44 | 48 | 3.01 | 4.7 | 77 | 17.4 | 16.4 | 200 |
| 70 | 15 | 13-Apr-19 | 634 | 43 26.68 | 169 20.74 | 43 25.03 | 169 24.09 | 134 | 136 | 2.93 | 4.5 | 89.5 | 17.5 | 13.4 | 380 |
| 71 | 15 | 13-Apr-19 | 1010 | 43 18.30 | 169 51.46 | 43 16.01 | 169 54.06 | 117 | 119 | 2.97 | 4.5 | 84.5 | 17.2 | 13.7 | 340 |
| 72 | 12 | 13-Apr-19 | 1334 | 43 13.40 | 169 53.62 | 43 11.19 | 169 56.06 | 149 | 151 | 2.83 | 4.4 | 89.7 | 16.2 | 13.6 | 420 |
| 73 | 5 | 14-Apr-19 | 637 | 41 34.95 | 171 37.02 | 41 32.79 | 171 39.84 | 64 | 66 | 3.01 | 4.5 | 73.6 | 17.9 | 16.5 | 200 |
| 74 | 5 | 14-Apr-19 | 849 | 41 27.45 | 171 48.95 | 41 24.77 | 171 50.78 | 45 | 46 | 3.01 | 4.6 | 76.3 | 17.6 | 16.9 | 200 |
| 75 | 5 | 14-Apr-19 | 1054 | 41 22.45 | 171 59.02 | 41 19.64 | 172 00.55 | 38 | 39 | 3.03 | 4.6 | 76.2 | 17.5 | 17.5 | 200 |
| 76 | 1 | 14-Apr-19 | 1309 | 41 11.04 | 171 56.04 | 41 08.20 | 171 57.03 | 82 | 84 | 2.93 | 4.5 | 78.8 | 18.7 | 15.9 | 240 |
| 77 | 1 | 15-Apr-19 | 644 | 40 38.13 | 172 08.55 | 40 40.98 | 172 07.28 | 92 | 98 | 3 | 4.6 | 80.7 | 17.7 | 15.2 | 270 |
| 78 | 1 | 15-Apr-19 | 927 | 40 32.44 | 172 17.31 | 40 30.23 | 172 20.12 | 91 | 95 | 3.07 | 4.5 | 80.1 | 17.5 | 14.9 | 270 |

## Appendix 3: Catch summary in order by weight. * = less than 0.5%.

| Species code | Common name | Scientific name | Catch (kg) | % of total catch | No. of stations | % occurrence | Depth (m) Min. | Max. |
|---|---|---|---|---|---|---|---|---|
| SPD | Spiny dogfish | *Squalus acanthias* | 6194.4 | 16.2 | 62 | 80.5 | 20 | 314 |
| SNA | Snapper | *Pagrus auratus* | 5278.5 | 13.8 | 39 | 50.6 | 13 | 197 |
| BAR | Barracouta | *Thyrsites atun* | 3185.6 | 8.3 | 57 | 74 | 13 | 281 |
| GIZ | Giant stargazer | *Kathetostoma giganteum* | 2801.7 | 7.3 | 37 | 48.1 | 29 | 370 |
| GUR | Gurnard | *Chelidonichthys kumu* | 2740.9 | 7.2 | 55 | 71.4 | 13 | 205 |
| HOK | Hoki | *Macruronus novaezelandiae* | 2019.2 | 5.3 | 22 | 28.6 | 63 | 370 |
| NMP | Tarakihi | *Nemadactylus macropterus* | 1717.1 | 4.5 | 51 | 66.2 | 17 | 338 |
| SPO | Rig | *Mustelus lenticulatus* | 1312.3 | 3.4 | 51 | 66.2 | 13 | 363 |
| RCO | Red cod | *Pseudophycis bachus* | 1184.6 | 3.1 | 44 | 57.1 | 20 | 370 |
| SCH | School shark | *Galeorhinus galeus* | 1064.7 | 2.8 | 57 | 74 | 19 | 282 |
| JMN | Yellowtail jack mackerel | *Trachurus novaezelandiae* | 1043.3 | 2.7 | 40 | 51.9 | 13 | 134 |
| RSO | Gemfish | *Rexea solandri* | 779.6 | 2 | 24 | 31.2 | 104 | 370 |
| FRO | Frostfish | *Lepidopus caudatus* | 685.9 | 1.8 | 31 | 40.3 | 45 | 370 |
| GSH | Ghost shark | *Hydrolagus novaezealandiae* | 637.5 | 1.7 | 30 | 39 | 66 | 370 |
| LIN | Ling | *Genypterus blacodes* | 596.5 | 1.6 | 31 | 40.3 | 31 | 370 |
| WAR | Common warehou | *Seriolella brama* | 585.4 | 1.5 | 26 | 33.8 | 18 | 150 |
| CAR | Carpet shark | *Cephaloscyllium isabellum* | 551.4 | 1.4 | 47 | 61 | 14 | 370 |
| SQU | Arrow squid | *Nototodarus sloanii & N. gouldi* | 538 | 1.4 | 58 | 75.3 | 20 | 370 |
| LEA | Leatherjacket | *Meuschenia scaber* | 463.2 | 1.2 | 18 | 23.4 | 18 | 91 |
| JDO | John dory | *Zeus faber* | 346.9 | 0.9 | 40 | 51.9 | 13 | 200 |
| SSK | Smooth skate | *Dipturus innominatus* | 326.4 | 0.9 | 20 | 26 | 54 | 370 |
| HAK | Hake | *Merluccius australis* | 262.1 | 0.7 | 25 | 32.5 | 31 | 281 |
| SDO | Silver dory | *Cyttus novaezealandiae* | 246 | 0.6 | 29 | 37.7 | 63 | 370 |
| JMD | Greenback jack mackerel | *Trachurus declivis* | 218.9 | 0.6 | 33 | 42.9 | 19 | 363 |
| CBI | Two saddle rattail | *Coelorinchus biclinozonalis* | 215.2 | 0.6 | 22 | 28.6 | 45 | 282 |
| RSK | Rough skate | *Zearaja nasuta* | 200.8 | 0.5 | 31 | 40.3 | 38 | 282 |
| CDO | Capro dory | *Capromimus abbreviatus* | 192.7 | 0.5 | 22 | 28.6 | 63 | 370 |
| WIT | Witch | *Arnoglossus scapha* | 186.4 | 0.5 | 56 | 72.7 | 17 | 370 |
| SPE | Sea perch | *Helicolenus spp.* | 174.3 | 0.5 | 35 | 45.5 | 27 | 370 |
| ERA | Electric ray | *Torpedo fairchildi* | 165.5 | 0.4 | 16 | 20.8 | 14 | 282 |
| EGR | Eagle ray | *Myliobatis tenuicaudatus* | 164.7 | 0.4 | 10 | 13 | 13 | 58 |
| TRE | Trevally | *Pseudocaranx georgianus* | 156 | 0.4 | 13 | 16.9 | 13 | 98 |
| WOD | Wood | Wood | 155.7 | 0.4 | 18 | 23.4 | 13 | 370 |
| POP | Porcupine fish | *Allomycterus jaculiferus* | 153.8 | 0.4 | 16 | 20.8 | 35 | 181 |
| BCO | Blue cod | *Parapercis colias* | 146.9 | 0.4 | 16 | 20.8 | 18 | 58 |
| SCG | Scaly gurnard | *Lepidotrigla brachyoptera* | 137.9 | 0.4 | 48 | 62.3 | 29 | 234 |
| NSD | Northern spiny dogfish | *Squalus griffini* | 131.2 | 0.3 | 13 | 16.9 | 82 | 338 |
| KIN | Kingfish | *Seriola lalandi* | 127.7 | 0.3 | 11 | 14.3 | 14 | 122 |
| SFL | Sand flounder | *Rhombosolea plebeia* | 100.3 | 0.3 | 25 | 32.5 | 13 | 56 |
| THR | Thresher shark | *Alopias vulpinus* | 100 | 0.3 | 1 | 1.3 | 150 | 150 |
| ELE | Elephant fish | *Callorhinchus milii* | 96.4 | 0.3 | 8 | 10.4 | 31 | 66 |
| ATT | Kahawai | *Arripis trutta* | 94 | 0.2 | 13 | 16.9 | 17 | 45 |
| LSO | Lemon sole | *Pelotretis flavilatus* | 83 | 0.2 | 41 | 53.2 | 13 | 205 |
| CON | Conger eel | *Conger spp.* | 76.3 | 0.2 | 16 | 20.8 | 18 | 370 |
| BRA | Short-tailed black ray | *Dasyatis brevicaudata* | 59.7 | 0.2 | 4 | 5.2 | 17 | 27 |
| ESO | N.Z. sole | *Peltorhamphus novaezeelandiae* | 57.7 | 0.2 | 14 | 18.2 | 19 | 82 |
| CUC | Cucumber fish | *Paraulopus nigripinnis* | 39.1 | 0.1 | 20 | 26 | 91 | 234 |
| YBF | Yellowbelly flounder | *Rhombosolea leporina* | 36.7 | 0.1 | 10 | 13 | 13 | 38 |
| CCX | Small banded rattail | *Coelorinchus parvifasciatus* | 34.7 | 0.1 | 11 | 14.3 | 117 | 370 |
| SSH | Slender smooth-hound | *Gollum attenuatus* | 33.9 | 0.1 | 3 | 3.9 | 338 | 370 |
| OPE | Orange perch | *Lepidoperca aurantia* | 30.3 | 0.1 | 1 | 1.3 | 200 | 200 |
| SWA | Silver warehou | *Seriolella punctata* | 25.4 | 0.1 | 20 | 26 | 35 | 234 |
| RUB | Rubbish other than fish | NA | 20.8 | 0.1 | 10 | 13 | 13 | 89 |
| OCT | Octopus | *Pinnoctopus cordiformis* | 20.5 | 0.1 | 8 | 10.4 | 13 | 118 |
| HAP | Hapuku | *Polyprion oxygeneios* | 20 | 0.1 | 3 | 3.9 | 190 | 234 |
| SPZ | Spotted stargazer | *Genyagnus monopterygius* | 19.6 | 0.1 | 7 | 9.1 | 14 | 29 |
| ONG | Sponges | *Porifera (Phylum)* | 17.5 | * | 2 | 2.6 | 13 | 29 |
| SEV | Broadnose sevengill shark | *Notorynchus cepedianus* | 17.2 | * | 1 | 1.3 | 48 | 48 |

## Appendix 3 continued:

| Species code | Common name | Scientific name | Catch (kg) | % of total catch | No. of stations | % occurrence | Depth (m) Min. | Max. |
|---|---|---|---|---|---|---|---|---|
| YEM | Yellow-eyed mullet | *Aldrichetta forsteri* | 16 | * | 7 | 9.1 | 18 | 38 |
| GLM | Green-lipped mussel | *Perna canaliculus* | 15.1 | * | 3 | 3.9 | 13 | 18 |
| JFI | Jellyfish | NA | 14.4 | * | 10 | 13 | 13 | 314 |
| SRH | Silver roughy | *Hoplostethus mediterraneus* | 11.1 | * | 3 | 3.9 | 104 | 370 |
| TUR | Turbot | *Colistium nudipinnis* | 10.9 | * | 2 | 2.6 | 39 | 48 |
| ASC | Sea squirt | Ascidiacea | 10.6 | * | 15 | 19.5 | 13 | 53 |
| FHD | Deepsea flathead | *Hoplichthys haswelli* | 10.5 | * | 4 | 5.2 | 227 | 370 |
| BRI | Brill | *Colistium guntheri* | 9.6 | * | 7 | 9.1 | 31 | 51 |
| GLB | Globefish | *Contusus richei* | 9.3 | * | 5 | 6.5 | 31 | 48 |
| STY | Spotty | *Notolabrus celidotus* | 9 | * | 11 | 14.3 | 13 | 38 |
| LDO | Lookdown dory | *Cyttus traversi* | 8.7 | * | 1 | 1.3 | 370 | 370 |
| JAV | Javelin fish | *Lepidorhynchus denticulatus* | 7.5 | * | 7 | 9.1 | 205 | 370 |
| SUA | Fleshy club sponge | *Suberites affinis* | 7.1 | * | 5 | 6.5 | 35 | 56 |
| SPM | Sprat | *Sprattus muelleri* | 6.9 | * | 10 | 13 | 31 | 92 |
| SSI | Silverside | *Argentina elongata* | 6.4 | * | 22 | 28.6 | 44 | 370 |
| BTS | Prickly deepsea skate | *Brochiraja spinifera* | 5.3 | * | 3 | 3.9 | 190 | 363 |
| BSQ | Broad squid | *Sepioteuthis australis* | 5.1 | * | 12 | 15.6 | 13 | 38 |
| BGZ | Banded stargazer | *Kathetostoma binigrasella* | 3.5 | * | 1 | 1.3 | 98 | 98 |
| SPN | Sea pen | NA | 3.4 | * | 1 | 1.3 | 227 | 227 |
| RMU | Red mullet | *Upeneichthys lineatus* | 3.2 | * | 8 | 10.4 | 27 | 45 |
| CBO | Bollons rattail | *Coelorinchus bollonsi* | 3.2 | * | 2 | 2.6 | 281 | 370 |
| SCC | Sea cucumber | *Stichopus mollis* | 3 | * | 12 | 15.6 | 14 | 58 |
| JMM | Slender jack mackerel | *Trachurus murphyi* | 2.7 | * | 1 | 1.3 | 104 | 104 |
| CRA | Rock lobster | *Jasus edwardsii* | 2.7 | * | 2 | 2.6 | 29 | 282 |
| CRS | Airy finger sponge | *Callyspongia ramosa* | 2.6 | * | 10 | 13 | 14 | 53 |
| SPA | Slender sprat | *Sprattus antipodum* | 2.4 | * | 2 | 2.6 | 31 | 43 |
| PRK | Prawn killer | *Ibacus alticrenatus* | 2.4 | * | 8 | 10.4 | 134 | 363 |
| PCO | Ahuru | *Auchenoceros punctatus* | 2.4 | * | 6 | 7.8 | 31 | 48 |
| RBT | Redbait | *Emmelichthys nitidus* | 2.3 | * | 7 | 9.1 | 155 | 227 |
| CDY | Cosmasterias dyscrita | *Cosmasterias dyscrita* | 2.3 | * | 6 | 7.8 | 14 | 32 |
| RHY | Common roughy | *Paratrachichthys trailli* | 2.1 | * | 3 | 3.9 | 227 | 370 |
| JGU | Spotted gurnard | *Pterygotrigla picta* | 2.1 | * | 2 | 2.6 | 227 | 338 |
| HEX | Sixgill shark | *Hexanchus griseus* | 1.6 | * | 1 | 1.3 | 92 | 92 |
| GAS | Gastropods | Gastropoda | 1.3 | * | 7 | 9.1 | 18 | 148 |
| DPA | Dactylia palmata | *Dactylia palmata* | 1.3 | * | 4 | 5.2 | 27 | 58 |
| DIR | Pagurid | *Diacanthurus rubricatus* | 1.1 | * | 3 | 3.9 | 13 | 281 |
| EMA | Blue mackerel | *Scomber australasicus* | 1 | * | 10 | 13 | 18 | 58 |
| LSK | Softnose skate (longtail skate) | *Arhynchobatis asperrimus* | 0.8 | * | 1 | 1.3 | 282 | 282 |
| HDR | Hydroid | Hydrozoa (Class) | 0.8 | * | 4 | 5.2 | 29 | 53 |
| ANC | Anchovy | *Engraulis australis* | 0.8 | * | 6 | 7.8 | 18 | 45 |
| KWH | Knobbed whelk | *Austrofucus glans* | 0.8 | * | 2 | 2.6 | 17 | 18 |
| PAT | Patiriella spp. | *Patiriella spp.* | 0.7 | * | 3 | 3.9 | 14 | 18 |
| SAL | Salps | NA | 0.7 | * | 1 | 1.3 | 166 | 166 |
| SYC | Clubbed tunicate | *Styela clava* | 0.6 | * | 3 | 3.9 | 13 | 20 |
| POL | Polychaete | Polychaeta | 0.6 | * | 2 | 2.6 | 91 | 146 |
| SDR | Spiny seadragon | *Solegnathus spinosissimus* | 0.6 | * | 4 | 5.2 | 178 | 227 |
| BRN | Barnacle | Cirripedia (Class) | 0.6 | * | 2 | 2.6 | 53 | 363 |
| YBO | Yellow boarfish | *Pentaceros decacanthus* | 0.5 | * | 1 | 1.3 | 370 | 370 |
| SLS | Slender sole | *Peltorhamphus tenuis* | 0.5 | * | 3 | 3.9 | 31 | 43 |
| PIG | Pigfish | *Congiopodus leucopaecilus* | 0.5 | * | 2 | 2.6 | 19 | 136 |
| BEN | Scabbardfish | *Benthodesmus spp.* | 0.5 | * | 1 | 1.3 | 370 | 370 |
| TOD | Dark toadfish | *Neophrynichthys latus* | 0.4 | * | 3 | 3.9 | 178 | 227 |
| SEO | Seaweed | NA | 0.4 | * | 3 | 3.9 | 20 | 91 |
| PSI | Geometric star | *Psilaster acuminatus* | 0.4 | * | 4 | 5.2 | 29 | 370 |
| PCH | Penion chathamensis | *Penion chathamensis* | 0.4 | * | 2 | 2.6 | 148 | 205 |
| NEE | Nemertesia elongata | *Nemertesia elongata* | 0.4 | * | 2 | 2.6 | 19 | 29 |
| LEH | Leech - generic | Hirudinea | 0.4 | * | 4 | 5.2 | 79 | 282 |

## Appendix 3 continued:

| Species code | Common name | Scientific name | Catch (kg) | % of total catch | No. of stations | % occurrence | Depth (m) Min. | Max. |
|---|---|---|---|---|---|---|---|---|
| EGC | Egg case | NA | 0.4 | * | 4 | 5.2 | 39 | 200 |
| CCM | Eleven-arm seastar | *Coscinasterias muricata* | 0.4 | * | 1 | 1.3 | 13 | 13 |
| SQP | Bobtail squid | *Sepioloidea pacifica* | 0.2 | * | 2 | 2.6 | 31 | 48 |
| SPT | Heart urchin | *Spatangus multispinus* | 0.2 | * | 2 | 2.6 | 111 | 370 |
| SBN | Stalked barnacle | Scalpellidae (Family) | 0.2 | * | 2 | 2.6 | 314 | 338 |
| PRE | Cushion starfish | *Patiriella regularis* | 0.2 | * | 1 | 1.3 | 13 | 13 |
| PAD | Paddle crab | *Ovalipes catharus* | 0.2 | * | 2 | 2.6 | 35 | 39 |
| MMU | Pearlside | *Maurolicus australis* | 0.2 | * | 2 | 2.6 | 282 | 363 |
| CRU | Crustacea | NA | 0.2 | * | 2 | 2.6 | 51 | 166 |
| COZ | Bryozoan | Bryozoa (Phylum) | 0.2 | * | 2 | 2.6 | 18 | 53 |
| CAS | Oblique banded rattail | *Coelorinchus aspercephalus* | 0.2 | * | 2 | 2.6 | 63 | 205 |
| BPD | Lamp shells | Brachiopoda | 0.2 | * | 2 | 2.6 | 52 | 53 |
| SUR | Kina | *Evechinus chloroticus* | 0.1 | * | 1 | 1.3 | 18 | 18 |
| SPS | Speckled sole | *Peltorhamphus latus* | 0.1 | * | 1 | 1.3 | 38 | 38 |
| SLT | Orange fat finger sponge | *Stelletta spp.* | 0.1 | * | 1 | 1.3 | 200 | 200 |
| SHO | Seahorse | *Hippocampus abdominalis* | 0.1 | * | 1 | 1.3 | 63 | 63 |
| SCA | Scallop | *Pecten novaezelandiae* | 0.1 | * | 1 | 1.3 | 13 | 13 |
| PSE | Sea urchin | *Pseudechinus spp.* | 0.1 | * | 1 | 1.3 | 18 | 18 |
| PRM | Lanternfish | *Protomyctophum bolini* | 0.1 | * | 1 | 1.3 | 51 | 51 |
| OPA | Opalfish | *Hemerocoetes spp.* | 0.1 | * | 1 | 1.3 | 227 | 227 |
| NMA | Notopandalus magnoculus | *Notopandalus magnoculus* | 0.1 | * | 1 | 1.3 | 370 | 370 |
| MSA | Battle axe | *Musculista senhousia* | 0.1 | * | 1 | 1.3 | 53 | 53 |
| LNV | Rock star | *Lithosoma novaezelandiae* | 0.1 | * | 1 | 1.3 | 197 | 197 |
| HSI | Jackknife prawn | *Haliporoides sibogae* | 0.1 | * | 1 | 1.3 | 370 | 370 |
| HDF | Feathery hydroids | Leptomeduseae (Order) and Anthoathecatae (Order) | 0.1 | * | 1 | 1.3 | 17 | 17 |
| GGC | Guttigadus globiceps | *Guttigadus globiceps* | 0.1 | * | 1 | 1.3 | 363 | 363 |
| COL | Olivers rattail | *Coelorinchus oliverianus* | 0.1 | * | 1 | 1.3 | 370 | 370 |
| CAL | Giant purple pedinid | *Caenopedina porphyrogigas* | 0.1 | * | 1 | 1.3 | 18 | 18 |
| APD | Seamice | Aphroditidae | 0.1 | * | 1 | 1.3 | 44 | 44 |
| ALL | Alcithoe larochei | *Alcithoe larochei* | 0.1 | * | 1 | 1.3 | 17 | 17 |

## Appendix 4: Benthic macro-invertebrates taken as bycatch during the survey.

| Species | Common name | Scientific name | No. of stations |
|---|---|---|---|
| ALL | *Alcithoe laroche*i | *Alcithoe larochei* | 1 |
| APD | Seamice | Aphroditidae | 1 |
| ASC | Sea squirt | Ascidiacea | 15 |
| BPD | Lamp shells | Brachiopoda | 2 |
| BRN | Barnacle | Cirripedia (Class) | 2 |
| CAL | Giant purple pedinid | *Caenopedina porphyrogigas* | 1 |
| CCM | Eleven-arm seastar | *Coscinasterias muricata* | 1 |
| CDY | *Cosmasterias dyscrita* | *Cosmasterias dyscrita* | 6 |
| COZ | Bryozoan | Bryozoa (Phylum) | 2 |
| CRA | Rock lobster | *Jasus edwardsii* | 2 |
| CRS | Airy finger sponge | *Callyspongia ramosa* | 10 |
| CRU | Crustacea | - | 2 |
| DIR | Pagurid | *Diacanthurus rubricatus* | 3 |
| DPA | *Dactylia palmata* | *Dactylia palmata* | 4 |
| GAS | Gastropods | Gastropoda | 7 |
| GLM | Green-lipped mussel | *Perna canaliculus* | 3 |
| HDF | Feathery hydroids | Leptomeduseae (Order) and Anthoathecatae (Order) | 1 |
| HDR | Hydroid | Hydrozoa (Class) | 4 |
| HNO | *Hippellozoon novaezelandiae* | *Hippellozoon novaezelandiae* | 1 |
| KWH | Knobbed whelk | *Austrofucus glans* | 2 |
| LEH | Leech - generic | Hirudinea | 4 |
| MSA | Battle axe | *Musculista senhousia* | 1 |
| NEE | *Nemertesia elongata* | *Nemertesia elongata* | 2 |
| NMA | *Notopandalus magnoculus* | *Notopandalus magnoculus* | 1 |
| OCT | Octopus | *Pinnoctopus cordiformis* | 8 |
| ONG | Sponges | Porifera (Phylum) | 2 |
| PAD | Paddle crab | *Ovalipes catharus* | 2 |
| PAT | *Patiriella* spp. | *Patiriella spp.* | 3 |
| PCH | *Penion chathamensis* | *Penion chathamensis* | 2 |
| POL | Polychaete | Polychaeta | 2 |
| PRE | Cushion starfish | *Patiriella regularis* | 1 |
| PRK | Prawn killer | *Ibacus alticrenatus* | 8 |
| PSE | Sea urchin | *Pseudechinus spp.* | 1 |
| PSI | Geometric star | *Psilaster acuminatus* | 4 |
| SAL | Salps | - | 1 |
| SBN | Stalked barnacle | Scalpellidae (Family) | 2 |
| SCA | Scallop | *Pecten novaezelandiae* | 1 |
| SCC | Sea cucumber | *Stichopus mollis* | 12 |
| SLT | Orange fat finger sponge | *Stelletta spp.* | 1 |
| SPA | Slender sprat | *Sprattus antipodum* | 2 |
| SPN | Sea pen | - | 1 |
| SPT | Heart urchin | *Spatangus multispinus* | 2 |
| SUA | Fleshy club sponge | *Suberites affinis* | 5 |
| SUR | Kina | *Evechinus chloroticus* | 1 |
| SYC | Clubbed tunicate | *Styela clava* | 3 |