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EXECUTIVE SUMMARY

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This report gives the results of the seventh in a series of inshore trawl surveys along the west coast of the South Island from Farewell Spit to the Haast River mouth and within Tasman and Golden Bays at depths of 20 to 400 m by RV *Kaharoa*.

The survey took place in March-April 2005. It used a two-phase design optimised for giant stargazer, red cod, red gurnard, and tarakihi. Biomass estimates, catch distribution, and population length frequencies for the major species are described.

The biomass estimates and coefficient of variation (c.v.) for the target species were giant stargazer, 1458 t (19%); red gurnard, 442 t (17%), red cod, 2610 t (18%), and tarakihi, 2050 t (12%). All c.v.s were lower than the target c.v.s of 20–25% for red cod and 20% for giant stargazer, red gurnard, and tarakihi.

Other commercial species with c.v.s less than 15% were spiny dogfish, barracouta, school shark, John dory, and arrow squid.

The estimates of total biomass for all the target species were higher than in 2003 and for tarakihi were the highest for any survey in the series. For giant stargazer, the estimated biomass was the second highest in the series and reversed the decreasing trend seen in 200 and 2003.

A CTD monitor was used for the first time on this survey. Gear trials were performed with the CTD unit to determine if it affected headline height because it resides on the top of the net. Results showed that the CTD did not havean effect on headline height.

It is recommended that a further survey be carried out in 2007, and that spiny dogfish be added to the list of target species. It is also recommended that a review of the series be carried out following the next survey.

1. INTRODUCTION

This report presents results from the seventh in a time series of stratified random trawl surveys with RV *Kaharoa* in waters between 20 and 400 m off the west coast of the South Island, and within Tasman and Golden Bays. The survey was optimised for giant stargazer (*Kathetostoma* spp.), red cod (*Pseudophycis bachus*), red gurnard (*Chelidonichthys kumu*), and tarakihi (*Nemadactylus macropterus*). The results of earlier surveys in this series were reported by Drummond & Stevenson (1995a, 1995b, 1996) and Stevenson (1998, 2002, 2004) and the series was reviewed by Stevenson & Hanchet (2000a).

The principal objective of the surveys is to develop a time series of relative abundance indices for giant stargazer, red cod, red gurnard, and tarakihi for the inshore waters of the west coast of the South Island and within Tasman and Golden Bays. Changes in the relative abundance and length frequency distributions over time should reflect changes in the abundance and size distributions of the underlying fish populations. A standardised index of relative abundance estimates for key inshore species will therefore provide the basis for stock assessment and management strategies. This is particularly important for giant stargazer (STA 7) and rig (SPO 7) which are currently in the Adaptive Management Programme (AMP) (Sullivan et al. 2005).

This report details the survey design and methods, and provides relevant stock assessment data for commercially important Individual Transferable Quota (ITQ) and non-ITQ species.

This report fulfils in part the requirements of Ministry of Fisheries contract INT200401.

1.1 Programme objective

To determine the relative abundance and distribution of inshore finfish off the west coast of the South Island, and in Tasman Bay and Golden Bay, focusing on red cod (*Pseudophycis bachus*), red gurnard (*Chelidonichthys kumu*), giant stargazer (*Kathetostoma giganteum*), and tarakihi (*Nemadactylus macropterus*).

1.2 Specific objectives (2005)

1. To determine the relative abundance and distribution of red cod, red gurnard, stargazer, and tarakihi 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 (c.v.s) of the biomass estimates for these species are as follows: red cod (20–25%), red gurnard (20%), giant stargazer (20%), and tarakihi (20%).

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

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

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

5. To collect and identify benthic macroinvertebrates collected during the survey.

6. To tag lively school shark, rough skate, and smooth skate.

2. METHODS

2.1 Survey area and design

The survey area (Figure 1) 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 within Tasman and Golden Bays inside a line drawn between Farewell Spit and Stephens Island. 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 25 507 km^2, including untrawlable ground, was divided into 16 strata by area and depth (Table 1, Figure 1). Stratum depth ranges on the west coast were 20–100 m and 100–200 m north of Karamea, and 25–100 m, 100–200 m, and 200–400 m south of Karamea. Strata were identical to those used in previous surveys. The trawlable ground within the survey area represented 84% of the total survey area.

Phase 1 station allocation was optimised using the R function *allocate* to achieve the target c.v.s. Stratum area and catch rate data from previous *Kaharoa* trawl surveys were used to simulate optimal allocation and simulations were run for each target species separately. Results indicated that 80 stations and a two-phase design (after Francis 1984) were required to achieve the predicted c.v.s with about 80% of stations allocated to phase 1.

Before the survey began, sufficient trawl stations to cover both first and second phase stations were randomly generated for each stratum by the computer program 'Rand_stn v2.1' (Vignaux 1994). The stations were required to be a minimum of 5.6 km (3 n. miles) apart. Non-trawlable ground was identified before the voyage from data collected during previous trawl surveys in the area. The distribution of non-trawlable ground is given in Table 1 and shown in Figures 1a and 1b.

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, 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 and is based on an 'Alfredo' design. The net was fitted with a 74 mm (inside measurement) knotless codend. Details of the net design were given by Drummond & Stevenson (1995a).

Gear specifications were the same as for previous surveys (Drummond & Stevenson 1996). Doorspread and headline height measurements were recorded from Scanmar monitoring equipment and an average taken of five readings at 10–15 min intervals during each tow. When no direct readout was possible, doorspread value was calculated as being equal to the mean of the doorspread from stations within the same depth range for which direct readings were available.

A Seabird CTD was used for the first time and recorded sea temperatures, conductivity, and water pressure. Since the CTD rests on the top of the net near the headline, gear trials were conducted to determine if the headline height was affected by the CTD unit.

Gear trial tows were of 30 min duration over the same ground and in the same direction as a standard tow and completed as soon as possible after the standard tow to eliminate as much as possible any effect of changes in tide flow.

Procedures followed those recommended by Stevenson & Hanchet (1999). All tows were undertaken in daylight, and four to six tows a day were planned. For each tow, the vessel steamed to the station

position and, if necessary, the bottom was checked with the depth sounder. Once the station was considered trawlable, the gear was set away so that the midpoint of the tow would coincide as nearly as possible with the station position. 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 tow.

If the station was found to be in an area of foul or the depth was out of the stratum range, an area within 5 km of the station was searched for a replacement. If the search was unsuccessful, the station was abandoned and the next alternative from the random station list was chosen. Standard tows were of 1 h duration at a speed over the ground of 3 kn and the distance covered was measured by GPS. The tow was deemed to have started when the net monitor indicated the net was on the bottom, and was completed when hauling began.

A warp length of 200 m was used for all tows at less than 70 m depth. At greater depths, the warp to depth ratio decreased linearly to about 2.3:1 at 400 m.

2.3 Water temperatures

The surface and bottom temperatures at each station were recorded by the CTD unit. Surface temperatures were taken at a depth of 5 m and bottom temperatures when the net settled on the bottom. Bottom temperatures were taken at about 5 m above the sea floor because the CTD rests on the net just behind the headline.

2.4 Tagging

As soon as the net was brought on board, lively school shark (*Galeorhinus galeus*) and rough (*Raja nasuta*) and smooth (*R. innominata*) skate were separated from the catch and tagged with Hallprint dart tags whenever possible. Length, weight, and sex were recorded for each tagged fish.

2.5 Catch and biological sampling

The catch from each tow was sorted into species on deck and weighed on 100 kg electronic motion-compensating Seaway scales to the nearest 0.1 kg. Finfish, squid, and crustaceans (except crabs) were classified by species: crabs, shellfish, and other invertebrate species not readily identified were preserved in 10% buffered formalin for later identification because of difficulty in identifying individual species and the limited sorting time available between tows.

Length, to the nearest whole centimetre below the actual length, and sex (where possible) were recorded for all ITQ species, either for the whole catch or a randomly selected subsample of up to 200 fish per tow.

Individual fish weights and/or reproductive state were collected for the target species and Murphy's mackerel (*Trachurus symmetricus murphyi*), rough skate, smooth skate, and school shark. Individual fish weights were measured to enable length-weight relationships to be determined for scaling length frequency data and calculation of biomass for length intervals. Samples were selected non-randomly from the random length frequency sample to ensure a wide range was obtained for each species. Up to five otolith pairs per sex per centimetre size class were collected from length frequency samples for red cod, red gurnard, tarakihi, and Murphy's mackerel. More otolith pairs were taken from giant stargazer as part of another project.

2.6 Data analysis

Relative biomass estimates and scaled length-frequency distributions were estimated by the area-swept method (Francis 1981, 1989) using the TrawlSurvey Analysis program (Vignaux 1994). All data were entered into the Ministry of Fisheries *trawl* database.

The following assumptions were made for extracting biomass estimates with the TrawlSurvey Analysis program.

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.

Although these assumptions are unlikely to be correct, their adoption provides the basis for a time series of relative biomass estimates (Stevenson & Hanchet 1999). All assumptions listed are consistent with those used for previous surveys in the series.

All stations where the gear performance code was 1 or 2 (76 stations) were used for biomass estimation. All gear trial tows were given a gear performance code of 3 because they were of only 30 min duration and over the same ground as a standard tow. The c.v. associated with estimates of biomass was calculated by the method of Vignaux (1994).

Biomass and scaled length frequency distributions were derived using the TrawlSurvey Analysis program (Vignaux 1994). 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 this survey. For other species, coefficients were chosen from the *trawl* database and a selection made on the basis of whether coefficients were available from previous surveys in the series or on the best match between the size range of the fish used to calculate the coefficients 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 Survey area, design, and gear performance

Trawling began in Tasman and Golden Bays and after 3 days working continued on the west coast in a generally north to south direction.

A total of 83 stations was successfully completed, 72 in phase 1, 4 in phase 2, and 7 for gear trials. Two stations were rejected because of poor gear performance and one gear trial tow was repeated because of a lengthy delay between it and its corresponding standard tow which was also discarded because of gear problems. Station density ranged from one station per 102 km^2 in stratum 17 to one

station per 1076 km^2 in stratum 2, with an average density of one station per 336 km^2 (Table 1). At least three stations were completed in all 16 strata and all project and survey objectives were achieved. 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.

Phase two stations were allocated to giant stargazer and red gurnard to reduce their c.v.s towards the target levels. Two phase 2 stations were allocated to stratum 6 for giant stargazer and two stations were allocated to stratum 5 for red gurnard. Catch rates of red cod and tarakihi were not used for allocation of phase 2 stations because the c.v.s for these species were within target levels.

Data from the gear trials (Table 2) indicated that the addition of the CTD unit did not affect headline height. The CTD had compensating flotation and the same unit had been used on the *Tangaroa* for several years without problems. Only one station (station 8) had a recorded headline height that was more than 0.2 m different from the corresponding standard tow. However, the doorspread was also quite different and it was more likely that other reasons than the presence of the CTD unit were the cause of the difference.

Tow and gear parameters by depth are shown in Table 2. Doorspread varied from 63.3 to 94.3 m and headline height varied between 4.2 and 5.7 m (Table 2, Appendix 2). Measurements of headline height and doorspread, together with observations that the doors and trawl gear were polishing well, indicated that the gear was, in general, operating correctly. Gear parameters were similar to those of previous surveys indicating consistency between surveys (Stevenson & Hanchet 2000a).

3.2 Catch composition

A total of about 43.7 t of fish was caught from the 76 biomass tows at an average of 575 kg per tow (range 94.1–3558.2 kg). Amongst the vertebrate fish catch, 1 agnathan, 18 elasmobranchs and 64 teleosts were recorded. Species codes, common names, scientific names, and catch weights of all species identified during the survey are given in Appendix 3. Invertebrate species identified from the catch are given in Appendix 4.

The most abundant species by weight was spiny dogfish (*Squalus acanthias*) with 8.9 t caught (19.5% of the total catch). The top four species, spiny dogfish, barracouta, red cod, and hake made up 47.9% of the total. Giant stargazer, red cod, red gurnard, and tarakihi made up 5.1, 10.6, 4.3, and 1.8% of the catch, respectively. Arrow squid (*Nototodarus sloanii*), barracouta (*Thyrsites atun*), spiny dogfish, and school shark occurred in over 80% of the tows.

Forty species of invertebrates were identified from retained specimens. This compares to 45 species in 2003 and over 150 in 2000. However, the lower numbers of invertebrate species does not necessarily indiate reduced 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 (e.g., bryozoans).

3.3 Catch rates and species distribution

Distribution by stratum and catch rates for the 15 most abundant commercially important species are shown in Figures 2a–2o (biomass tows only). On average a standard tow covers 0.44 km^2, therefore a catch rate of 100 kg.km^{-2} equates to a catch of 44 kg.

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

3.4 Biomass estimation

Relative biomass estimates for all species of which more than 100 kg was caught and silver warehou, New Zealand sole, and lemon sole are given by sub-area in Table 4. Spiny dogfish had the largest estimated biomass, followed by barracouta and red cod. Coefficients of variation for the target species were: giant stargazer, 19%; red cod, 18%; red gurnard, 17%; and tarakihi, 12% (Table 4).

Biomass estimates of recruited fish for barracouta, blue warehou, giant stargazer, hoki, John dory, red cod, red gurnard, rig, sand flounder, school shark, silver warehou, and tarakihi are given in Table 5. For the target species giant stargazer, red cod, red gurnard, and tarakihi, the percentages of total biomass that were recruited fish were 99%, 46%, 79%, and over 99% respectively.

Biomass estimates by year class (where discernible from the length frequency distributions) for barracouta, blue warehou, hake, hoki, jack mackerel (*Trachurus novaezelandiae*), red cod, red gurnard, school shark, silver warehou, and tarakihi are given in Table 6. For red cod, the 1+ cohort made up about 54% of the total biomass. For red gurnard, the 2+ cohort made up 8% of the total biomass and for tarakihi the 2+ cohort made up less than 1% of the total (Table 6).

The relative biomass estimates for the 20 most abundant, commercially important species are given by stratum in Table 7.

3.5 Water temperatures

Isotherms estimated from CTD surface temperature recordings are shown in Figure 3 and from CTD bottom temperature recordings in Figure 4. Temperatures can not be directly compared with those from previous surveys because earlier recordings were not taken from calibrated instruments.

3.6 Length frequency and biological data

The numbers of length frequency and biological samples taken during the survey are given in Table 8. Scaled length frequency distributions (by depth range where appropriate) for the 24 most abundant ITQ species are shown in Figure 5.

Length-weight coefficients were determined for giant stargazer, red cod, red gurnard, tarakihi, and school shark (Appendix 1).

Details of gonad stages for giant stargazer, red cod, red gurnard, and tarakihi are given in Table 9.

3.7 Tagging

A total of 141 school shark were tagged (68 females and 73 males) ranging in length from 49 to 149 cm. In addition, 25 rough skate (13 females, 12 males), and 16 smooth skate (8 females, 8 males) were tagged.

3.8 Target species

3.8.1 Giant stargazer

Giant stargazer were caught at 61% of stations in Tasman and Golden Bays and 71% of stations along the west coast, with the highest catch rates south of Cape Foulwind in strata 8, 11, 12, and 13 (Figure 2f, see Table 3). The total estimated biomass of 1458 t was the second highest in the series. Eighty-one percent of the relative biomass estimate was south of Cape Foulwind, and almost 65% (946 t) was within the 100–200 m depth range (see Table 7). Only one giant stargazer longer than 45 cm was caught in Tasman and Golden Bays (Figure 5) and no clear year class modes were apparent in the length frequency distributions. The sex ratios (male:female) along the west coast were 1:1 at depths less than 100 m, 1.6:1, at 100–200 m, 0.8:1 at 200–400 m, and 1.3:1 overall (Figure 5). Virtually all females under 50 cm total length were immature or had resting gonads, but above this size, most had maturing gonads. Males under 40 cm were immature or resting, and most males over 40 cm were maturing (Table 9).

3.8.2 Red cod

Red cod were caught at all but one station in Tasman and Golden Bays and 79% of stations along the west coast, with the highest catch rates in stratum 7. The proportion of the estimated biomass in Tasman and Golden Bays was 14% (Figure 2j, see Tables 3 and 4). Almost all of the estimated biomass on the west coast was in depths less than 200 m (Table 7). The length frequency data show a dominant 1+ cohort (22–40 cm) present on the west coast at the time of the survey. Only a few fish in the 10–20 cm range were caught which would represent 0+ fish (Figure 5). The sex ratio in Tasman and Golden Bays favoured females (0.6:1), while on the west coast it varied considerably with depth (1.4:1 inside 100 m, 2.0:1 in 100–200 m, and 5.6:1 in 200–400 m) (Figure 5). Most red cod examined had immature or resting gonads, and a few fish were at later stages of reproductive development but no females were found to be running ripe (Table 9).

3.8.3 Red gurnard

Red gurnard were caught at all stations in Tasman and Golden Bay and at 52% of stations along the west coast (Figure 2k). The highest catch rates were in strata 5, and 7 (see Table 3). The relative biomass estimate of 442 t was unevenly divided between Tasman and Golden Bays (155 t) and the west coast (287 t) (see Table 4). There was a substantial difference in the length frequency distributions between the sub-areas (Figure 5) with the pre-recruit biomass (67 t) mainly in Tasman and Golden Bays (52 t). The recruited biomass estimate (30 cm or over) was 375 t (85% of the total) with 272 t occurring on the west coast (see Table 5). Over 96% of red gurnard biomass was at depths less than 100 m and no gurnard were caught deeper than 200 m (Table 7). Sex ratios were 0.5:1 in Tasman and Golden Bays and 1.8:1 on the west coast (Figure 5). Most red gurnard longer than 30 cm and some smaller fish had developing or mature gonads (Table 9).

3.8.4 Tarakihi

Tarakihi were caught at 61% of biomass stations in Tasman and Golden Bays and in 76% of the stations on the west coast. The highest catch rates were in strata 2, 9, 12, and 13. Over 99% of the relative biomass estimate was recruited fish (25 cm or over) (see Tables 4 and 5). The length frequency data for Tasman and Golden Bays showed a mode at 18–23 cm of 2+ fish. There is a weak mode at 11–15 cm of 0+ fish and a few fish at 25–28 cm, probably 3+ fish. The two older year classes were also present on the west coast (Figure 5). There is a strong mode at 28–32 (possibly 4+

fish). Of the total tarakihi biomass (2050 t), over 99% was on the west coast, and over 75% (1608 t) of this was at depths between 100 to 200 m (see Table 7). The sex ratios on the west coast were 0.22:1 inside 100 m, 0.48:1 at 100–200 m, and 5.12:1 at 200–400 m (Figure 5). There was little reproductive development in tarakihi under 30 cm FL, but for bigger fish the full range of gonad stages was recorded (Table 9).

4. DISCUSSION

The 2005 survey continued the March-April *Kaharoa* time series for the west coast of the South Island and Tasman and Golden Bays. Seventy-six biomass stations and seven gear trial tows were successfully completed. The mean catch per station of 575 kg is considerably higher than that in 2000 (305 kg) or 2003 (298 kg), but less than on the other surveys in the series which ranged from 606 kg to 1047 kg.

The c.v.s associated with the biomass estimates for the target species were all lower than the target c.v.s. This continues a time series of relative biomass estimates for the target species from this series. Other commercial species having biomass estimates with c.v.s less than 15% were arrow squid (9%), spiny dogfish (12%), barracouta (13%), John dory (14%), and school shark (14%). As in all previous years, spiny dogfish was the species caught in the greatest quantity (8.9 t or 19.5% of the total catch), and had the highest biomass estimate.

For this survey sea surface and bottom temperatures were recorded from a calibrated CTD for the first time in the series. Temperatures from previous surveys were recorded from a hull-mounted sensor or the net sonde, neither of which were calibrated. Therefore, sea surface and bottom temperatures from this survey are not directly comparable to previous surveys in the series. Gear trials to determine if the presence of the CTD unit on the headline showed that there was no evident effect (see Table 2). The CTD should therefore be used as much as possible because of the accuracy of the data obtained.

The biomass estimates for most benthic fish species were higher than in 2003 but were still lower than from earlier surveys in the series (Stevenson & Hanchet 2000a, Stevenson 2002, 2004). The amount and diversity of invertebrates continued to decline (Stevenson 1998, 2002, 2004). An extreme-year analysis was completed following Francis et al. (2001). The updated calculations suggest that 2005 was an extreme year in Tasman and Golden Bays and 2003 was an extreme year along the west coast of the Soputh Island (Appendix 4). In both cases the analyses show that many species had lower than normal biomass in the specified year. For the west coast area, it appears that catchability was anomalously low for many species in 2003. However, for Tasman and Golden Bays, the long-term trend is more suggestive of an overall decrease in biomass (across many species) than a fluctuation in catchability.

The biomass estimate for giant stargazer showed a marked increase from 2000 and 2003 (Table 10). The large mode of adult females at 60–70 cm is again apparent after the low numbers seen in the previous two surveys. There also appear to be reasonable numbers of pre-recruits (Figure 6a). The commercial catch for STA 7 peaked in 2000–01 season at 1440 t, but declined to 802 t in 2001–02, 957 t in 2002–03, and 954 t in 2003–04 (Sullivan et al. 2005).

The estimate for red cod was more than double the 2003 estimate, and more like that in earlier years (Table 10). The large 1+ mode is similar to that seen in 1997, but the fish are more similar in size to those seen in 1995 (Figure 6b) The high numbers of 1+ fish indicate the commercial catch in the next fishing year is likely to be good (Beentjes 2000).

The biomass estimate for red gurnard was also much higher than in 2003, but the abundance in

Tasman and Golden Bays has not recovered to previous levels (Table 11). There were more fish in the 20–30 cm range than in 2003, but there were again low numbers of smaller fish (Figure 6c). The commercial catch increased to 787 t in 2002–03, more than 100 t above the TACC. This overcatch is unlikely to continue given the lack of pre-recruits in 2003 and fish under 20 cm in this survey.

The biomass estimate for tarakihi was the highest in the series and is the first increase since 1995 (see Table 10). The depth distribution of adult tarakihi was similar to surveys prior to 2003 with most fish in the 100–200 m depth range (see Figure 5). The difference in biomass between this year and 2003 is mainly because of high numbers of fish at 28–32 cm (probably 3+, Stevenson & Horn 2004) and females at 35–40 cm. It is difficult to track these year classes through the research survey series in recent years, partly because of the intermittent nature of the series and partly because of the merging of modes as the fish grow. It would be useful to age the fish caught during the recent surveys to determine strong and weak year classes. The commercial catch has fluctuated around the TACC of 1087 t for this stock since 1996 (Sullivan et al. 2005).

Results for non-target species

The gemfish length frequency shows a strong mode at 60–70 cm (probably 5+ fish), which would correspond to a strong mode from 2003 at 40–50 cm (3+) (P. Horn, NIWA, Nelson, pers comm. 2005). For John dory, the biomass estimate was 222 t, down only slightly from 2003 (Stevenson 2004). However, the current estimate is for fewer and larger fish and the strong mode at 28–34 cm seen in the length frequency in 2003 is not apparent. The biomass estimate for spiny dogfish (6175 t) was within the range of previous surveys (3919–8370 t). The estimate for ling (274 t) was the highest since 1995 and there appeared to be good numbers of pre-recruit hake and hoki.

5. RECOMMENDATIONS

The MFish medium-term research plan calls for another survey in this series in 2007. With the completion of the eighth survey in the series, the series should be reviewed. The previous review was completed after four surveys and the additional information should provide better indications of trends in abundance for the target species and any non-target species the survey may be monitoring.

The c.v.s associated with the biomass estimates for spiny dogfish have consistently been low throughout the series and this species could be added as a target species.

Invertebrate monitoring could be improved with the deployment of a small benthic sampling net as used by the NOAA on the west coast of the United States (Stuart Hanchet, NIWA, pers. Comm. 2002).

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Table 1: Stratum depth ranges, survey area, non-trawlable area, number of successful phase 1 and phase 2 stations, and station density.

Stratum	Depth (m)	Area (km^2)	Non-trawlable area (km^2)	Number of stations		Station density (km^2 per station)
				Phase 1	Phase 2	
1	20–100	1 343	102	4	0	336
2	100–200	4 302	300	4	0	1 076
5	25–100	1 136	0	3	2	227
6	100–200	3 233	238	3	2	647
7	25–100	927	0	5	0	185
8	100–200	2 354	214	5	0	471
9	200–400	1 877	1 456	3	0	626
11	25–100	1 438	63	7	0	205
12	100–200	2 054	501	7	0	293
13	200–400	1 101	466	5	0	220
14	25–100	851	36	6	0	142
15	100–200	883	373	4	0	221
16	200–400	319	35	3	0	106
17	20–33	307	27	3	0	102
18	20–42	947	30	4	0	237
19	20–70	2 436	193	6	0	406
Total (average)		25 507	4 034	72	4	(336)

Table 2: Gear parameters for bimass stations by depth range (n, number of stations; s.d., standard deviation). Data for gear trials shown separately.

	n	Mean	s.d.	Range
All stations	73			
Headline height (m)		5.0	0.26	4.2–5.7
Doorspread (m)		78.8	7.68	63.2–94.3
Distance (n. miles)		3.0	0.18	2.25–3.23
Warp:depth ratio		3.7	1.79	2.2–9.76
Tasman/Golden Bays				
20–70 m	13			
Headline height (m)		5.0	0.30	4.4–5.4
Doorspread (m)		73.7	1.87	71.1–77.8
Distance (n. miles)		3.0	0.10	2.76–3.17
Warp:depth ratio		5.9	2.30	3.3–9.8
West coast				
20–400 m	60			
Headline height (m)		4.9	0.25	4.2–5.7
Doorspread (m)		79.9	8.02	63.2–94.3
Distance (n. miles)		3.0	0.20	2.25–3.23
Warp:depth ratio		3.3	1.28	2.2–7.4
20–100 m	26			
Headline height (m)		5.0	0.31	4.2–5.7
Doorspread (m)		72.6	4.46	63.2–82.9
Distance (n. miles)		3.0	0.18	2.25–3.17
Warp:depth ratio		4.2	1.55	2.8–7.4
100–200 m	24			
Headline height (m)		4.9	0.17	4.6–5.2
Doorspread (m)		83.9	4.34	70.9–89.8
Distance (n. miles)		3.0	0.17	2.27–3.23
Warp:depth ratio		2.7	0.08	2.6–2.9
200–400 m	10			
Headline height (m)		4.9	0.19	4.6–5.2
Doorspread (m)		89.6	4.07	81.4–94.3
Distance (n. miles)		2.9	0.27	2.28–3.13
Warp:depth ratio		2.4	0.14	2.2–2.7
Gear trials				
20–100 m	3			
Headline height (m)		4.9	0.32	4.5–5.1
Doorspread (m)		75.2	4.27	71.9–80.0
100–200 m	2			
Headline height (m)		5.1	0.07	5.0–5.1
Doorspread (m)		84.5	1.27	83.6–85.4
200–400 m	2			
Headline height (m)		5.0	0.14	4.9–5.1
Doorspread (m)		94.4	3.39	92.0–96.8

Table 3: Mean catch rates (kg.km^{-2}) with standard deviations (in parentheses) by stratum for the 20 most abundant commercially important species in order of catch abundance. Species codes are given in Appendix 3.

	Species code									
Stratum	SPD	BAR	RCO	HAK	STA	TAR	HOK	SCH	NOS	GSH
1	135	99	516	69	1	0	0	19	7	63
	(66)	(156)	(596)	(106)	(1)			(27)	(7)	(44)
2	74	51	0	0	4	229	0	23	30	60
	(109)	(48)			(5)	(99)		(29)	(13)	(60)
5	629	228	55	13	81	2	+	29	54	35
	(720)	(214)	(46)	(17)	(92)	(2)	(+)	(21)	(67)	(60)
6	220	21	1	0	49	57	0	30	17	34
	(214)	(29)	(2)		(83)	(45)		(27)	(11)	(18)
7	415	181	483	1 202	98	1	0	12	56	14
	(309)	(125)	(386)	(1 164)	(80)	(1)		(17)	(44)	(23)
8	559	194	53	43	108	70	14	62	50	77
	(305)	(184)	(74)	(53)	(171)	(46)	(16)	(53)	(50)	(99)
9	0	0	0	0	0	110	2	0	30	20
						(33)	(3)		(7)	(27)
11	156	143	216	58	106	11	8	17	19	1
	(91)	(123)	(143)	(54)	(172)	(19)	(19)	(13)	(19)	(2)
12	511	96	106	71	207	110	100	55	57	6
	(406)	(67)	(65)	(73)	(120)	(56)	(121)	(48)	(17)	(7)
13	60	10	24	5	111	156	374	48	26	37
	(102)	(6)	(26)	(10)	(212)	(194)	(758)	(34)	(19)	(30)
14	259	549	327	83	32	30	1	57	23	0
	(245)	(399)	(273)	(202)	(34)	(47)	(2)	(30)	(30)	
15	440	82	69	46	105	58	12	21	34	18
	(498)	(56)	(26)	(82)	(51)	(11)	(13)	(25)	(14)	(12)
16	11	26	85	11	43	47	83	28	25	118
	(12)	(45)	(140)	(7)	(51)	(22)	(68)	(20)	(19)	(166)
17	49	100	21	0	4	5	0	3	13	0
	(42)	(94)	(18)		(3)	(9)		(3)	(2)	
18	111	32	12	0	0	+	0	44	4	0
	(133)	(25)	(10)			(+)		(23)	(5)	
19	195	180	140	0	5	1	0	22	69	0
	(97)	(163)	(140)		(5)	(1)		(15)	(31)	

+ < 0.5 kg.km^{-2}

Table 3—*continued*

Stratum	Species code									
	LIN	SKI	GUR	FRO	WAR	SPO	JMN	SPE	JDO	LEA
1	1	0	19	0	+	9	3	0	23	0
	(1)		(24)		(1)	(12)	(3)		(18)	
2	+	4	1	3	0	0	0	+	9	0
	(+)	(9)	(1)	(5)				(+)	(7)	
5	3	0	62	22	3	28	3	+	3	0
	(3)		(57)	(46)	(4)	(26)	(5)	(+)	(3)	
6	+	1	1	1	0	1	0	+	9	0
	(+)	(2)	(2)	(3)		(2)		(1)	(9)	
7	8	0	107	2	1	15	+	0	1	0
	(7)		(100)	(3)	(1)	(15)	(1)		(3)	
8	1	5	3	11	0	1	0	15	8	0
	(1)	(8)	(4)	(9)		(3)		(9)	(10)	
9	0	31	0	0	0	0	0	2	0	0
		(17)						(2)		
11	9	0	37	4	8	10	0	0	0	0
	(14)		(35)	(7)	(12)	(15)				
12	22	10	2	152	2	0	0	26	0	0
	(31)	(13)	(4)	(240)	(5)	(0)		(33)		
13	43	318	0	10	0	2	0	29	0	0
	(60)	(464)		(14)		(4)		(21)		
14	20	0	23	0	72	28	0	+	0	0
	(29)		(22)		(123)	(27)		(+)		
15	40	0	0	5	16	0	0	10	0	0
	(64)			(6)	(26)			(7)		
16	309	32	0	57	3	0	0	5	0	0
	(475)	(47)		(78)	(5)			(4)		
17	12	0	5	0	56	8	161	5	9	16
	(5)		(2)		(52)	(14)	(72)	(8)	(10)	(22)
18	0	0	45	0	2	11	20	+	13	8
			(20)		(1)	(14)	(30)	(1)	(16)	(11)
19	0	0	45	1	+	15	10	5	34	52
			(48)	(3)	(1)	(18)	(5)	(5)	(19)	(26)

+ < 0.5 kg.km^{-2}

Table 4: Relative doorspread biomass estimates by sub-area for all species of which more than 100 kg were caught and silver warehou, NZ sole, and lemon sole, in order of decreasing total biomass.

	Tasman and Golden Bays		West coast		Total survey area	
Common name	Biomass (t)	c.v. (%)	Biomass (t)	c.v. (%)	Biomass (t)	c.v. (%)
Spiny dogfish	595	19	5 580	13	6 175	12
Barracouta	500	33	2 263	14	2 763	13
Red cod	358	39	2 252	20	2 610	18
Silver dory	0		2 211	15	2 211	15
Tarakihi	3	51	2 047	12	2 050	12
Hake	0		1 673	30	1 673	30
Giant stargazer	13	40	1 445	19	1 458	19
Two saddle rattail	+	100	1 148	25	1 148	25
Common roughy	0		1 064	77	1 064	77
Arrow squid (*Nototodarus sloanii*)	177	18	712	11	889	9
Dark ghost shark	0		832	22	832	22
School shark	97	19	677	15	774	14
Hoki	0		701	55	701	55
Gemfish	0		474	49	474	49
Red gurnard	155	31	287	20	442	17
Frostfish	3	100	420	45	423	45
Carpet shark	134	15	268	18	402	13
Ling	4	26	270	37	274	37
John dory	98	20	123	20	222	14
Northern spiny dogfish	0		180	22	180	22
Hapuku	0		154	42	154	42
Rig	49	40	104	20	153	19
Sea perch	13	36	137	21	150	20
Leatherjacket	139	20	0		139	20
Jack mackerel *(Trachurus declivis)*	8	97	110	22	118	21
Blue warehou	20	47	96	47	116	40
Jack mackerel *(Trachurus novaezelandiae)*	7	52	92	22	98	20
Smooth skate	17	73	63	33	80	30
Electric ray	34	60	28	54	62	41
Sand flounder	56	26	6	90	62	25
Elephantfish	0		59	33	59	33
Rough skate	10	50	48	34	58	30
Silver warehou	3	28	69	29	72	28
New Zealand sole	2	45	26	47	27	45
Lemon sole	4	32	17	52	21	42

+ < 0.5 t

Table 5: Recruited biomass estimates (t).

Species	Recruited length (cm)	Tasman and Golden Bays Biomass	Tasman and Golden Bays c.v.%	West coast Biomass	West coast c.v.%	Total survey area Biomass	Total survey area c.v.%
Barracouta	50	340	45	2 108	15	2 448	14
Blue warehou	45	0		87	50	87	50
Giant stargazer	30	11	42	1 431	20	1 442	19
Hoki	65	0		168	65	168	65
John dory	25	98	20	123	20	222	14
Ling	65	1	57	231	41	233	41
Red cod	40	212	42	997	16	1 209	15
Red gurnard	30	103	32	272	19	375	16
Rig	90	24	49	53	29	77	25
Sand flounder	25	45	28	5	89	50	27
School shark	90	17	65	459	19	476	19
Silver warehou	25	0		46	35	46	35
Tarakihi	25	1	72	2 044	12	2 046	12

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

Species	Year class	Length range (cm)	Biomass	c.v.%
Barracouta	1+	15– 32	197	43
	2+	33–48	334	30
	3+	49–60	146	31
Blue warehou	0+	< 20	7	30
	1+	20–28	17	56
Hake	0+	<20	0.5	44
	1+	29–49	1 616	30
Hoki	0+	14–35	166	43
	1+	36–52	306	72
Jack mackerel (*T. novaezelandiae)*	0+	< 13	0.1	56
	1+	13–22	56	29
Red cod	0+	<22	1	35
	1+	22–39	1 400	28
	2+	40–50	722	19
Red gurnard	2+	21–28	39	29
School shark	0+	< 42	2	59
	1+	42–55	21	46
Silver warehou	1+	15–23	26	30
	2+	24–34	31	45
Tarakihi	1+	10–16	0.3	48
	2+	16–21	3	44
	3+	22–27	17	64

Table 7: Estimated biomass (t) (and c.v.%) by stratum for the 20 most abundant commercially important species in order of catch abundance. Species codes are given in Appendix 3

	Species code									
Stratum	SPD	BAR	RCO	HAK	STA	TAR	HOK	SCH	NOS	GSH
1	181	127	693	93	1	0	0	26	10	84
	(25)	(81)	(58)	(77)	(69)			(72)	(49)	(35)
2	318	219	0	0	17	984	0	99	130	260
	(73)	(47)			(66)	(22)		(63)	(21)	(49)
5	715	242	62	14	92	2	+	33	62	40
	(51)	(41)	(38)	(60)	(51)	(41)	(100)	(31)	(56)	(76)
6	713	68	3	0	159	184	0	97	54	110
	(43)	(61)	(75)		(75)	(35)		(40)	(29)	(24)
7	385	149	447	1115	91	1	0	11	52	13
	(33)	(31)	(36)	(43)	(36)	(48)		(62)	(35)	(75)
8	1317	442	125	101	254	164	32	146	118	180
	(24)	(45)	(62)	(55)	(71)	(30)	(53)	(38)	(45)	(58)
9	0	0	0	0	0	207	3	0	56	38
					(0)	(17)	(83)		(13)	(78)
11	224	161	311	83	152	16	11	25	27	1
	(22)	(24)	(25)	(35)	(61)	(64)	(92)	(28)	(38)	(100)
12	1 050	198	218	147	424	226	205	113	117	11
	(30)	(26)	(23)	(39)	(22)	(19)	(46)	(33)	(11)	(49)
13	66	11	26	5	122	172	411	53	29	41
	(76)	(26)	(50)	(88)	(85)	(56)	(91)	(32)	(32)	(37)
14	220	410	278	71	27	26	1	48	19	0
	(39)	(35)	(34)	(99)	(43)	(63)	(100)	(22)	(54)	
15	388	72	60	41	92	51	11	18	30	16
	(57)	(34)	(19)	(89)	(24)	(9)	(54)	(60)	(21)	(34)
16	4	8	27	3	14	15	27	9	8	38
	(62)	(100)	(95)	(40)	(68)	(27)	(47)	(42)	(45)	(81)
17	15	29	6	0	1	2	0	1	4	0
	(49)	(56)	(50)		(48)	(95)		(63)	(10)	
18	106	21	11	0	0	+	0	41	4	0
	(60)	(45)	(45)		(0)	(50)		(26)	(68)	
19	474	291	340	0	12	2	0	55	169	0
	(20)	(52)	(41)		(44)	(55)		(28)	(18)	

+ < 0.5 t.

Table 7—*continued*

Stratum	Species code LIN	SKI	GUR	FRO	WAR	SPO	JMN	SPE	JDO	LEA
1	1 (64)	0	26 (63)	0	+ (100)	12 (68)	3 (68)	0	31 (39)	0
2	0 (100)	19 (100)	3 (100)	11 (100)	0	0	0	2 (45)	37 (38)	0
5	3 (52)	0	71 (41)	25 (92)	4 (62)	32 (41)	3 (87)	+ (63)	4 (41)	0
6	1 (100)	3 (100)	4 (67)	5 (100)	0	3 (100)	0	1 (100)	31 (41)	0
7	7 (41)	0	99 (42)	2 (61)	1 (33)	14 (44)	+ (100)	0	1 (100)	0
8	2 (65)	12 (66)	7 (55)	26 (38)	0	3 (100)	0	35 (26)	20 (53)	0
9	0	59 (31)	0	0	0	0	0	3 (67)	0	0
11	12 (62)	0	54 (35)	6 (66)	11 (57)	15 (54)	0	0	0	0
12	45 (53)	21 (48)	4 (76)	312 (60)	4 (100)	0	0	53 (48)	0	0
13	48 (61)	350 (65)	0	11 (64)	0	2 (100)	0	32 (32)	0	0
14	17 (59)	0	20 (38)	0	61 (70)	23 (40)	0	+ (100)	0	0
15	35 (81)	0	0	4 (61)	14 (81)	0	0	9 (36)	0	0
16	99 (89)	10 (84)	0	18 (79)	1 (100)	0	0	2 (44)	0	0
17	4 (26)	0	2 (22)	0	17 (53)	2 (100)	49 (26)	2 (100)	3 (65)	5 (81)
18	0	0	43 (22)	0	2 (37)	10 (66)	19 (77)	+ (100)	12 (60)	7 (75)
19	0	0	111 (43)	3 (100)	1 (100)	36 (51)	24 (19)	12 (40)	83 (22)	127 (21)

\+ < 0.5 t.

Table 8: Numbers of length frequency and biological samples collected. Species codes are given in Appendix 3.

Species code	Measure-ment method	Length frequency data: No. of samples	No. of fish	No. of males	No. of females	Biological data+: No. of samples	No. of fish	No. of otoliths
BAR	1	74	3 300	1 025	1 157			
BCO	2	7	15	3	12			
BRI	2	1	4	3	1			
BSH	2	1	2	2	0			
CBI	2	27	1 238	548	687			
CBO	2	1	14	0	13			
CRA	6	10	14	6	7	10	14	
ELE	1	10	50	20	30			
EMA	1	2	3	2	0			
ESO	2	12	198	67	131			
FRO	1	31	564	98	159			
GFL	2	1	2	1	1			
GSH	G	42	792	359	433			
GUR	1	49	1 655	819	830	49	950	257
HAK	2	39	1 359	663	618			
HAP	2	12	28	14	14			
HEP	2	1	1	0	1			
HEX	2	1	1	0	1			
HOK	2	34	1 578	431	258			
JDO	2	30	129	31	98			
JMD	1	34	209	102	107			
JMM	1	9	11	7	4	9	11	10
JMN	1	21	651	100	92			
KAH	1	2	2	20				
LDO	2	4	14	0	14			
LEA	2	9	746	Not sexed				
LIN	2	45	323	156	166	11	84	24
LSO	2	22	141	20	121			
MOK	1	1	1	0	1			
NOS	4	69	3 516	2 107	1 273			
NSD	2	23	88	41	47			
OPE	2	3	18	9	9			
RBM	1	3	4	2	2			
RCO	2	65	3 939	2 273	1662	62	1 252	330
RSK	5	17	37	19	18	13	30	
SCH	2	67	465	241	223	44	275	
SCI	B	1	1	1	0	1	1	
SFL	2	15	390	77	306			
SKI	1	20	262	141	121			
SNA	1	5	9	3	6			
SPD	2	68	3 805	1 704	2 101			
SPE	2	39	1 135	659	456			
SPO	2	33	126	85	40	1	2	

Table 8—*continued*

		Length frequency data				Biological data+		
Species code	Measurement method	No. of samples	No. of fish	No. of males	No. of females	No. of samples	No. of fish	No. of otoliths
SSH	2	5	21	3	18			
SSK	5	16	20	10	10	15	19	
STA	2	54	875	477	392	54	792	640
SWA	1	37	544	116	95			
TAR	1	60	1 871	695	1174	59	947	261
THR	2	2	2	1	1			
WAR	1	28	410	38	52			

Measurement methods: 1, fork length; 2, total length; 4, mantle length; 5, pelvic length; 6, carapace width B, carapace length; G, total length excluding tail filament

+ Data include one or more of the following: fish length, fish weight, gonad stage, otoliths.

Table 9: Numbers of the four target species sampled at each reproductive stage (small fish of undetermined sex are not included).

	Males Gonad stage					Females Gonad stage					
Total length (cm)	1	2	3	4	5	1	2	3	4	5	
Giant stargazer											
11–20	1	0	0	0	0	3	0	0	0	0	
21–30	40	3	0	0	0	21	0	0	0	0	
31–40	54	7	3	0	0	41	0	0	0	0	
41–50	22	66	23	1	2	27	1	0	0	0	
51–60	5	74	26	3	1	29	39	2	0	0	
61–70	1	18	6	0	2	5	112	4	1	2	
> 70	0	2	0	0	0	1	11	0	0	1	
Total	123	167	58	4	5	127	163	6	1	3	657
Red cod											
11–20	5	0	0	0	0	8	0	0	0	0	
21–30	101	1	0	0	0	22	0	0	0	0	
31–40	214	8	3	1	0	168	3	0	0	0	
41–50	87	35	22	20	14	159	8	1	0	4	
51–60	4	1	14	12	2	131	30	7	0	10	
> 60	0	0	0	0	0	12	5	2	0	4	
Total	411	45	39	33	16	500	46	10	0	18	1118
Red gurnard											
11–20	1	0	0	0	0	2	0	0	0	0	
21–30	58	32	3	3	3	51	11	1	0	3	
31–40	28	78	12	12	79	52	52	13	8	23	
41–50	0	9	2	0	12	9	57	20	9	17	
> 50	0	0	0	0	0	0	1	0	0	1	
Total	87	119	17	15	94	114	121	34	17	44	662
Tarakihi											
11–20	23	0	0	0	0	17	0	0	0	0	
21–30	39	21	2	2	0	61	2	1	0	0	
31–40	19	68	21	70	9	96	249	10	9	12	
41–50	1	8	4	18	0	3	141	8	9	3	
Total	59	97	27	90	9	160	392	19	18	15	886

Gonad stages used were: 1, immature or resting; 2, maturing (oocytes visible in females, thickening gonad but no milt expressible in males); 3, mature (hyaline oocytes in females, milt expressible in males); 4, running ripe (eggs and milt free flowing); 5, spent (gonads flacid and bloodshot)

Table 10: Estimated biomass (t) and coefficients of variation (c.v.%) for the target species, all years.

	KAH9204		KAH9404		KAH9504		KAH9701		KAH0004		KAH0304		KAH0503	
	Biomass	c.v. (%)	Biomass	c.v. (%)	Biomass	c.v. (%)	Biomass	c.v. (%)	Biomass	c.v. (%)	Biomass	c.v. (%)	Biomass	c.v. (%)
Giant stargazer	1 302	12	1 350	17	1 551	16	1 450	15	1 023	12	834	15	1 458	19
Red cod	2 719	13	3 169	18	3 123	15	2 546	23	414	26	906	24	2 610	18
Red gurnard	573	16	559	15	584	19	471	13	625	14	270	20	442	17
Tarakihi	1 409	14	1 394	13	1 389	10	1 087	12	964	19	912	20	2 050	12

Table 11:Biomass (t) by area for red gurnard, all years.

	KAH9204		KAH9404		KAH9504		KAH9701		KAH0004		KAH0304		KAH0503	
	Biomass	c.v. (%)	Biomass	c.v. (%)	Biomass	c.v. (%)	Biomass	c.v. (%)	Biomass	c.v. (%)	Biomass	c.v. (%)	Biomass	c.v. (%)
Tasman/Golden Bays	252	24	274	16	185	14	233	12	301	23	47	16	155	31
West coast	321	20	285	25	399	28	237	22	324	18	223	24	287	20

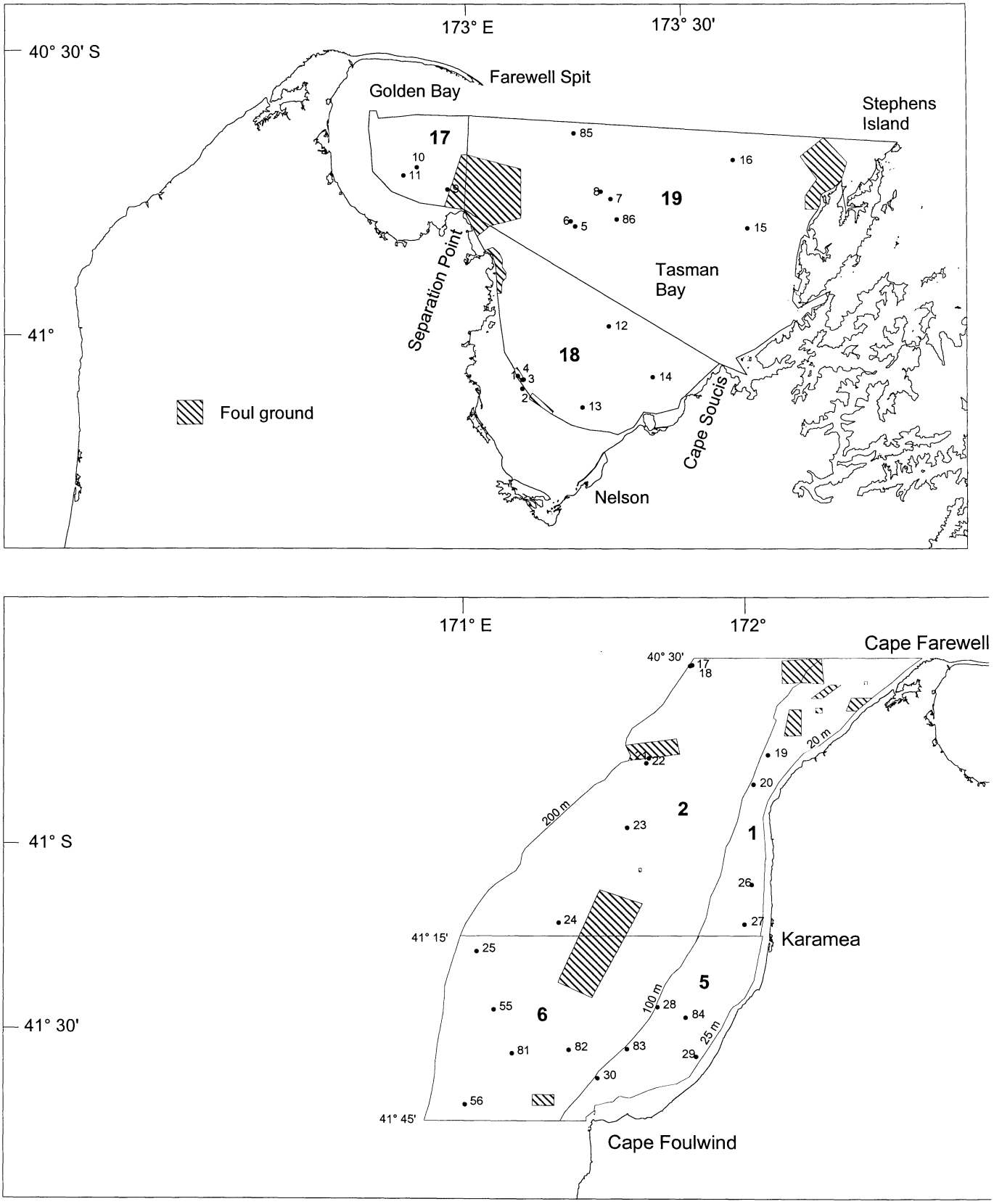

Figure 1a: Survey area showing stratum boundaries and numbers (bold type) for Tasman and Golden Bays (top) and west coast north of Cape Foulwind (bottom) with station positions and numbers.

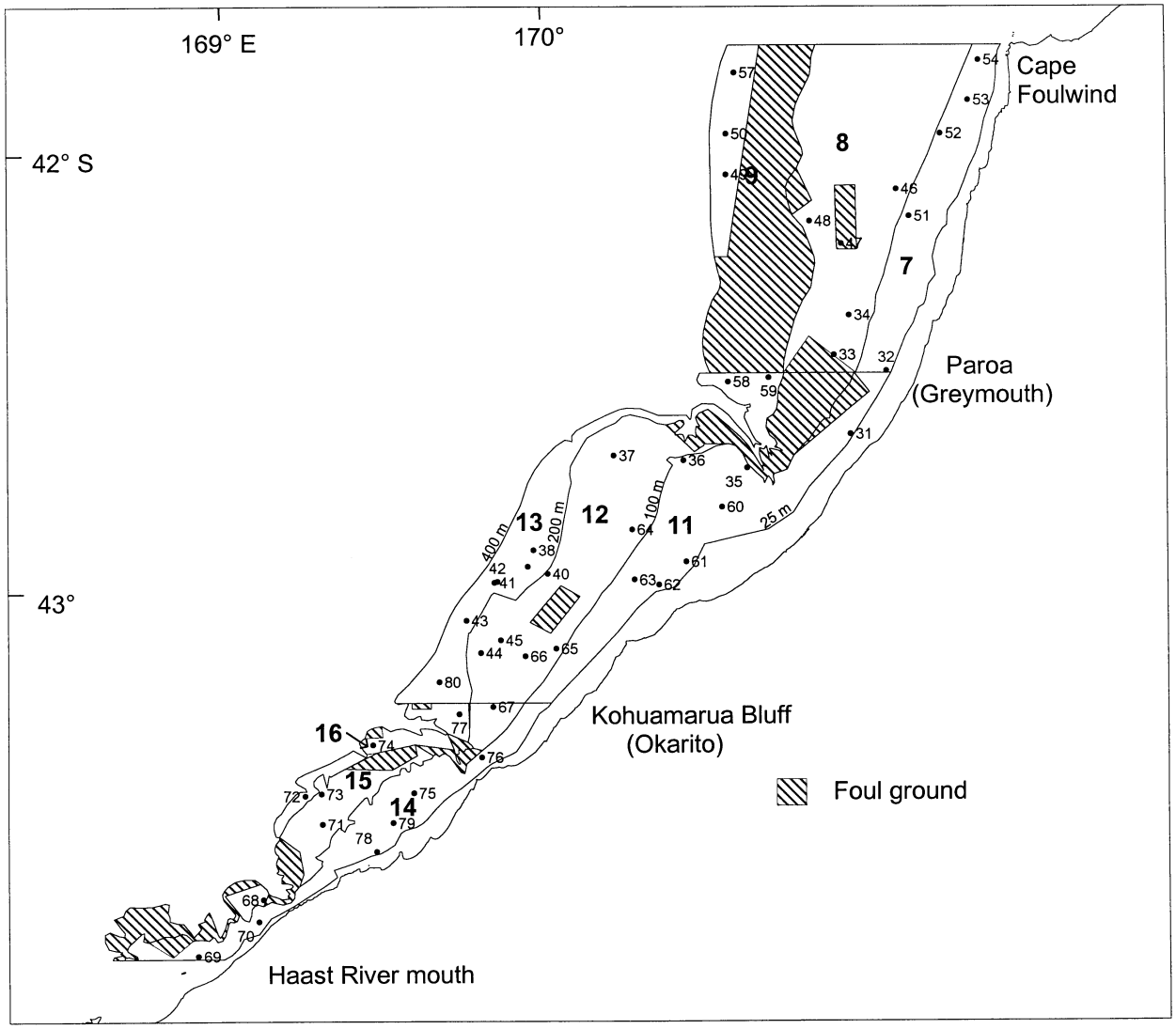

Figure 1b: Stratum boundaries and number (bold type) for the west coast south of Cape Foulwind with station positions and numbers.

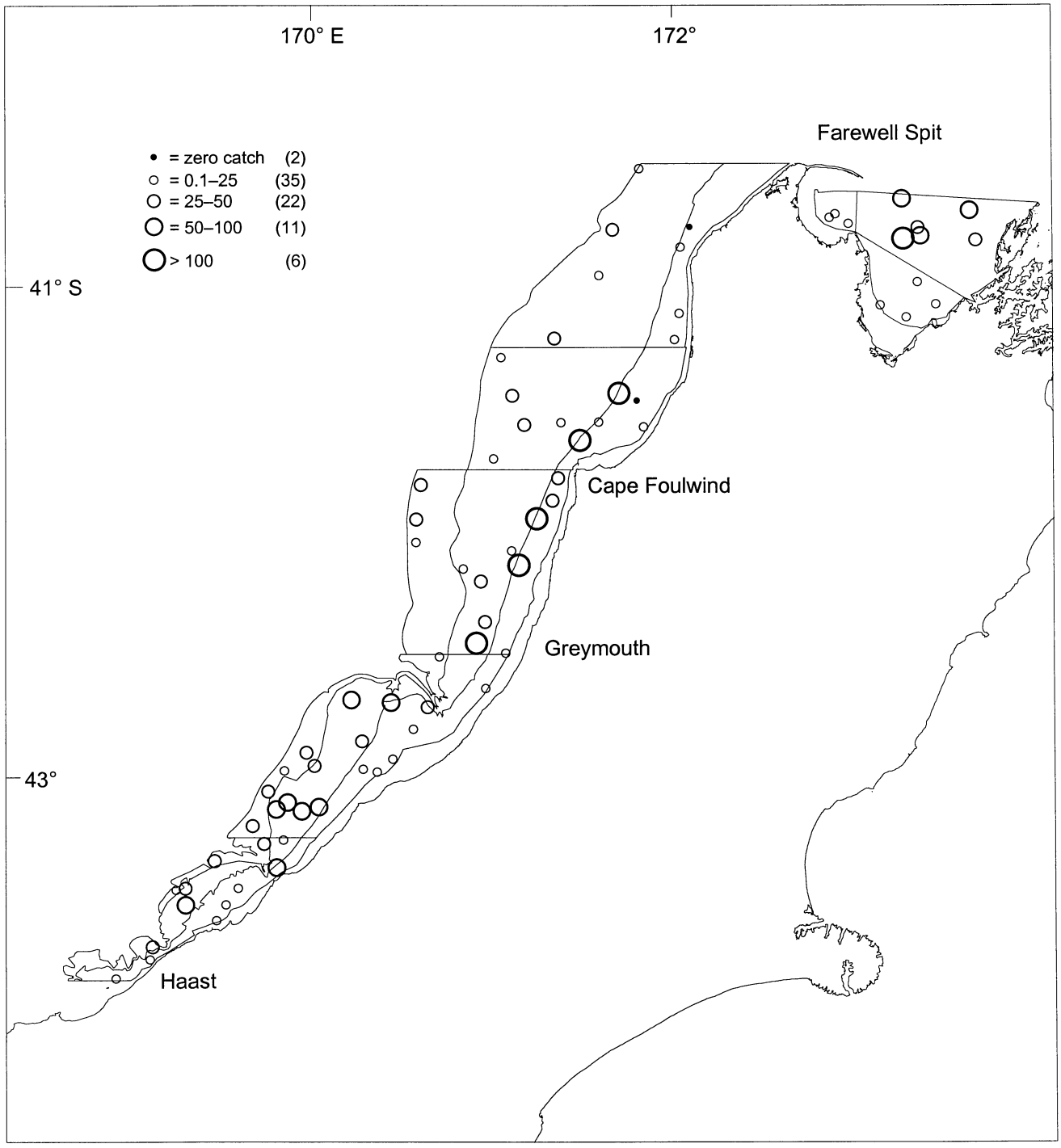

Figure 2: Catch rates (kg.km^{-2}) for the 15 most abundant commercial species in alphabetical order by common name (numbers in parenthesis are the number of catches within the given range).
a: Arrow squid (maximum catch rate 142 kg.km^{-2})

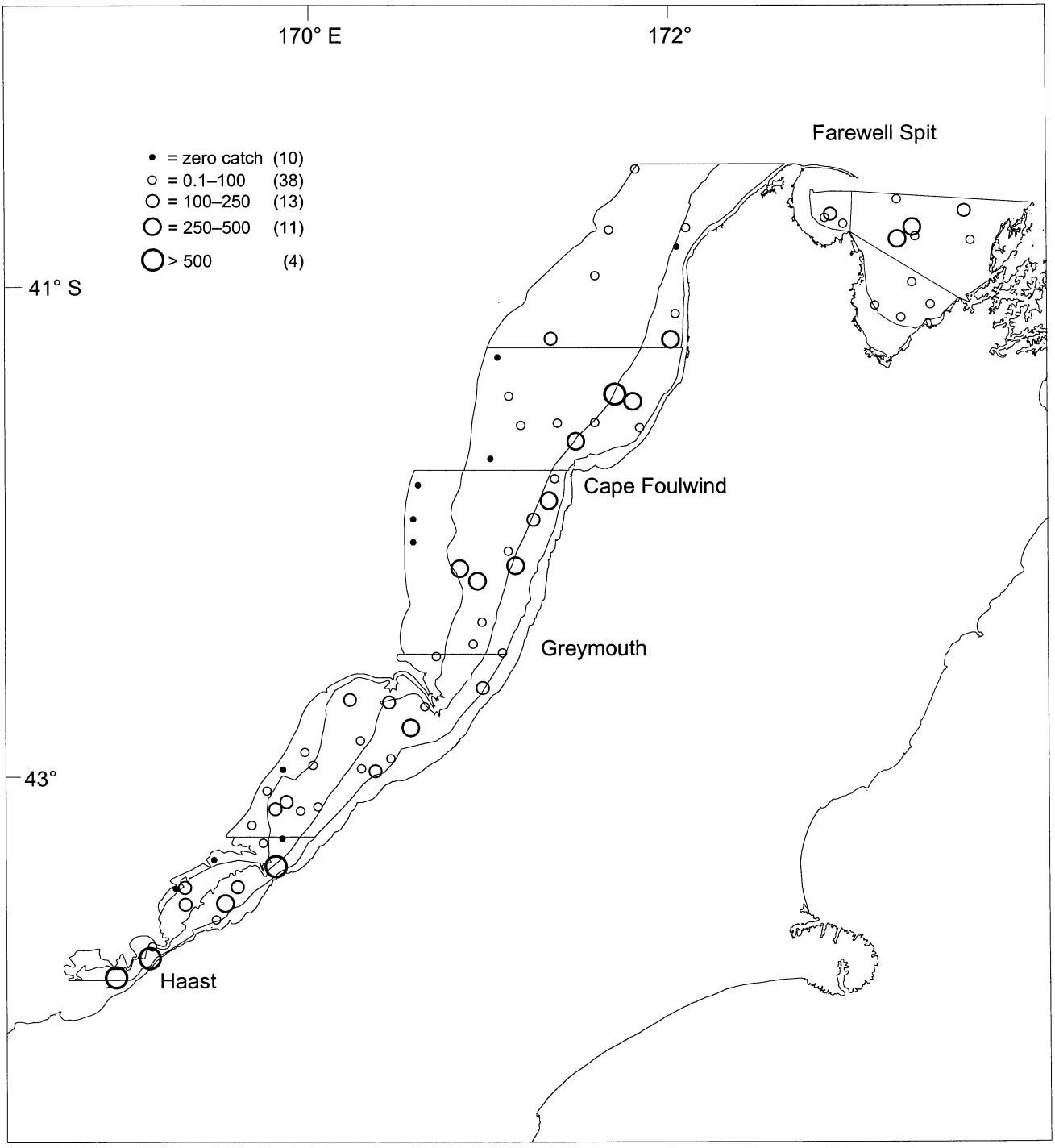

Figure 2b: Barracouta (maximum catch rate 978 kg.km^{-2})

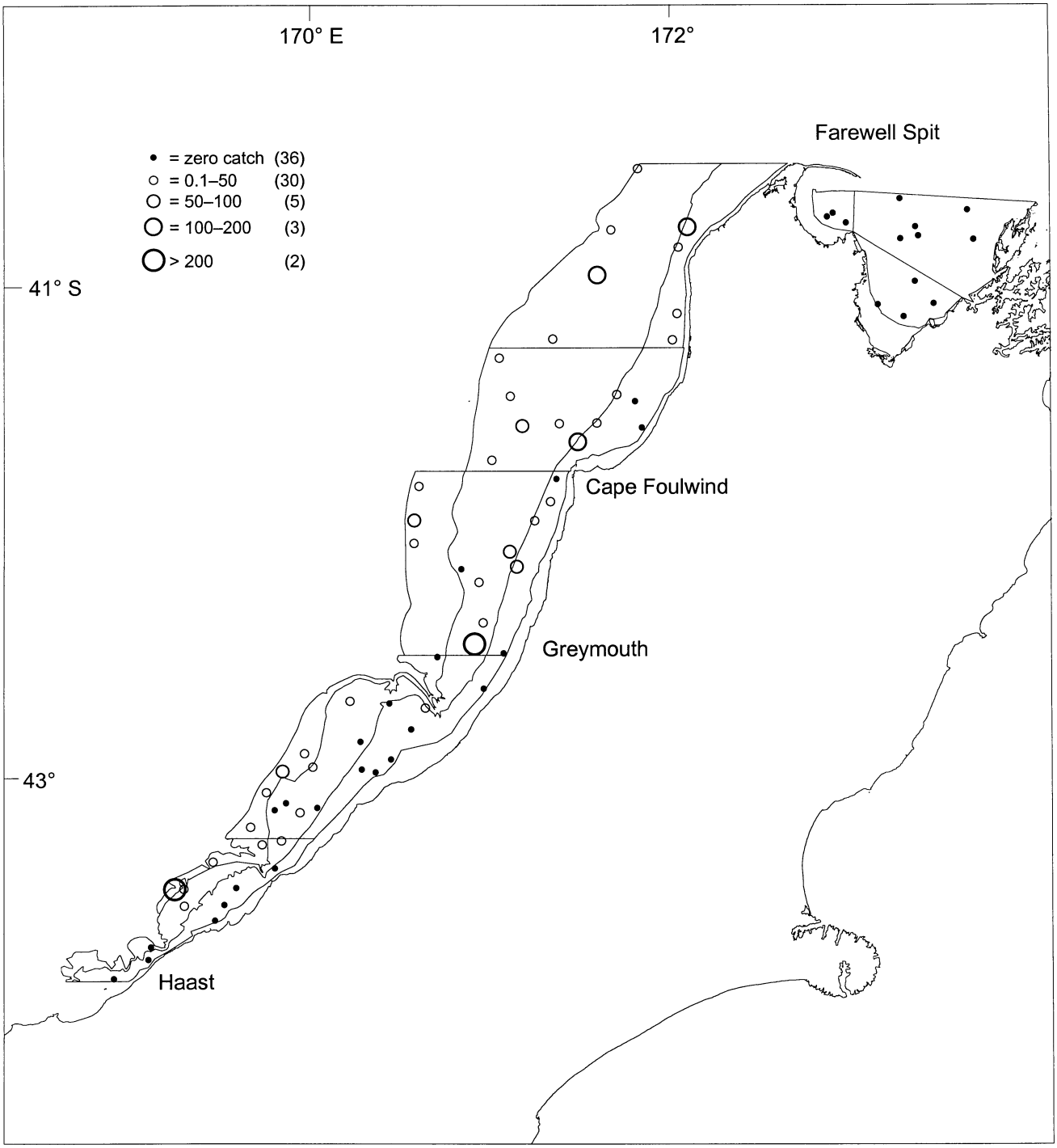

Figure 2c : Dark ghost shark (maximum catch rate 308 kg.km^{-2})

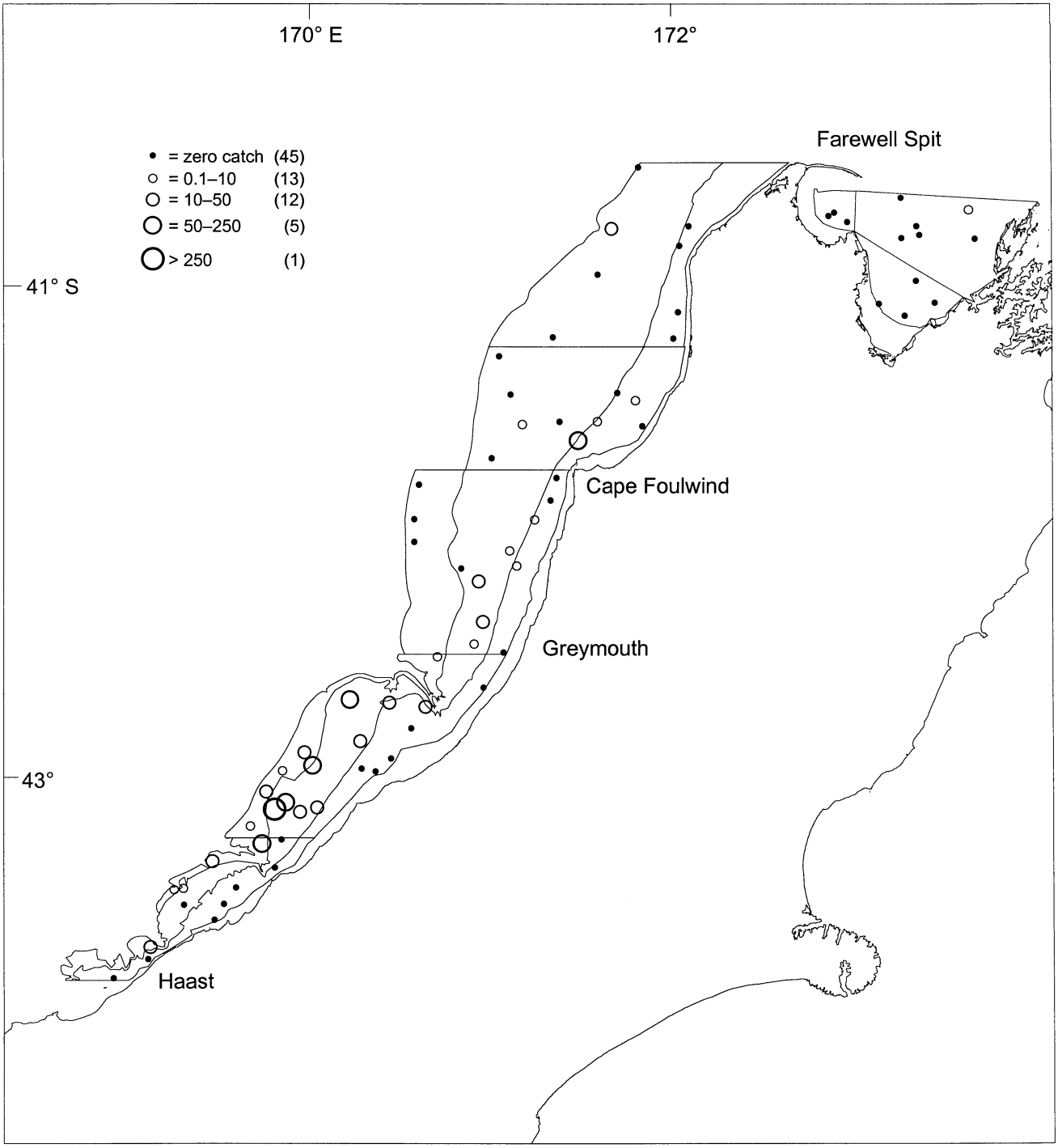

Figure 2d: Frostfish (maximum catch rate 689 kg.km^{-2})

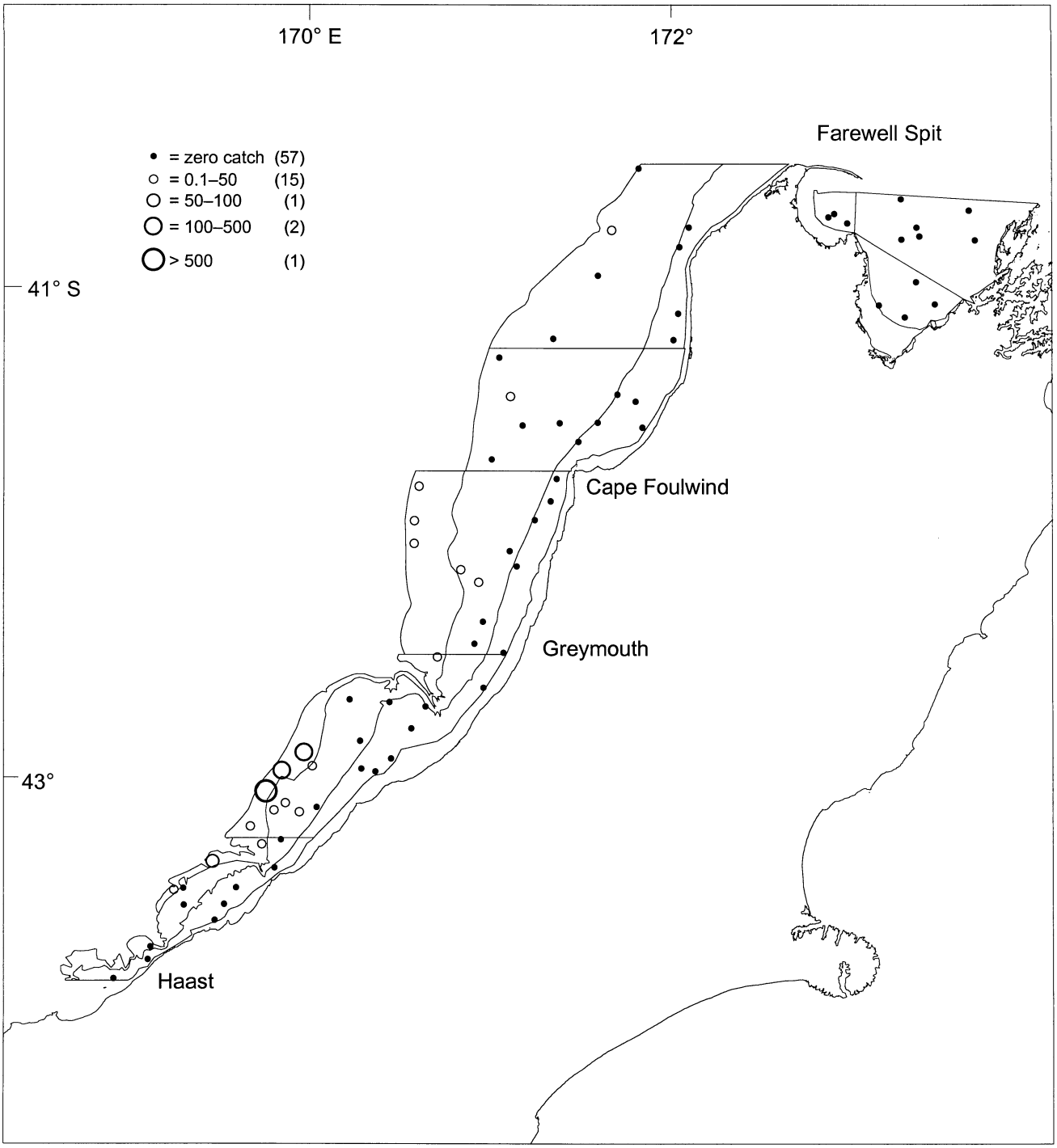

Figure 2e : Gemfish (maximum catch rate 1140 kg.km^{-2})

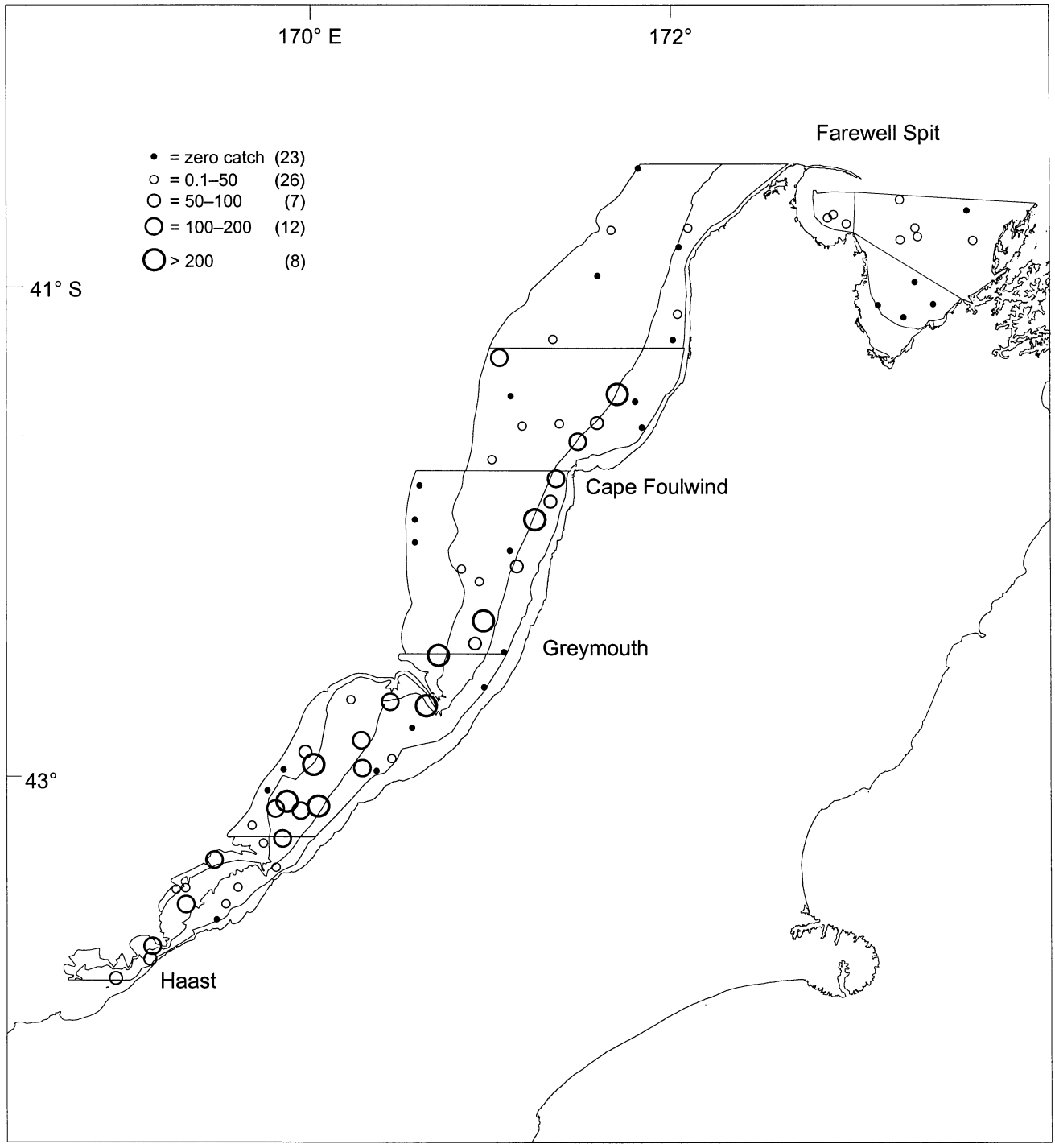

Figure 2e : Giant stargazer (maximum catch rate 487 kg.km^{-2})

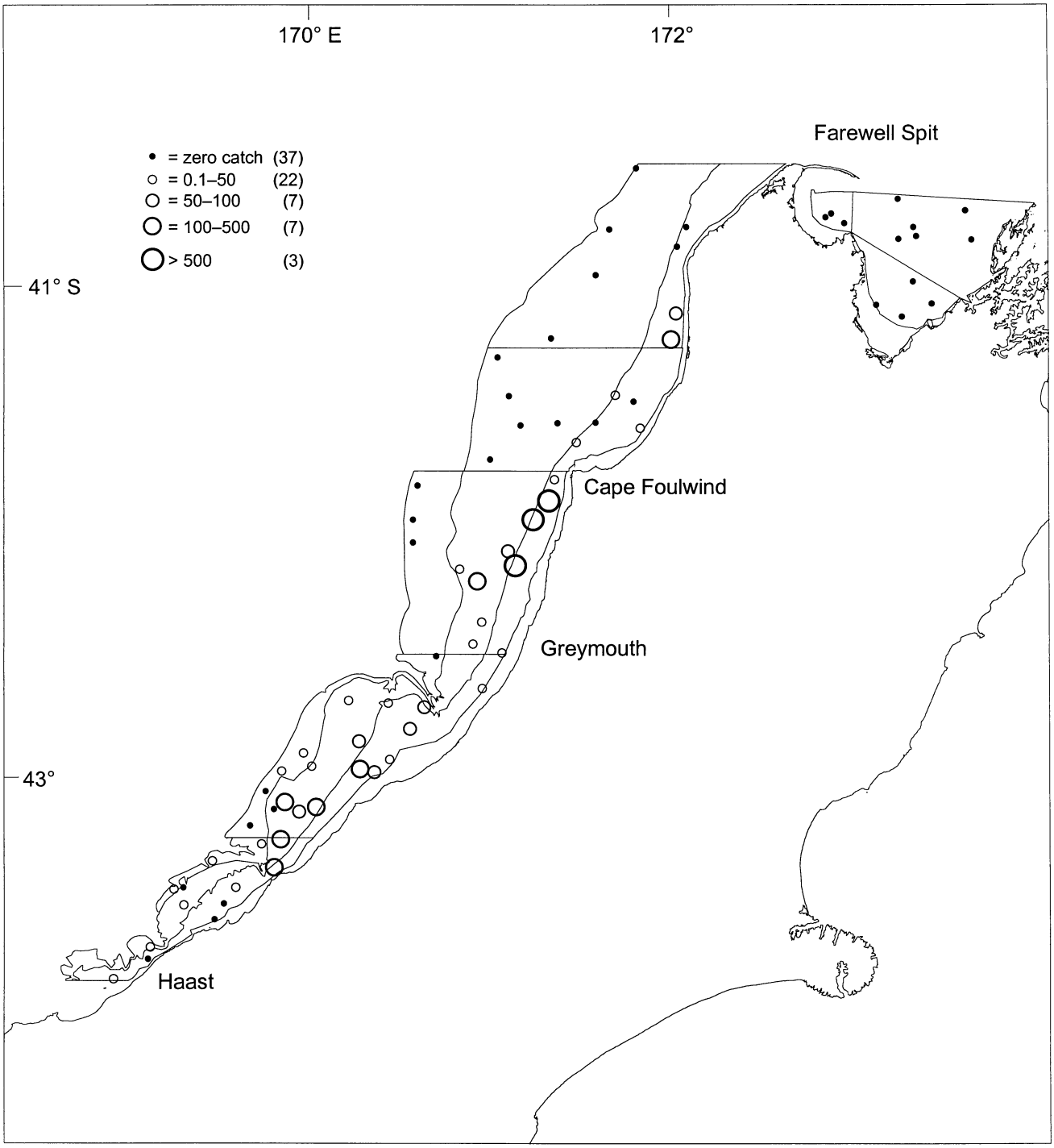

Figure 2g: Hake (maximum catch rate 2670 kg.km^{-2})

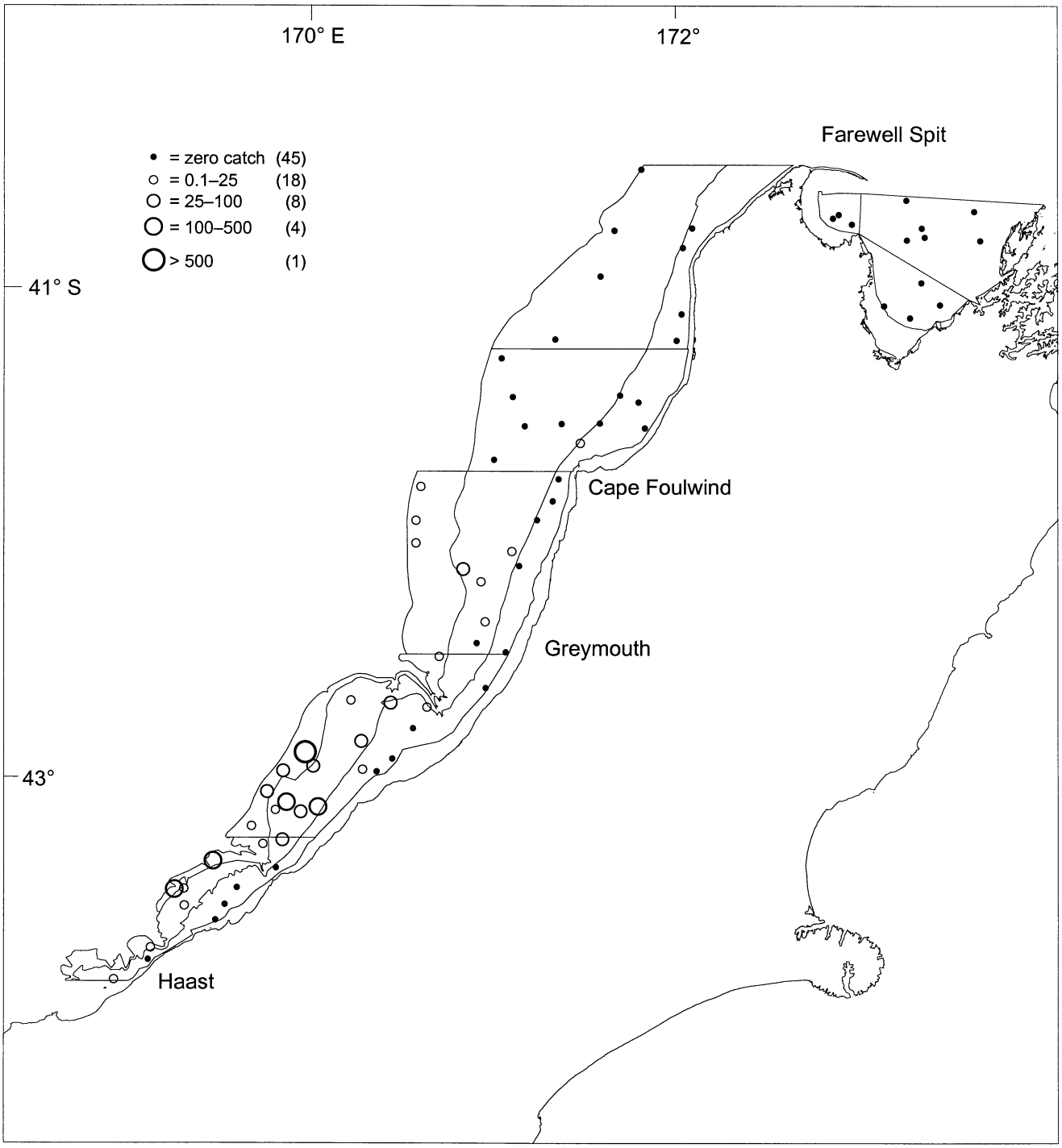

Figure 2h: Hoki (maximum catch rate 1730 kg.km^{-2})

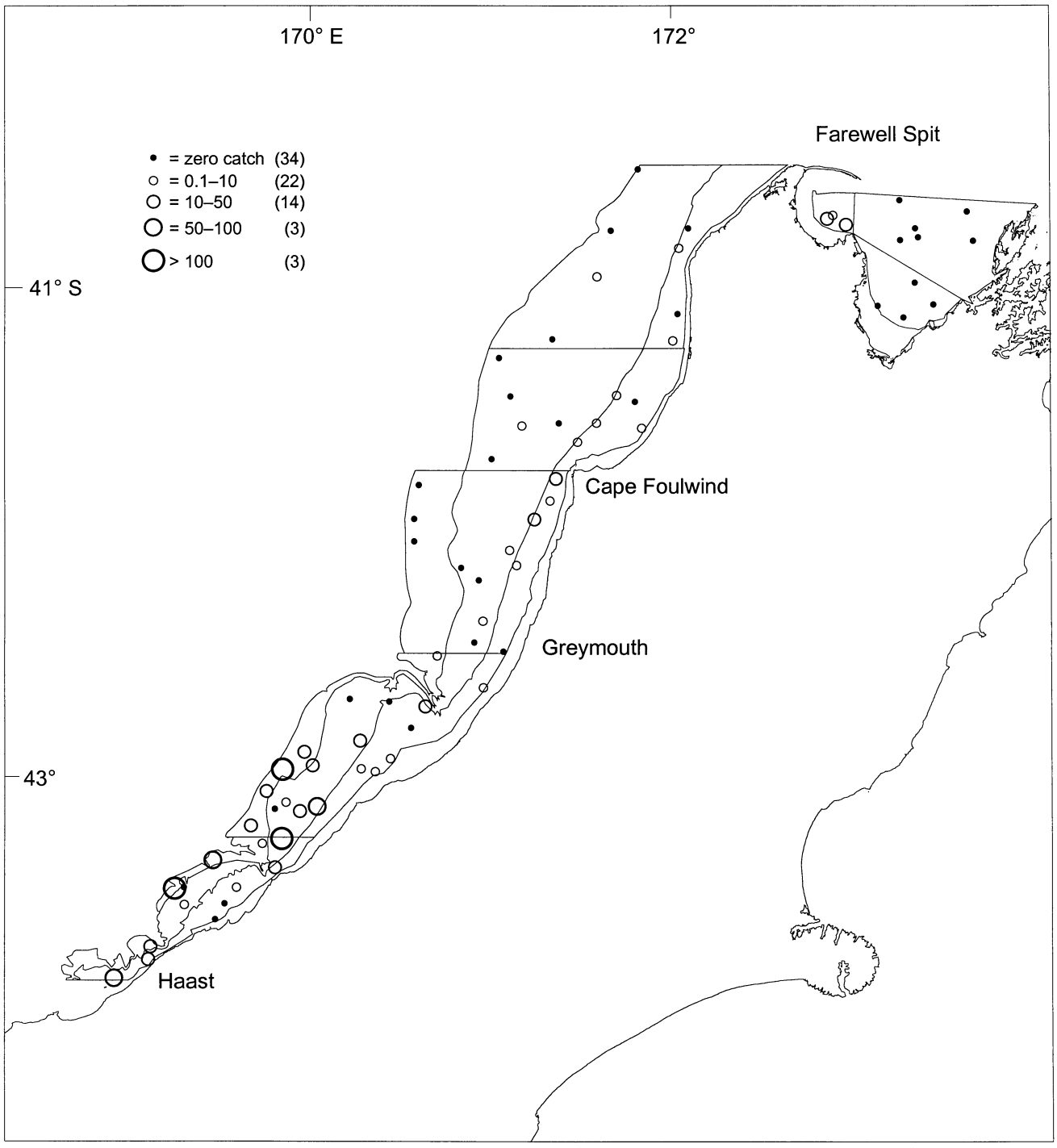

Figure 2i: Ling (maximum catch rate 856 kg.km^{-2})

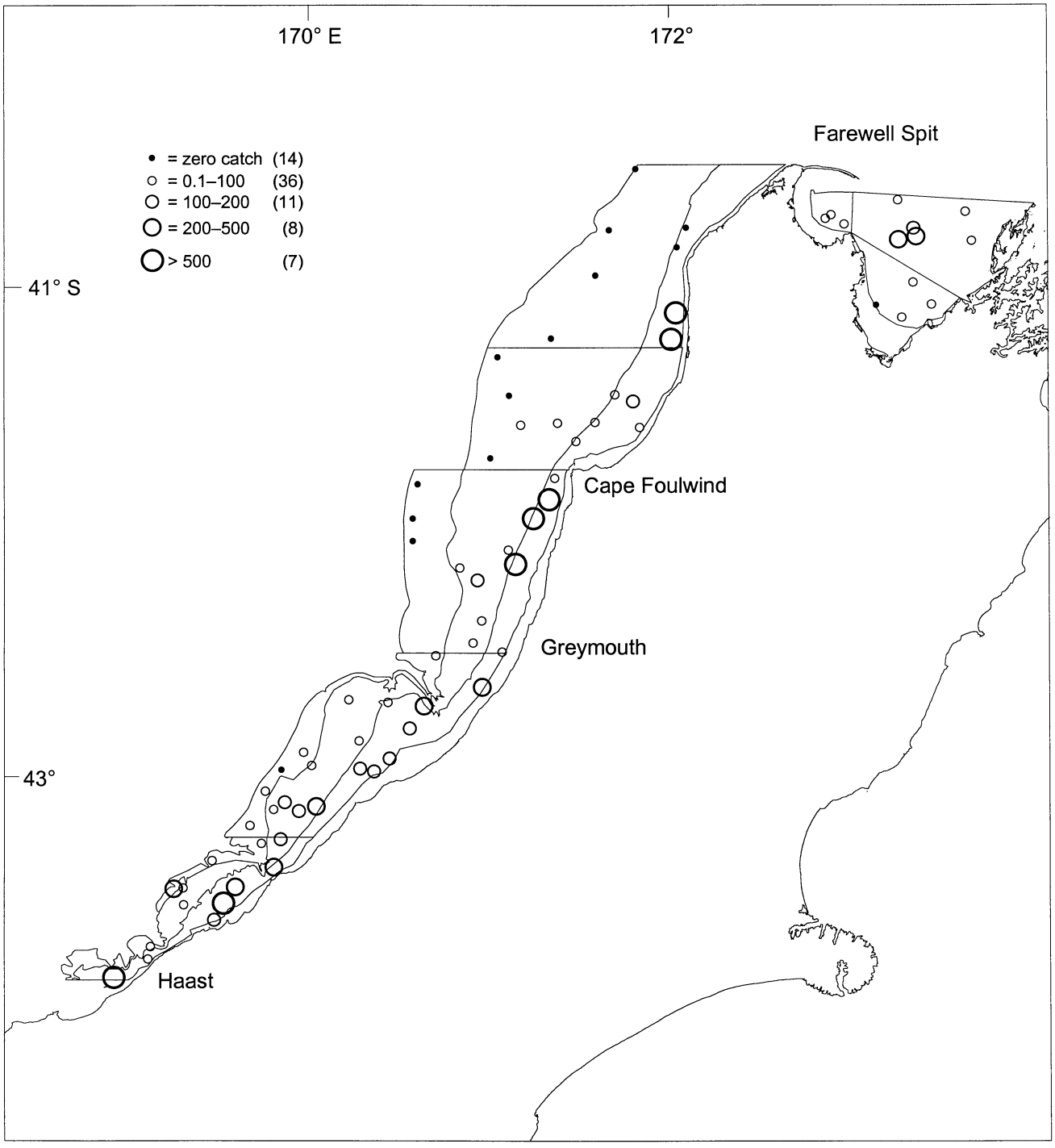

Figure 2j: Red cod (maximum catch rate 1060 kg.km^{-2})

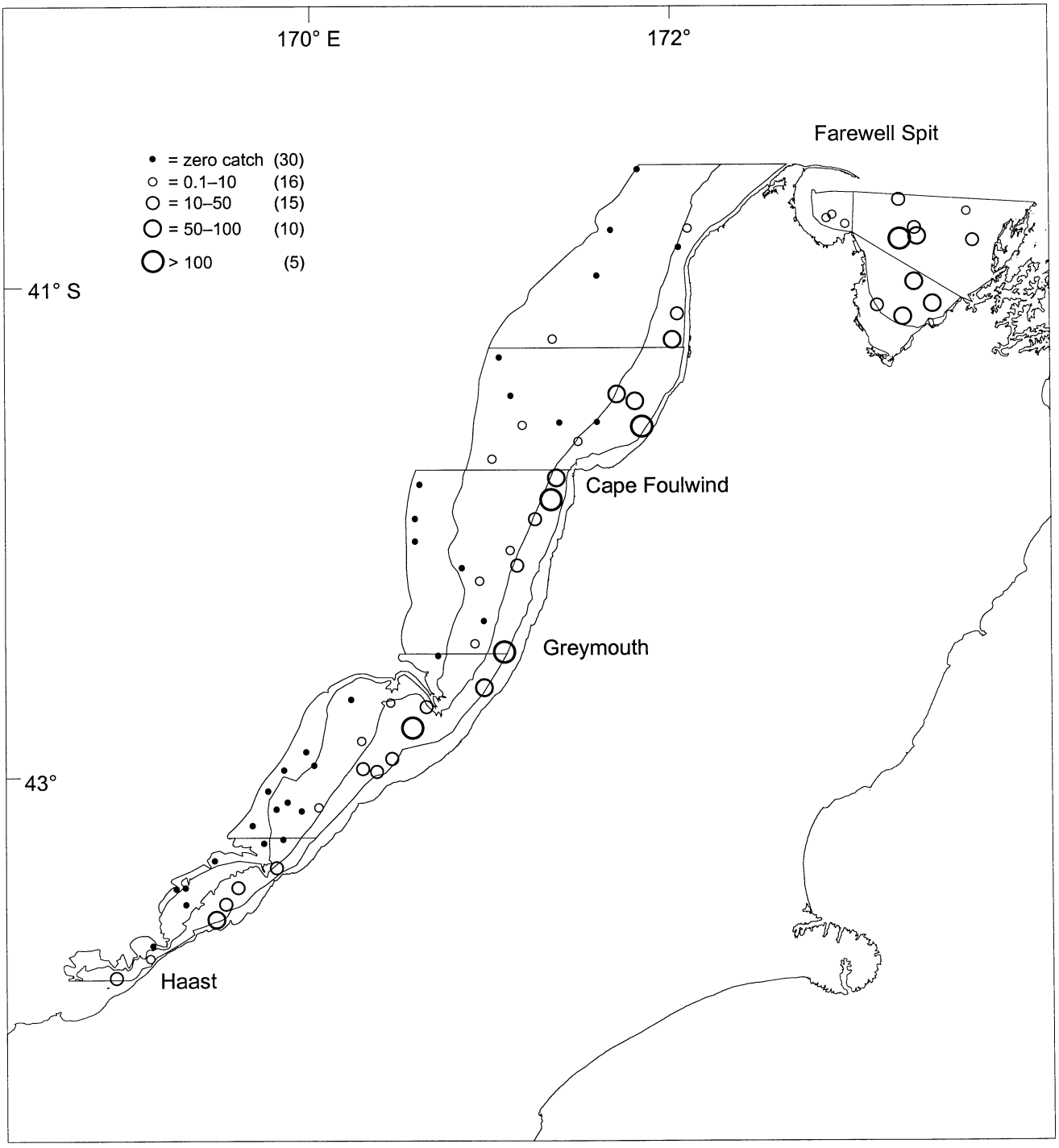

Figure 2k: Red gurnard (maximum catch rate 264 kg.km^{-2})

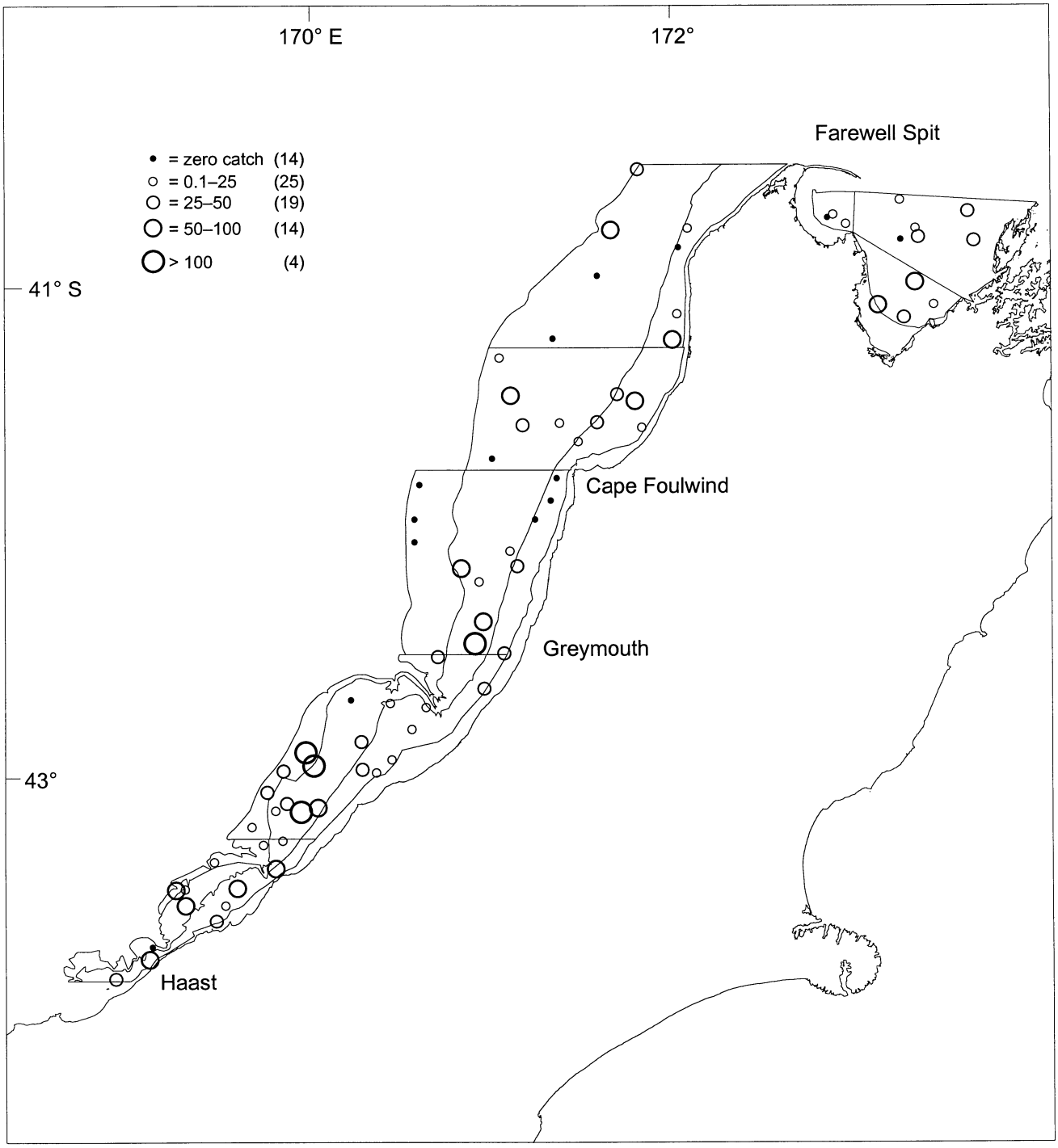

Figure 2l: School shark (maximum catch rate 133 kg.km^{-2})

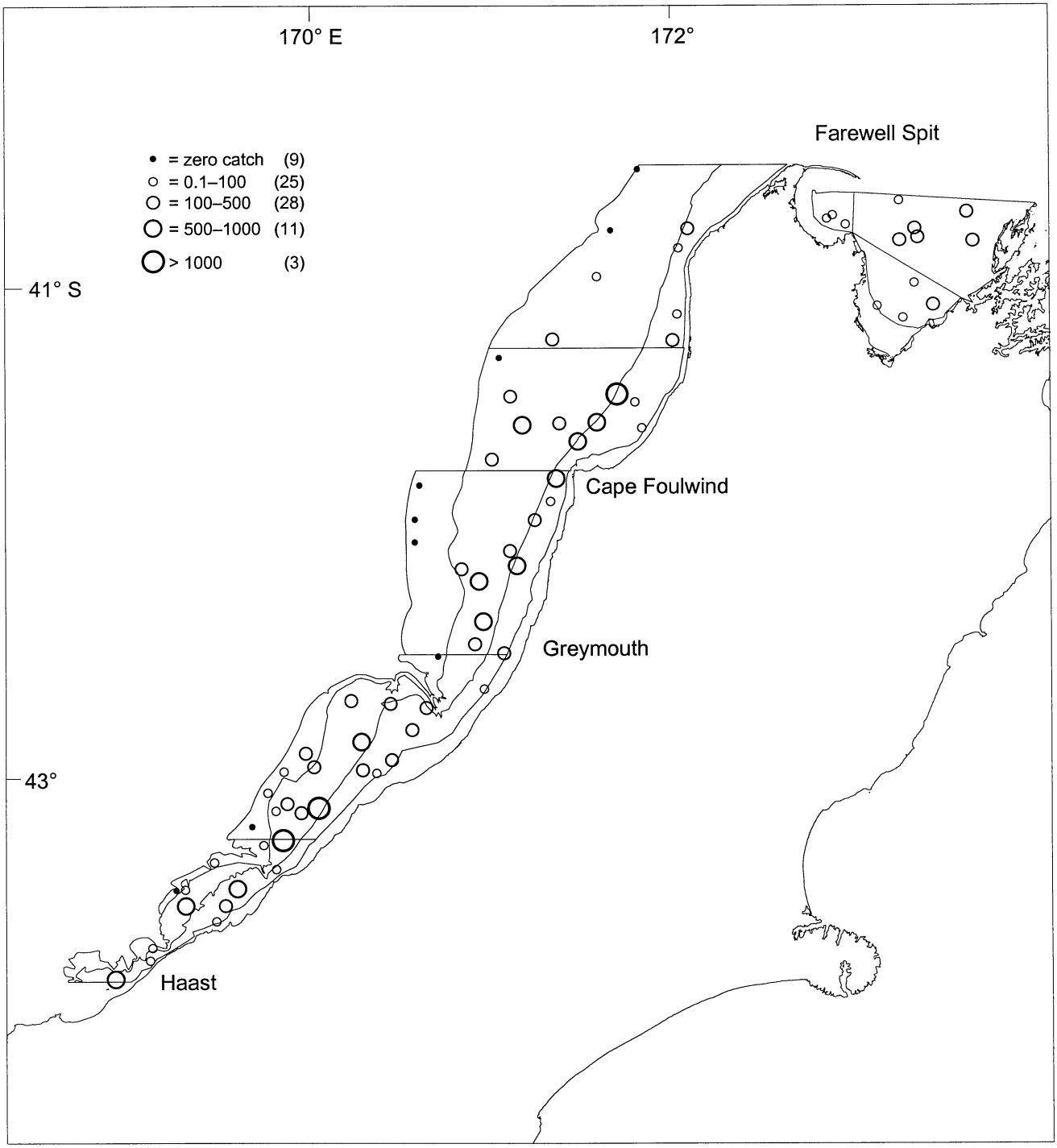

Figure 2m: Spiny dogfish (maximum catch rate 1750 kg.km^{-2})

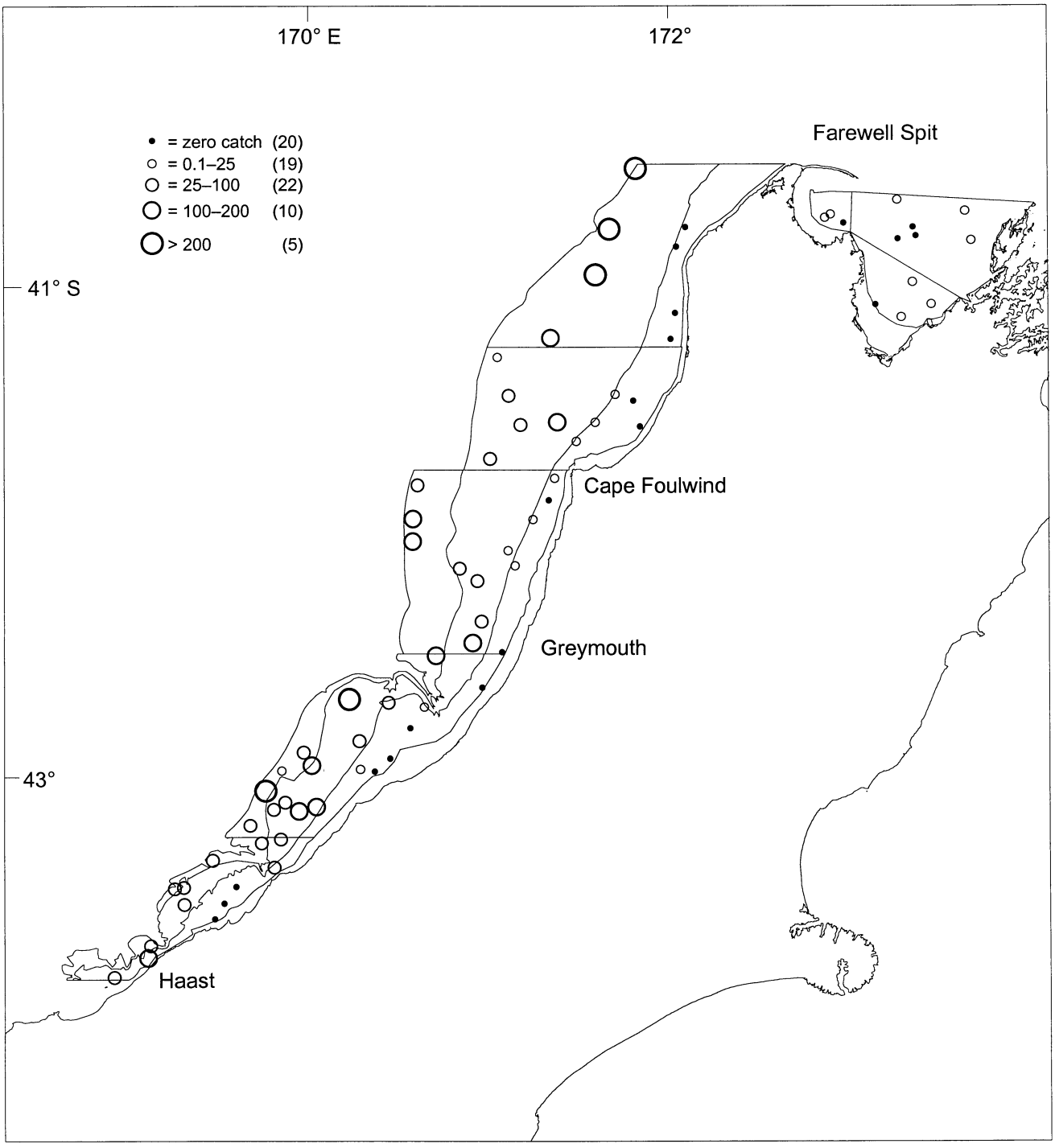

Figure 2n: Tarakihi (maximum catch rate 427 kg.km^{-2})

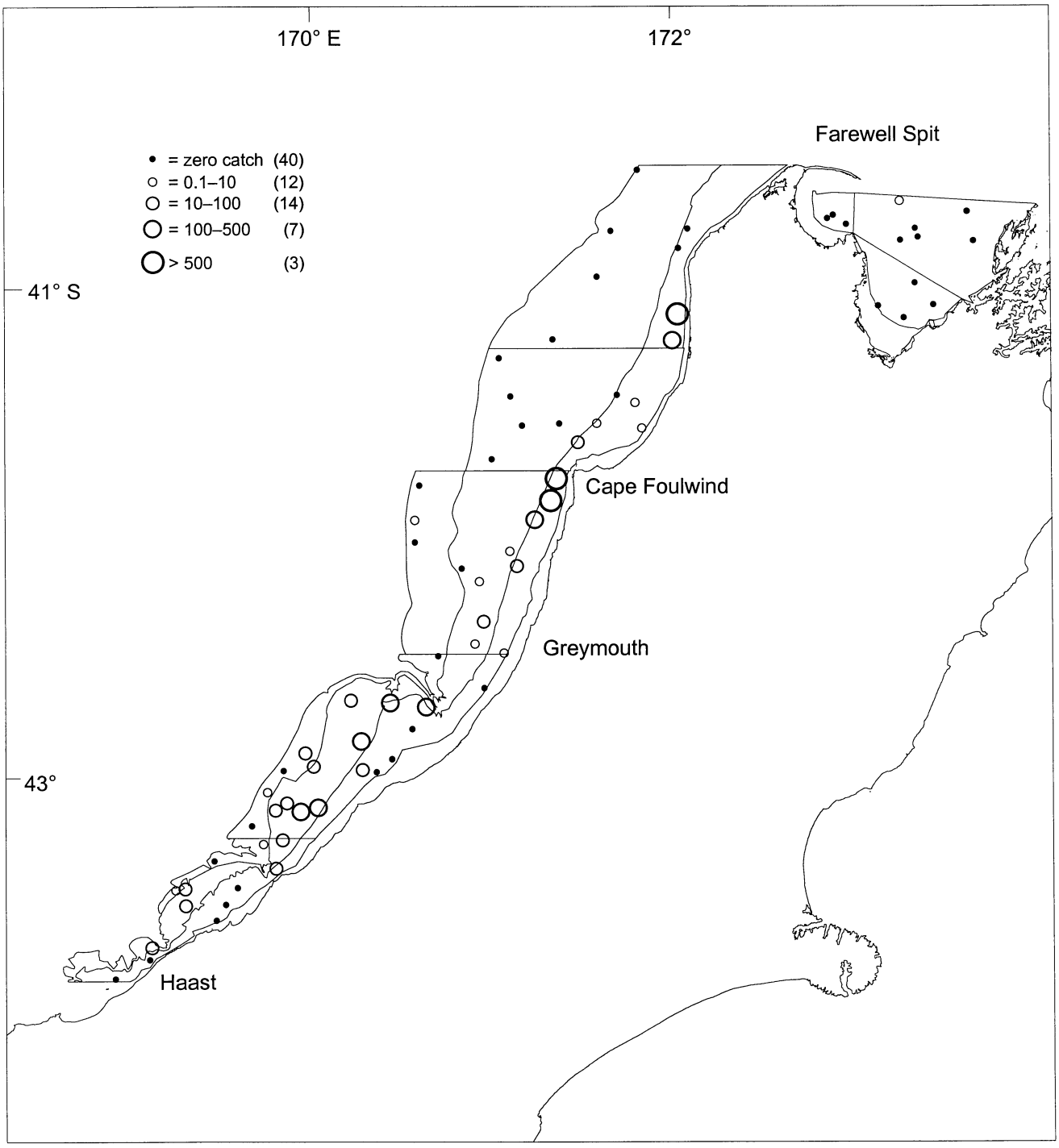

Figure 2o: Two saddle rattail (maximum catch rate 1090 kg.km^{-2})

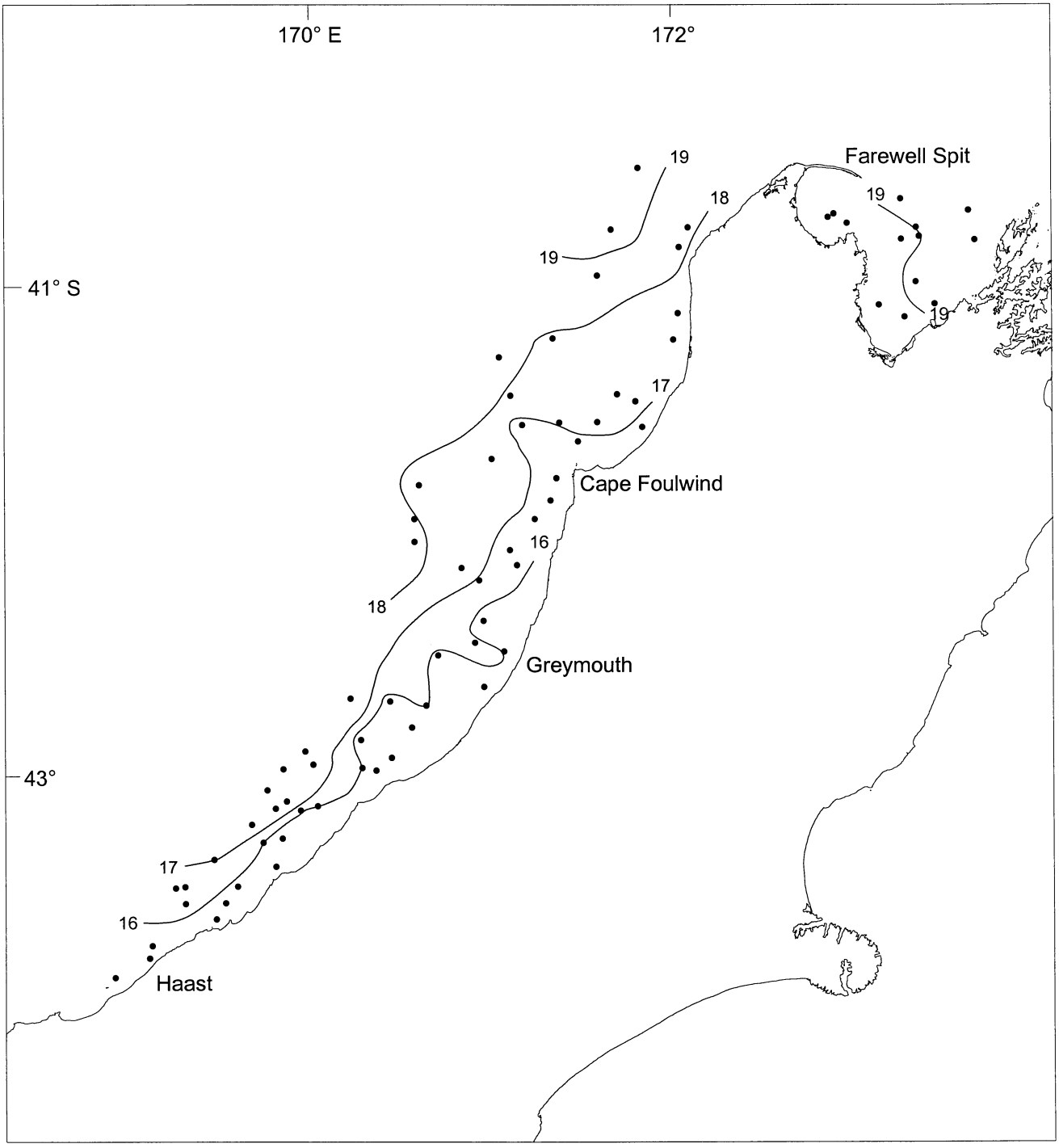

Figure 3: Positions of CTD sea surface temperature recordings and isotherms estimated from the temperature recordings.

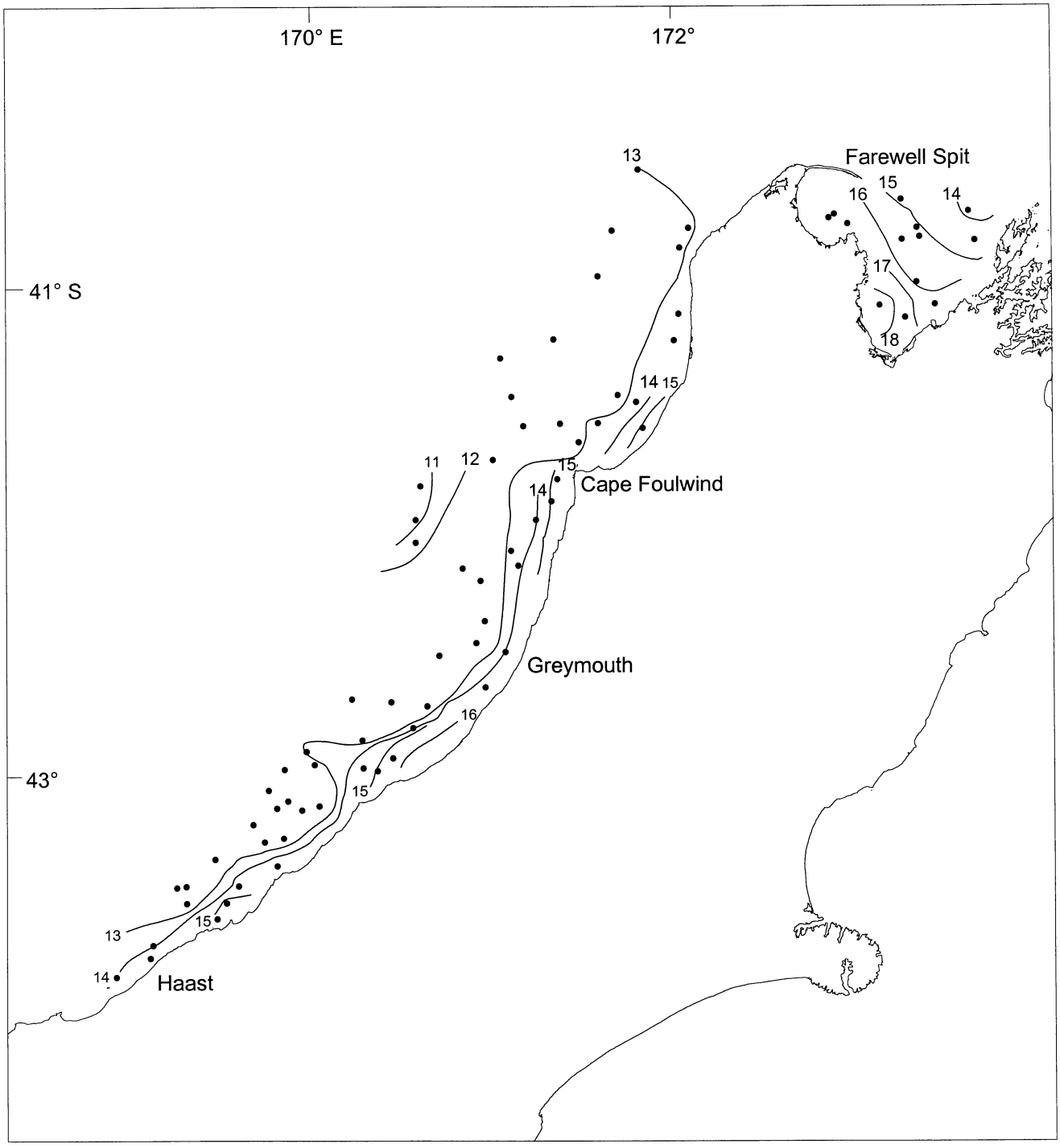

Figure 4: Positions of CTD bottom temperature recordings and isotherms estimated from the temperature recordings.

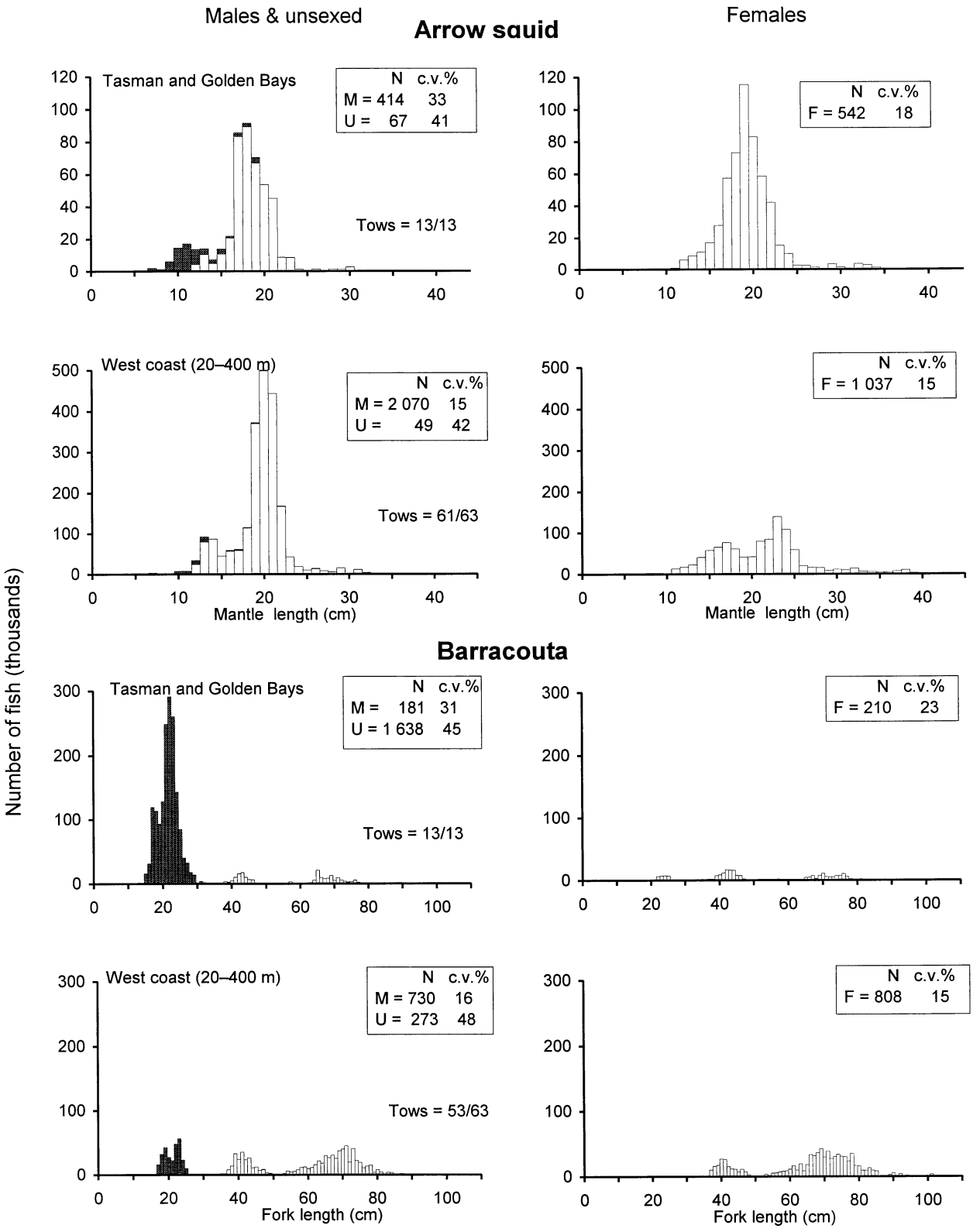

Figure 5: Length frequency distributions for the major commercial species (by depth where appropriate). N, estimated population (scaled, thousands); M, male; F, female; U, unsexed (shaded); Tows, number of stations where species was caught/total number of stations in area.

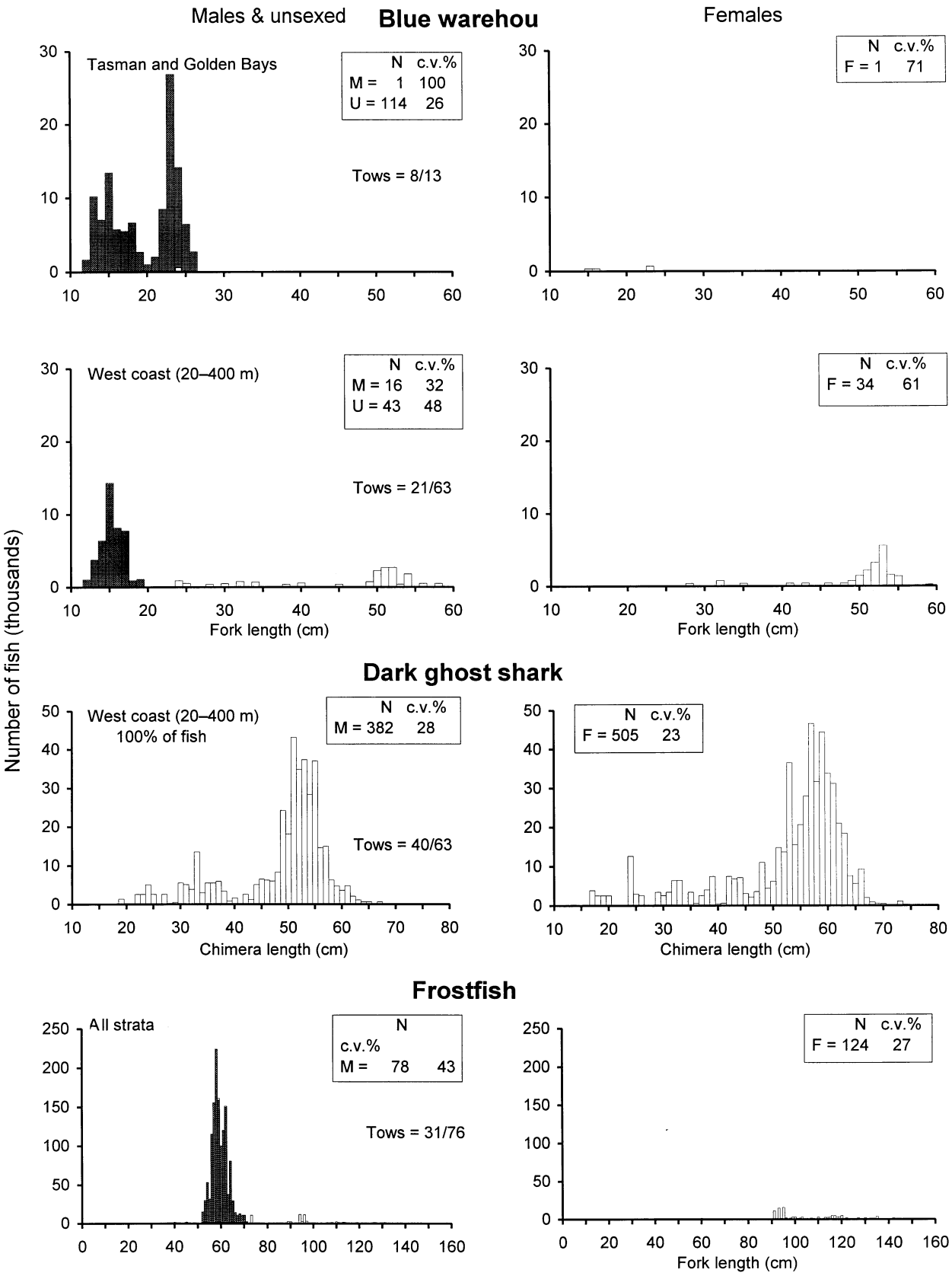

Figure 5—*continued*

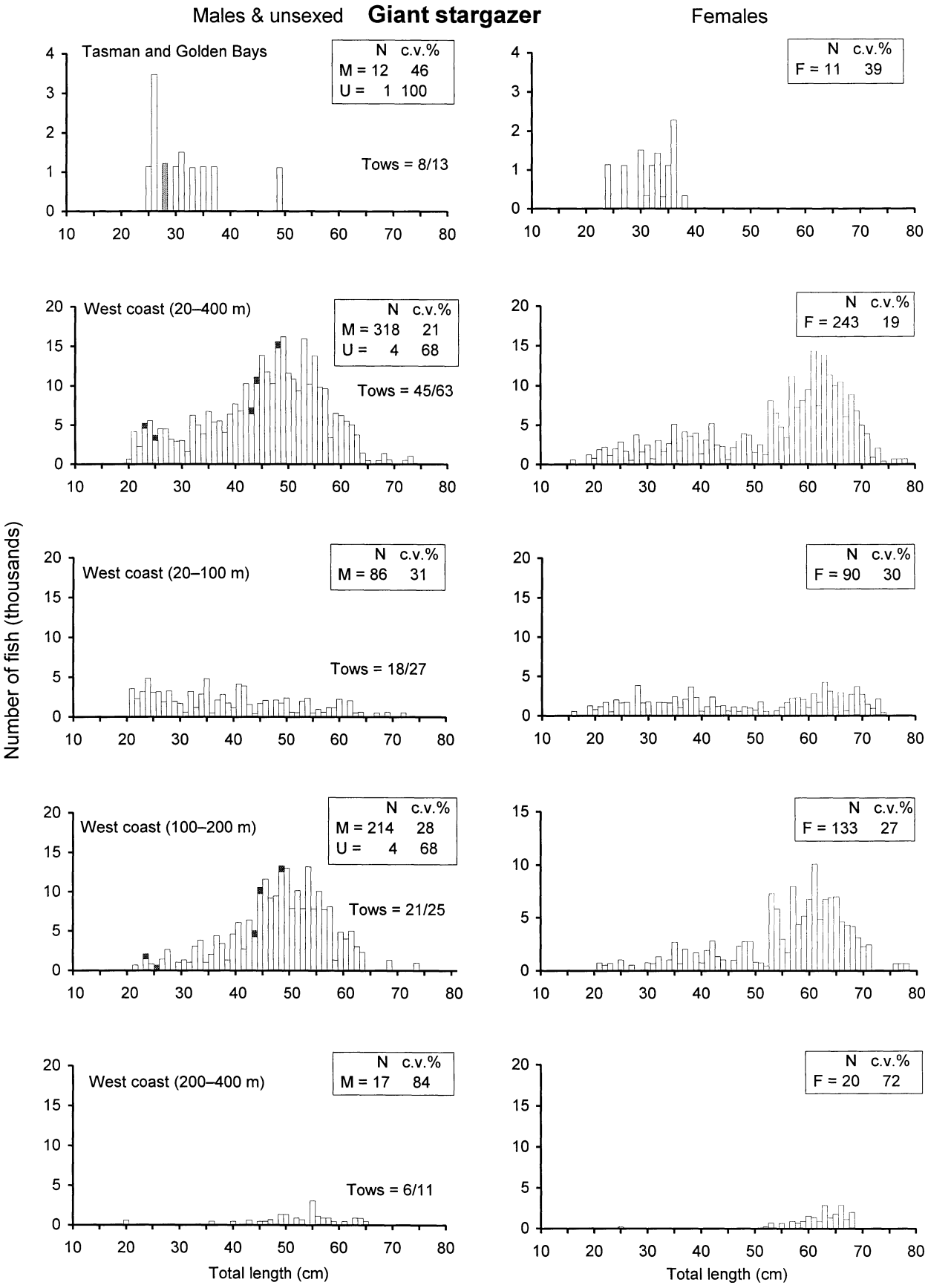

Figure 5–*continued*

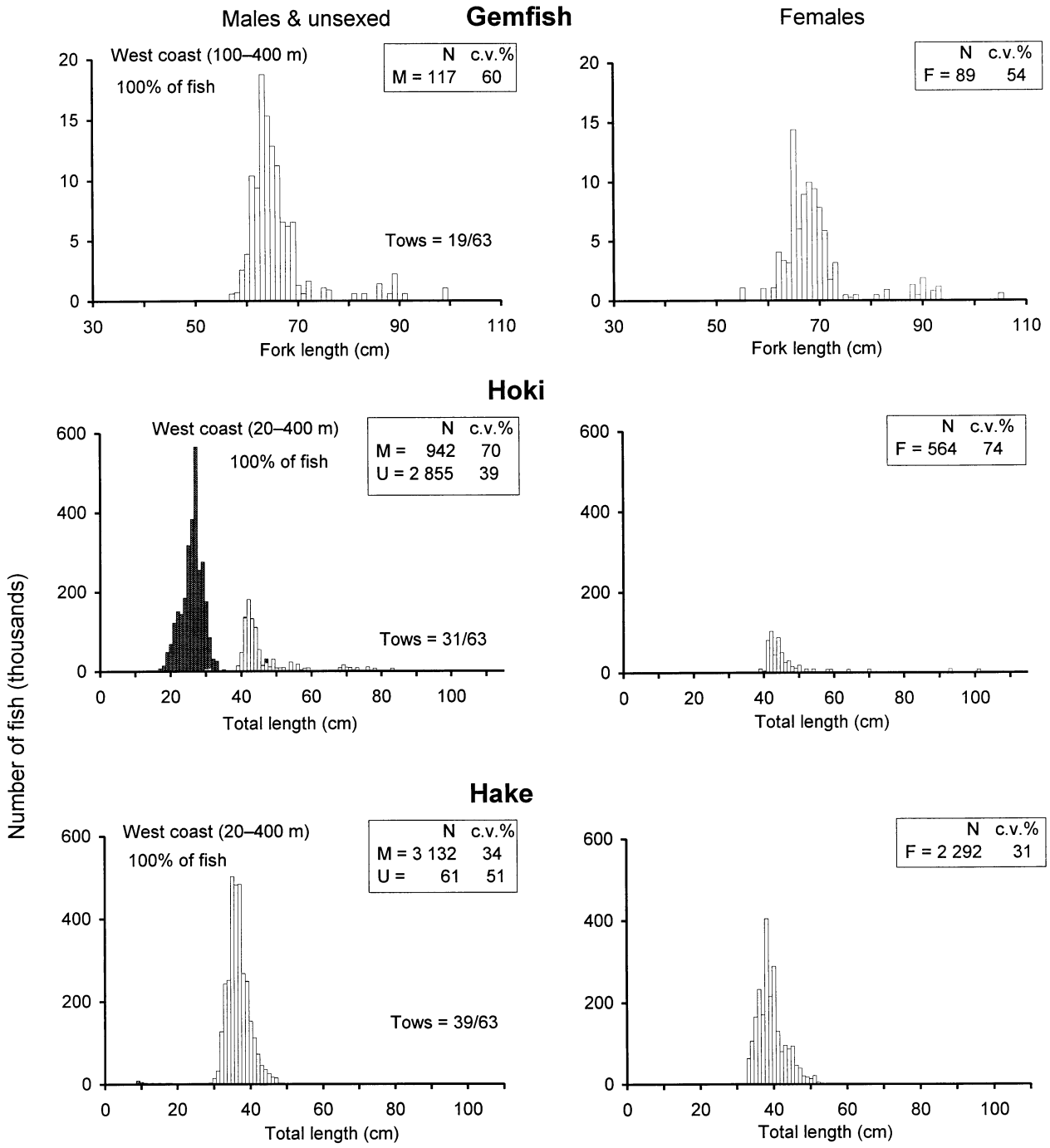

Figure 5—*continued*

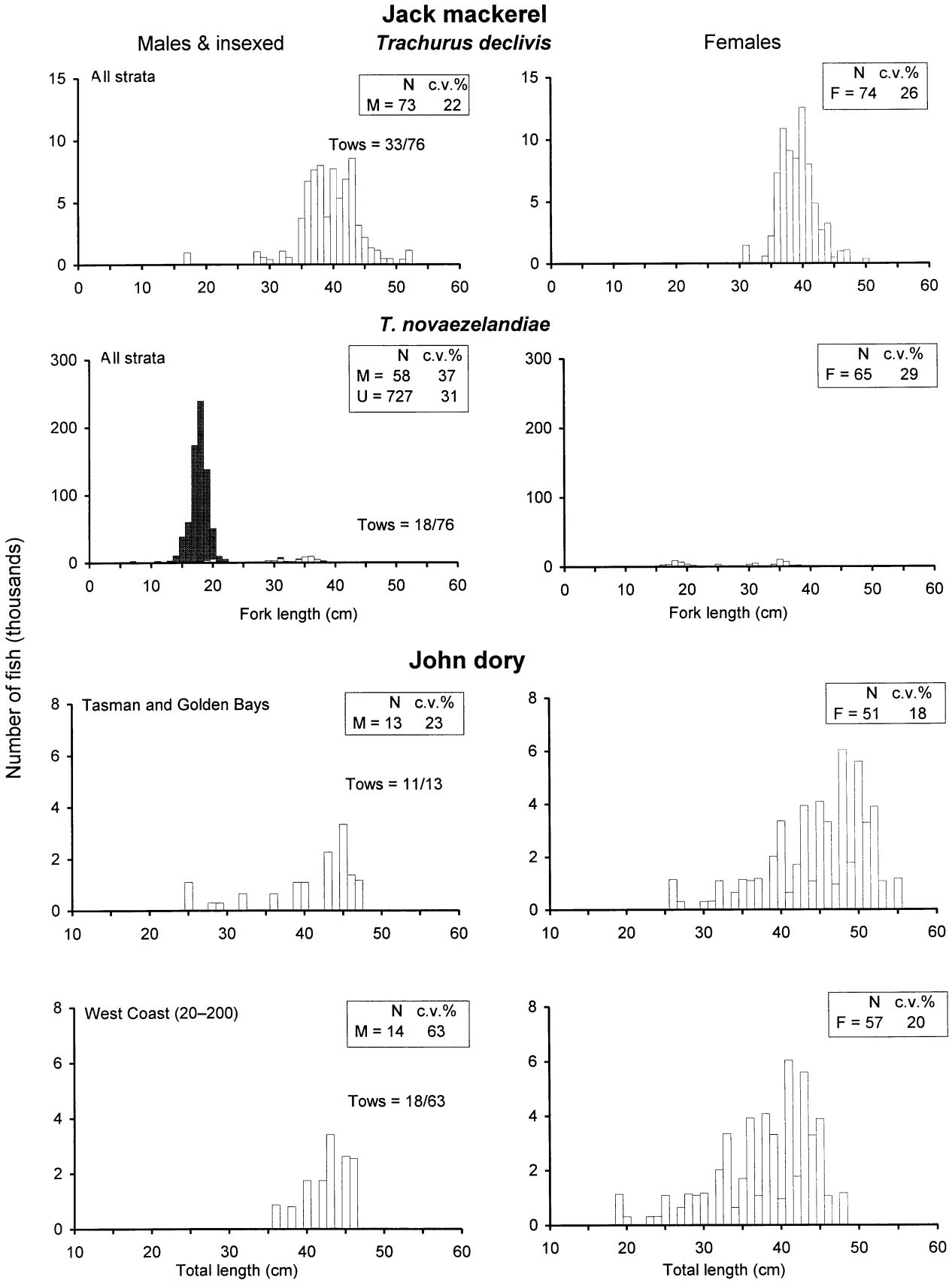

Figure 5—*continued*

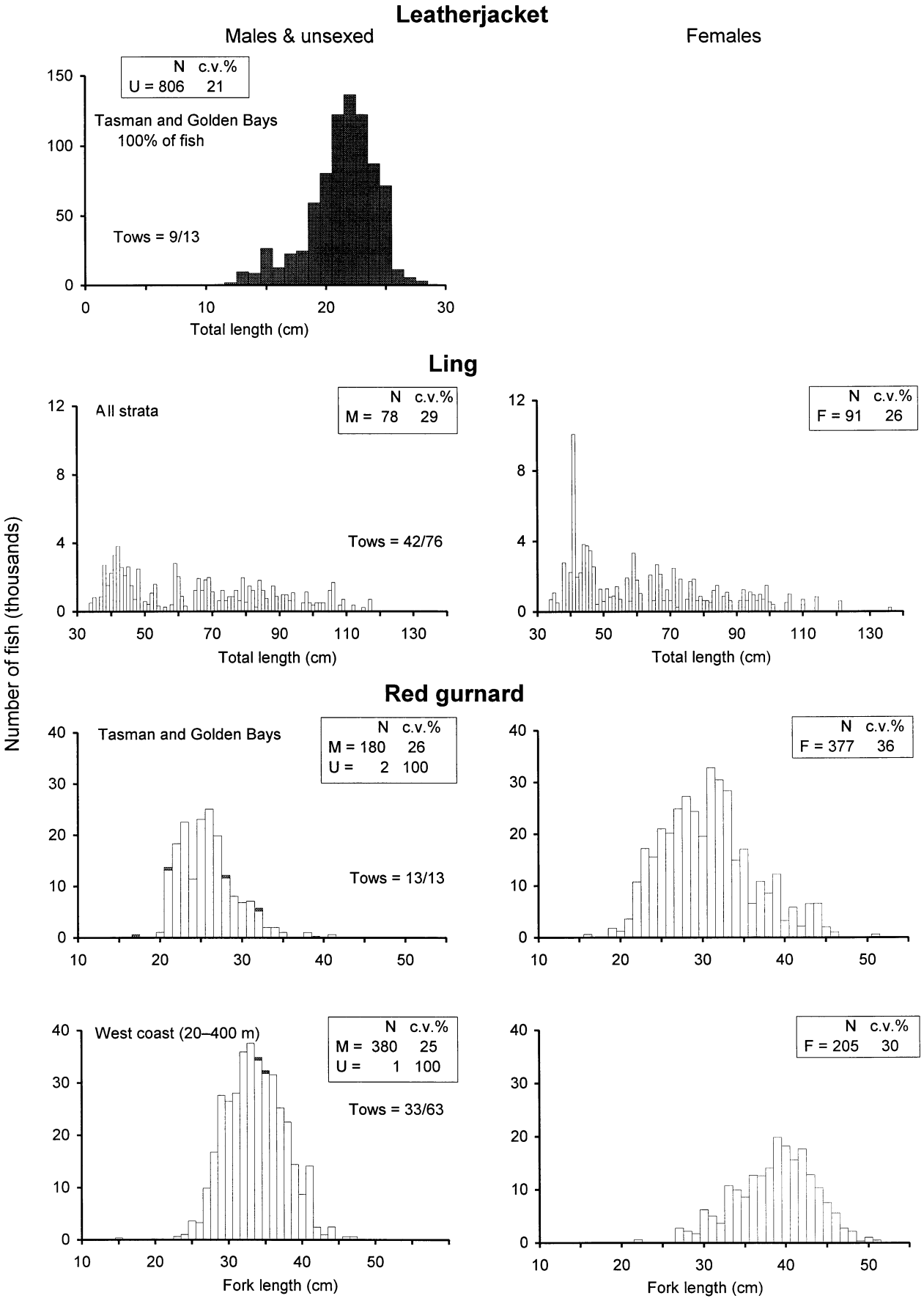

Figure 5—*continued*

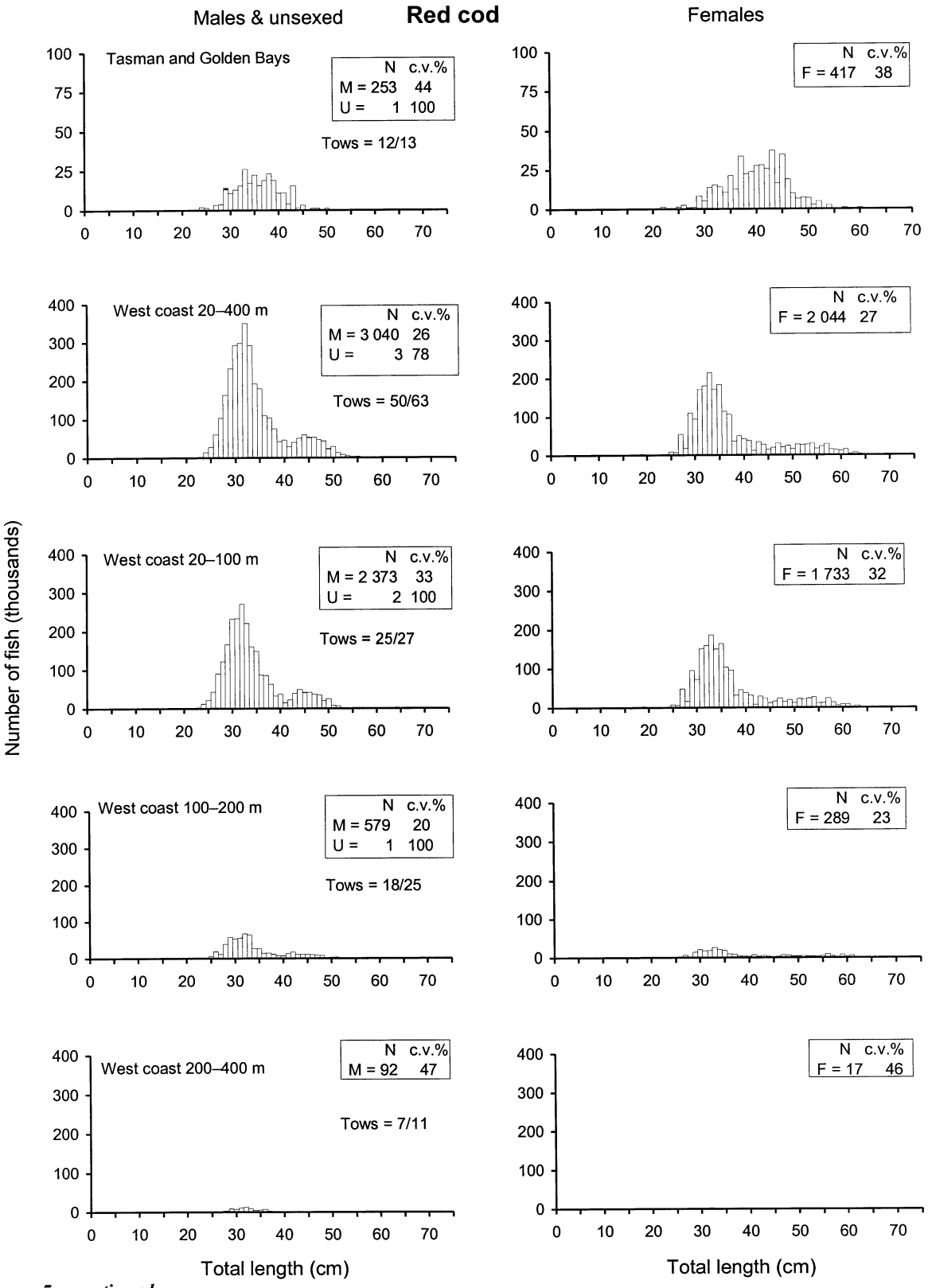

Figure 5—*continued*

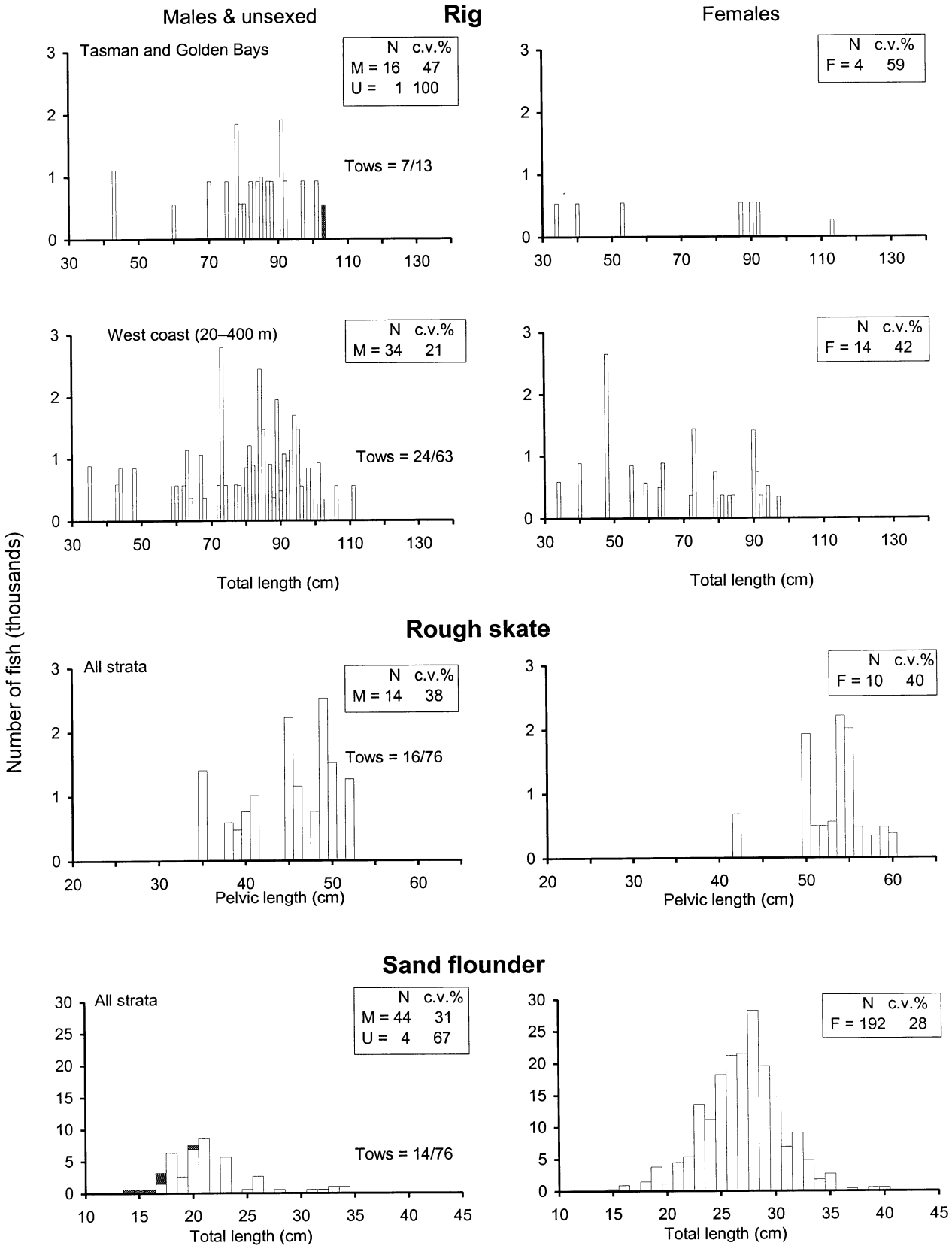

Figure 5—*continued*

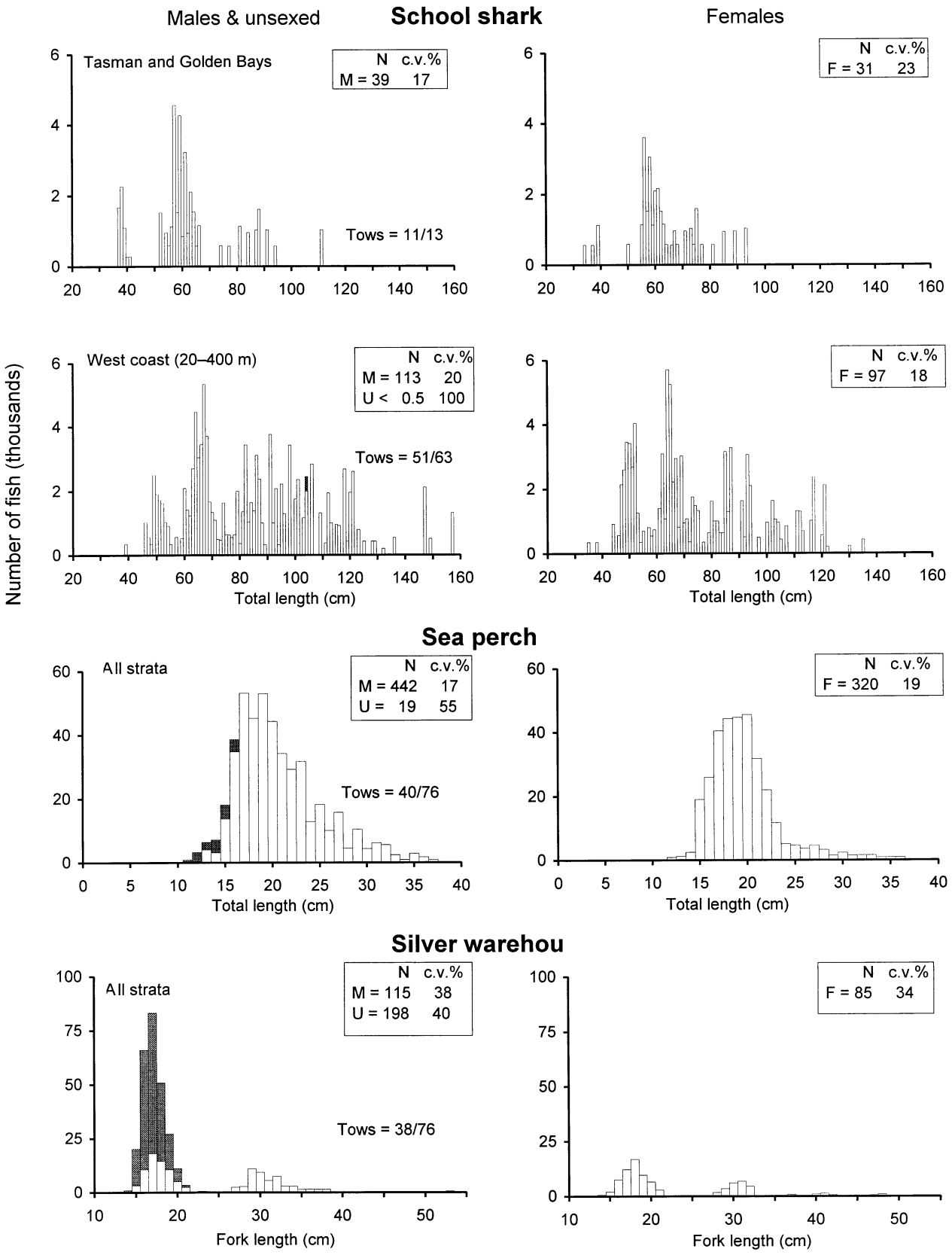

Figure 5—*continued*

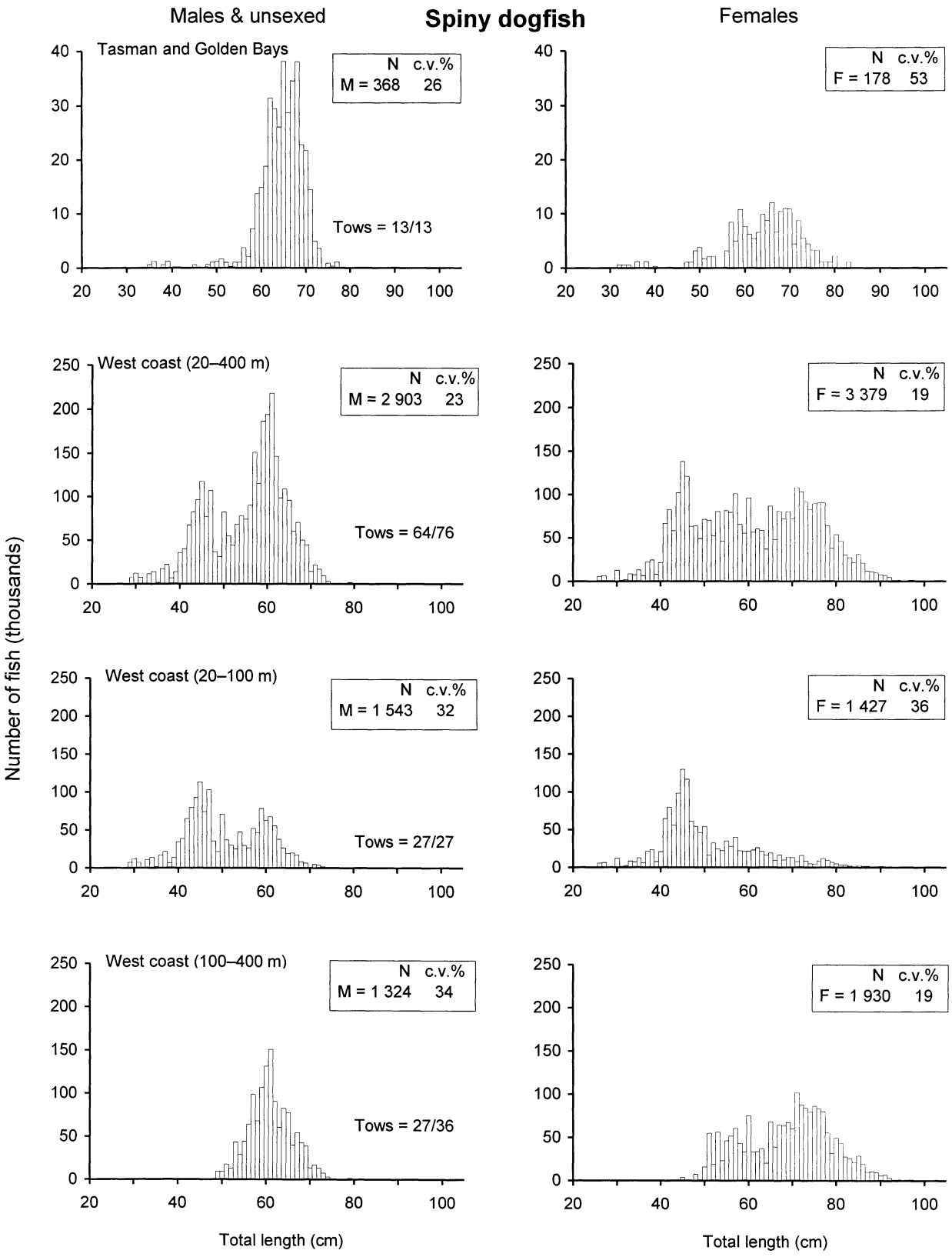

Figure 5—*continued*

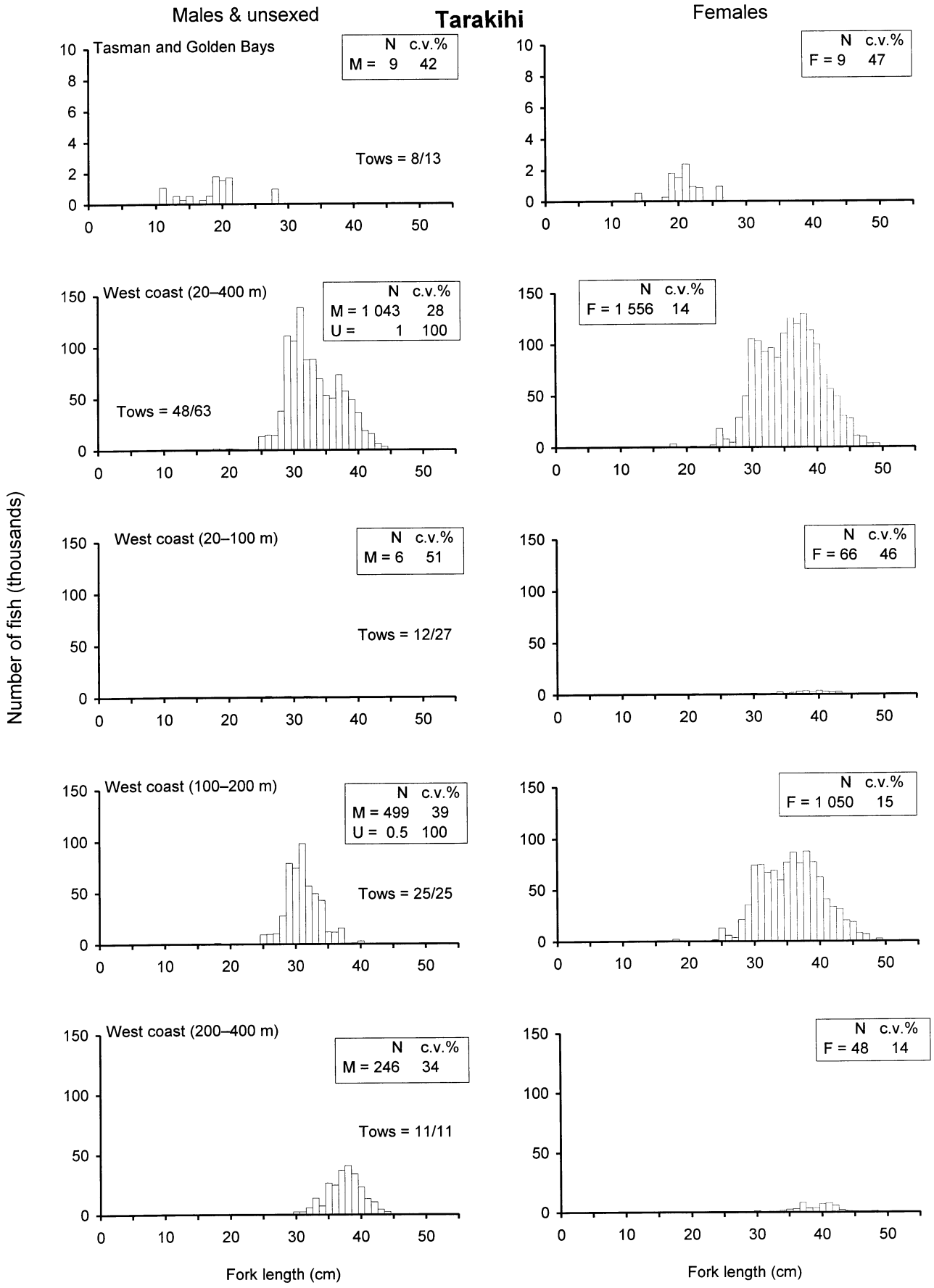

Figure 5—*continued*

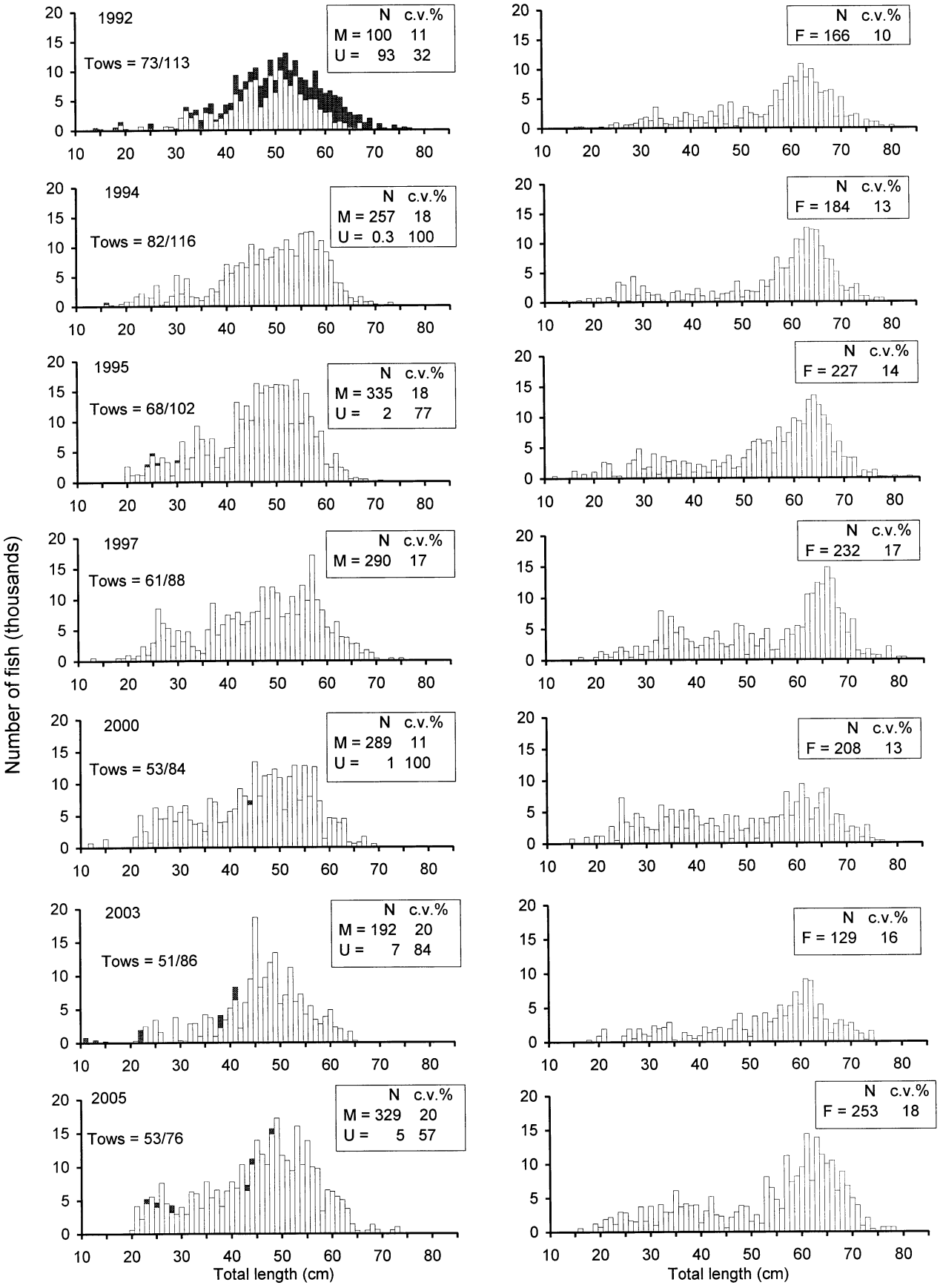

Figure 6: Scaled length frequencies (all areas combined) for the target species from all surveys in the series.
a: Giant stargazer

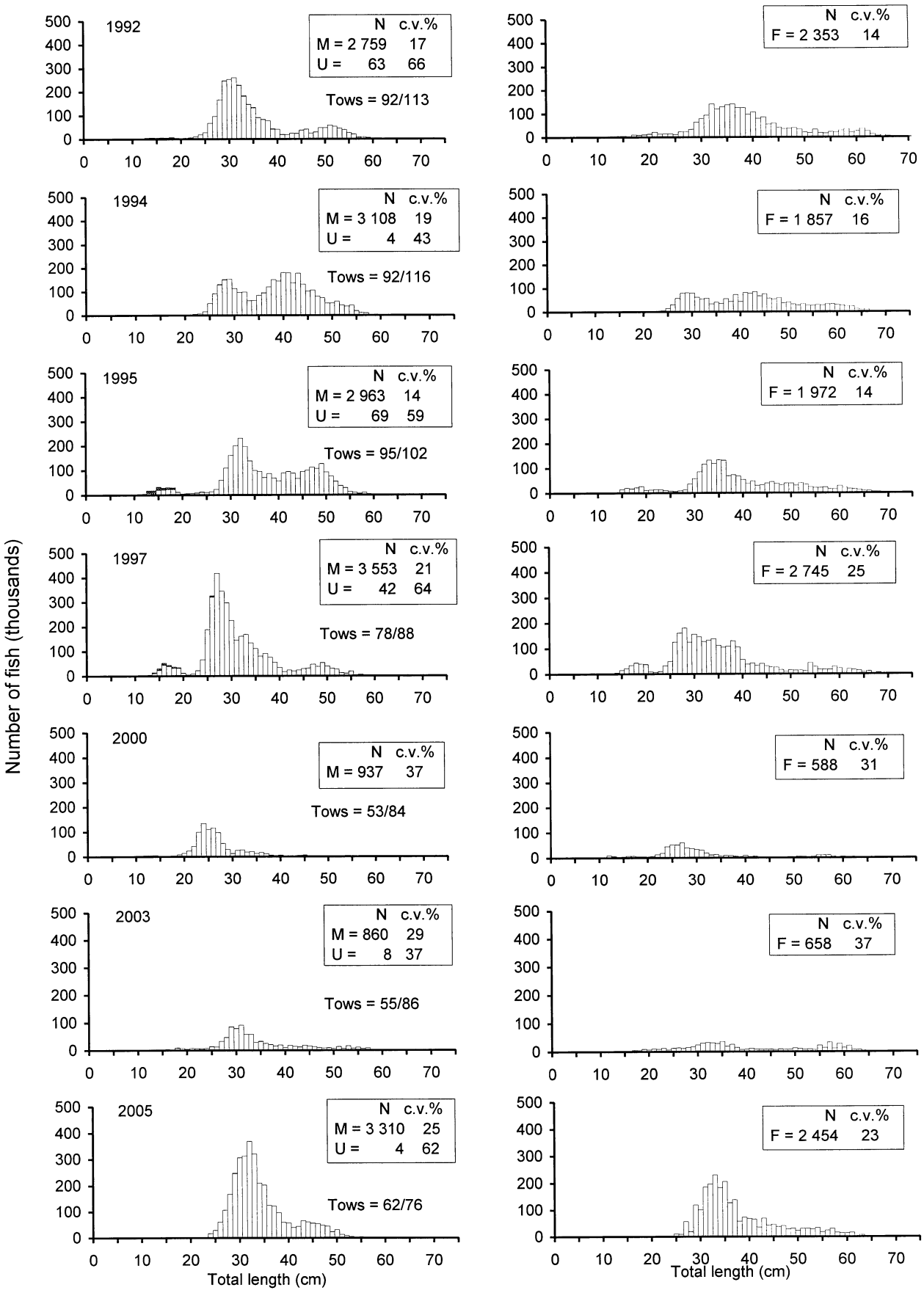

Figure 6b: Red cod

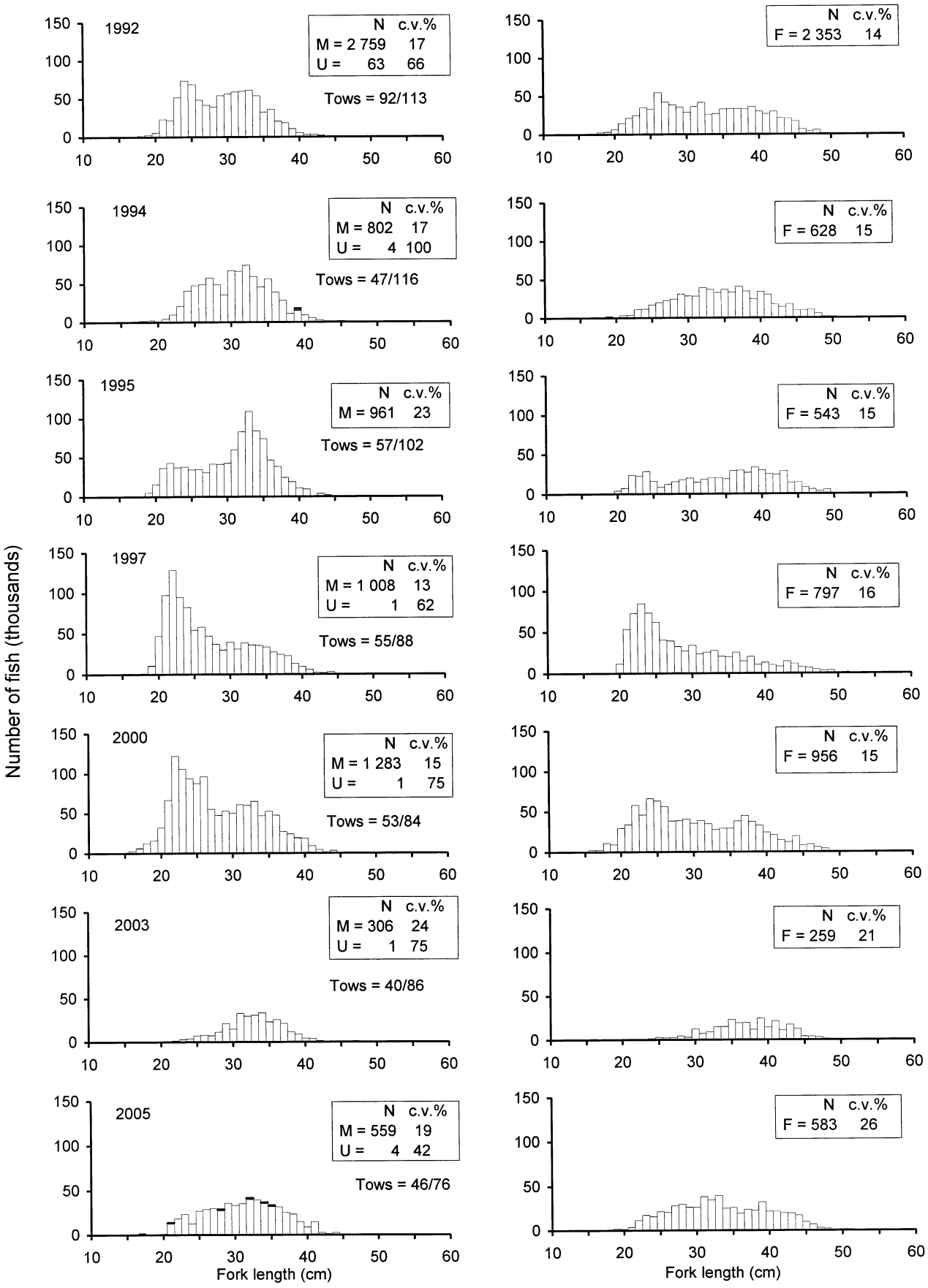

Figure 6c: Red gurnard

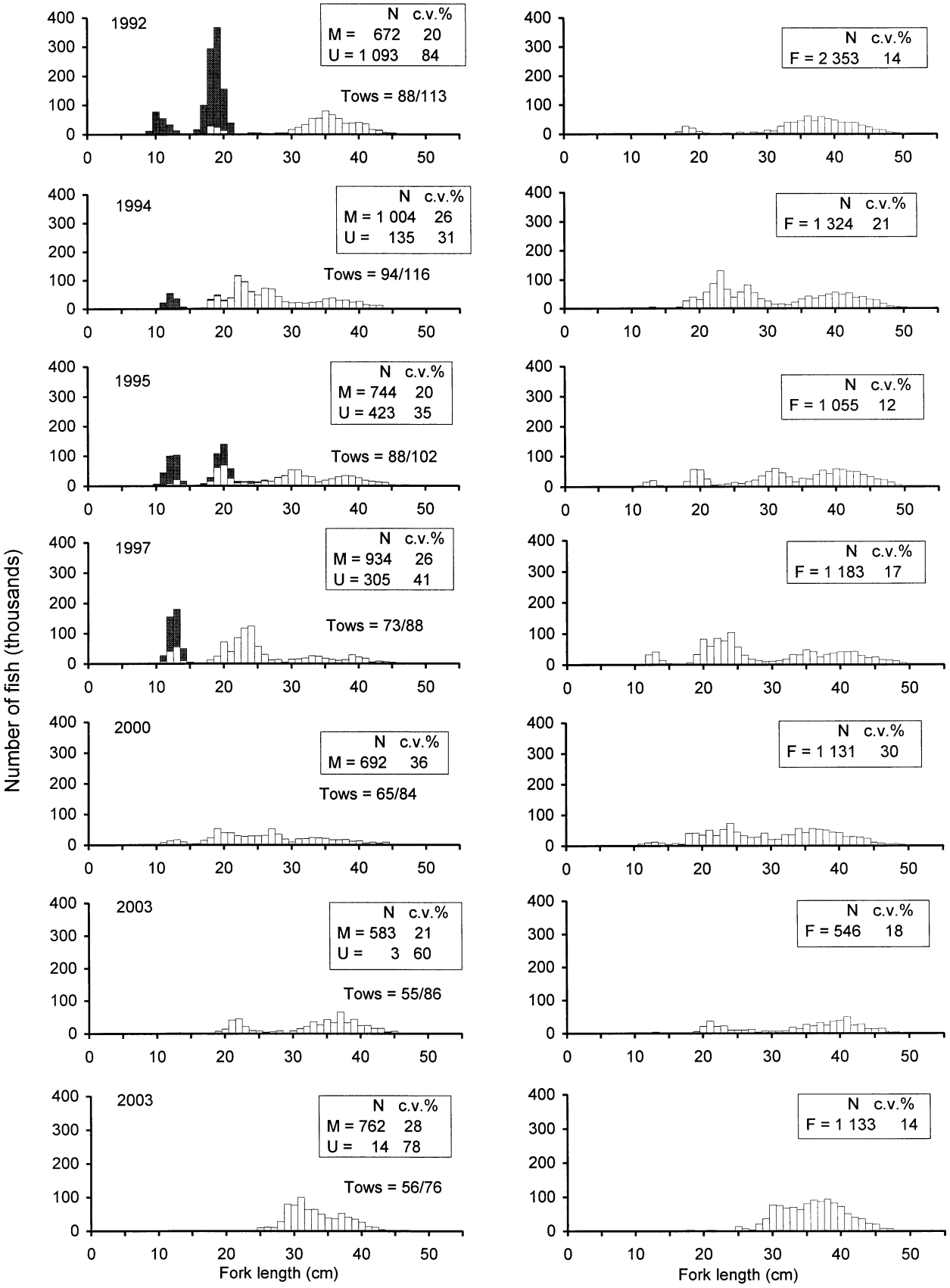

Figure 6d: Tarakihi

Appendix 1: Length-weight relationship parameters used to scale length frequencies and calculate length class biomass estimates. (DB, Ministry of Fisheries *trawl* database; –, no data; n, sample size.)

Group A: $W = a L^b$ where W is weight (g) and L is length (cm);

Species	*a*	*b*	n	Range Min.	Range Max.	Data source
Barracouta	0.0055	2.9812	429	23.8	87.2	DB, KAH9701
Blue warehou	0.0144	3.1050	338	27.4	69.6	DB, TAN9604
Dark ghost shark	0.0015	3.3611	332	21.2	67.9	DB, KAH9704
Frostfish	0.0004	3.1629	450	10.4	153	DB, KAH0004
Gemfish	0.0017	3.3419	391	32	107	DB, KAH9304, KAH9602
Giant stargazer	0.0072	3.2287	661	19.3	77.3	This survey
Hake	0.0014	3.3770	333	33	123	DB, TAN9601
Hapuku	0.0078	3.1400	307	49	108	DB, TAN9301
Hoki	0.0046	2.8840	525	22	110	DB, SHI8301
Jack mackerel						
(*Trachurus declivis*)	0.0165	2.9300	200	15	53	DB, COR9001
(*T. novaezelandiae*)	0.0163	2.9230	200	15	40	DB, COR9001
John dory	0.0065	3.2499	352	18.4	54.3	DB, KAH9902
Lemon sole	0.0080	3.1278	524	14.6	41.2	DB, KAH9809
Ling	0.0013	3.2801	179	32.2	123.7	DB, KAH0004
New Zealand sole	0.0049	3.2151	114	20	48	DB, KAH0304
Red cod	0.0099	2.9695	1127	13.5	67.1	This survey
Red gurnard	0.0046	3.2300	656	15.9	51.7	This survey
Rig	0.0033	3.0529	251	35	135	DB, KAH9701
Rough skate	0.0517	2.7556	153	16.7	63.2	DB, KAH0004
Sand flounder	0.0207	2.8768	282	13.5	44.5	DB, KAH9809
School shark	0.0034	3.0787	252	35.3	157	This survey
Sea perch	0.0262	2.9210	210	7	42	DB, KAH9618
Silver warehou	0.0048	3.3800	262	16.6	57.8	DB, TAN502
Smooth skate	0.0192	2.9889	59	19.3	114	DB, KAH0004
Spiny dogfish	0.0038	3.0108	441	26.6	93.1	DB, KAH9917
Tarakihi	0.0257	2.9868	924	11.7	49.9	This survey
Two saddle rattail	0.0010	3.43	383	24.6	58.3	DB, KAH0304

Group B: $W = a L^b L^{c\,(\ln L)}$

	a	*b*	*c*	n	Range (cm)	Data source
Arrow squid	0.2777	1.4130	0.2605	2 792	3–45	DB, *James Cook*, east coast South Island, 1982–83

Appendix 2: Summary of station data.

			Start of tow			End of tow		Gear depth (m)		Distance trawled	Headline	Doorspread	Surface temp	Bottom temp
Station	Stratum	Date	Time	° ' S	° ' E	° ' S	° ' E	Min.	Max.	(n. miles)	height (m)	(m)	(°C)	(°C)
1*	18	23-03-05	1219	41 04.33	173 07.28	41 01.56	173 05.63	19	19	3.03	4.7	73.9	19.8	18.6
2#	18	23-03-05	1808	41 05.66	173 07.90	41 04.19	173 07.53	19	21	1.49	5.1	73.9	19.8	18.5
3	18	24-03-05	1053	41 04.74	173 07.93	41 02.06	173 06.08	20	21	3.02	5	74.9	20	18.3
4#	18	24-03-05	1247	41 04.70	173 08.10	41 02.79	173 06.65	20	20	2.2	5.1	71.9	20.4	18.5
5	19	24-03-05	1537	40 48.61	173 15.33	40 50.37	173 18.53	43	43	2.99	5.1	74	19.1	15.1
6#	19	24-03-05	1730	40 48.06	173 14.71	40 49.05	173 16.17	44	44	1.48	5	73.6	19	15.1
7	19	25-03-05	627	40 45.70	173 20.20	40 46.23	173 16.29	47	50	3.07	5.2	74.8	19	15.1
8#	19	25-03-05	903	40 44.94	173 18.84	40 46.26	173 17.91	49	51	1.49	4.5	80	18.4	15.2
9	17	25-03-05	1310	40 44.70	172 57.44	40 43.37	172 54.03	25	27	2.9	4.9	71.1	19.1	16.9
10	17	25-03-05	1450	40 42.38	172 53.16	40 39.78	172 51.92	26	27	2.76	4.8	72.4	19.2	16.5
11	17	25-03-05	1634	40 43.24	172 51.27	40 45.52	172 53.88	21	23	3.01	4.5	71.3		
12	18	26-03-05	616	40 59.09	173 20.01	41 02.05	173 20.76	38	41	3.01	5.4	75.1	18.4	15.9
13	18	26-03-05	816	41 07.63	173 16.33	41 09.56	173 19.25	22	25	2.92	5.1	75	19.4	17.4
14	18	26-03-05	1030	41 04.47	173 26.07	41 04.44	173 29.99	33	33	2.95	4.4	77.8	18.7	16.3
15	19	26-03-05	1337	40 48.80	173 39.15	40 46.43	173 41.54	58	65	2.98	5.3	71.9	18.3	14.2
16	19	26-03-05	1535	40 41.59	173 37.18	40 39.28	173 34.78	57	57	2.94	5.3	72.6	18.3	13.9
17	2	27-03-05	659	40 31.25	171 48.90	40 28.98	171 51.43	188	189	2.97	5.2	83.6	19.1	13
18#	2	27-03-05	928	40 31.16	171 49.32	40 30.07	171 50.64	185	188	1.48	5.1	83.6	18.9	13.2
19	1	27-03-05	1426	40 45.68	172 05.44	40 48.59	172 04.22	88	91	3.05	4.3	82.9	18.1	12.8
20	1	27-03-05	1605	40 50.48	172 02.37	40 53.26	172 00.76	92	94	3.03	5	76.3	18.3	12.9
21	2	28-03-05	618	40 46.21	171 40.02	40 49.35	171 39.46	155	156	3.16	5	87.6	19.1	12.8
22#	2	28-03-05	814	40 46.99	171 39.44	40 48.51	171 38.99	156	158	1.55	5	85.4	18.9	12.9
23	2	28-03-05	1014	40 57.45	171 35.38	41 00.31	171 34.30	145	147	2.97	5	88.3	18.7	12.1
24	2	28-03-05	1325	41 12.87	171 20.63	41 14.72	171 17.42	157	165	3.04	5.2	84.2	17.7	12.1
25	6	28-03-05	1559	41 17.50	171 02.93	41 19.96	171 00.51	186	186	3.05	4.9	88.1	18.4	12.7
26	1	29-03-05	612	41 06.72	172 01.96	41 09.69	172 02.67	50	58	3.01	4.9	71.9	17.4	13
27	1	29-03-05	758	41 13.16	172 00.43	41 15.52	171 57.92	50	52	3.02	5	74.8	17.5	13.4
28	5	29-03-05	1054	41 26.53	171 41.89	41 29.28	171 40.26	86	93	3	5.2	78.1	16.3	12.2
29	5	29-03-05	1326	41 34.60	171 50.13	41 36.36	171 46.79	30	31	3.05	5.2	75	16.9	15
30	5	29-03-05	1603	41 38.05	171 28.91	41 40.22	171 26.21	93	93	2.96	5.1	76.3	16.4	12.2

Appendix 2—*continued*

			Start of tow			End of tow		Gear depth (m)		Distance trawled	Headline	Doorspread	Surface temp	Bottom temp
Station	Stratum	Date	Time	° ' S	° ' E	° ' S	° ' E	Min.	Max.	(n. miles)	height (m)	(m)	(°C)	(°C)
31	11	30-03-05	658	42 38.41	170 57.64	42 35.92	170 59.92	29	30	3	5	68.7	17.2	11.7
32	7	30-03-05	855	42 29.74	171 04.31	42 26.82	171 05.25	27	31	3	5.3	72.9	16	14.1
33	8	30-03-05	1114	42 27.54	170 54.63	42 24.53	170 55.59	131	137	3.09	4.7	82.9	16.2	12.1
34	8	30-03-05	1315	42 22.15	170 57.45	42 18.92	170 57.62	135	137	3.23	4.6	78.8	15.4	12.1
35	11	31-03-05	610	42 43.02	170 38.43	42 41.47	170 34.91	68	68	3.01	5.7	70	16	12.9
36	11	31-03-05	816	42 41.98	170 26.52	42 44.00	170 23.39	99	99	3.06	5.1	80.3	15.7	12.8
37	12	31-03-05	1043	42 41.32	170 13.43	42 43.47	170 10.60	148	151	2.99	4.8	79.7	17.7	12.6
38	13	31-03-05	1337	42 54.19	169 58.36	42 57.18	169 57.07	268	282	3.13	4.7	89.7	19	13.7
39#	13	31-03-05	1727	42 56.42	169 57.30	42 57.61	169 56.58	275	284	1.3	4.9	92	18.1	12.6
40	12	01-04-05	619	42 57.44	170 01.02	42 58.68	169 58.41	184	193	2.27	4.9	89.2	18	12.6
41	13	01-04-05	813	42 58.62	169 51.09	43 00.10	169 48.71	340	340	2.28	5.1	93.9	18.3	12.2
42#	13	01-04-05	1024	42 58.50	169 51.65	42 59.35	169 49.95	334	341	1.5	5.1	96.8	18	12.4
43	13	01-04-05	1157	43 03.78	169 45.80	43 06.23	169 43.69	245	276	2.89	5.2	84.5	18	12.6
44	12	01-04-05	1408	43 08.22	169 48.48	43 05.25	169 48.49	188	192	2.97	4.7	81.2	18.1	12.7
45	12	01-04-05	1618	43 06.47	169 52.20	43 03.81	169 54.07	179	181	2.99	4.6	81.2	18.1	12.7
46	8	02-04-05	615	42 04.77	171 06.31	42 07.50	171 04.70	124	124	2.97	4.6	88.7	16.2	12.7
47	8	02-04-05	830	42 12.24	170 56.08	42 14.53	170 53.51	174	184	2.97	4.9	86.3	17	12.5
48	8	02-04-05	1036	42 09.17	170 50.24	42 06.04	170 50.16	192	197	3.13	4.7	85.2	17.1	12.3
49	9	02-04-05	1338	42 02.74	170 34.72	41 59.73	170 34.63	352	368	3.01	4.8	90	18.4	11.9
50	9	02-04-05	1539	41 57.17	170 34.78	41 54.40	170 35.91	388	396	2.89	4.9	88.4	18.2	10.9
51	7	03-04-05	624	42 08.47	171 08.68	42 05.78	171 10.50	82	85	3	4.8	74.3	16.1	14.4
52	7	03-04-05	932	41 57.16	171 14.57	41 55.27	171 16.23	80	87	2.25	5	69.2	16.4	13.4
53	7	03-04-05	1113	41 52.59	171 19.78	41 49.69	171 21.23	62	62	3.09	5.2	69.5	16.7	14.9
54	7	03-04-05	1325	41 47.11	171 21.74	41 44.79	171 23.45	68	70	2.64	5.2	63.2	16.6	15.3
55	6	05-04-05	638	41 26.90	171 06.63	41 29.84	171 06.01	169	175	2.97	4.8	89.8	17.9	12.1
56	6	05-04-05	1008	41 42.36	171 00.41	41 45.22	170 58.97	158	160	3.05	4.9	87.2	17.9	12.4
57	9	05-04-05	1401	41 48.83	170 36.34	41 51.86	170 35.86	375	392	3.05	4.7	89.1	17.9	10.8
58*	13	06-04-05	639	42 31.22	170 34.92	42 31.44	170 35.61	276	280	0.55	4.8	90.1	15.8	10.8
59	13	06-04-05	825	42 30.63	170 42.41	42 33.66	170 41.77	248	268	3.06	5	92	15.5	11.6
60	11	06-04-05	1128	42 48.35	170 33.73	42 50.09	170 30.28	35	38	3.07	5.2	74.1	15.6	15.4

Appendix 2—*continued*

Station	Stratum	Date	Start of tow Time	Start of tow ° ' S	Start of tow ° ' E	End of tow ° ' S	End of tow ° ' E	Gear depth (m) Min.	Gear depth (m) Max.	Distance trawled (n. miles)	Headline height (m)	Doorspread (m)	Surface temp (°C)	Bottom temp (°C)
61	11	06-04-05	1328	42 55.77	170 27.00	42 57.75	170 23.88	29	30	3.02	4.9	69.8	15.8	15.4
62	11	06-04-05	1457	42 58.93	170 21.85	43 00.36	170 18.20	30	38	3.02	5	70.4	15.8	16.4
63	11	06-04-05	1631	42 58.23	170 17.22	42 55.64	170 19.59	66	73	3.11	5.4	73.9	16.1	13.1
64	12	07-04-05	627	42 51.41	170 16.86	42 53.78	170 14.22	115	118	3.05	4.9	70.9	15.5	12.8
65	12	07-04-05	938	43 07.63	170 02.56	43 10.05	169 59.88	115	124	3.11	5.1	80.7	16.3	12.7
66	12	07-04-05	1149	43 08.69	169 56.82	43 11.16	169 54.39	151	157	3.04	5	83.3	15.9	12.5
67	15	07-04-05	1403	43 15.58	169 50.77	43 18.06	169 48.24	145	153	3.12	4.8	86.3	15.7	12.5
68	15	08-04-05	626	43 41.84	169 07.77	43 42.89	169 03.83	108	115	3.03	4.9	83.2	15.7	12.8
69	14	08-04-05	845	43 49.59	168 55.72	43 48.47	168 59.63	44	44	3.03	4.2	78.8	15.6	13.9
70	14	08-04-05	1058	43 44.91	169 06.91	43 43.05	169 10.33	46	61	3.09	4.6	70.4	15.7	15.6
71	15	08-04-05	1357	43 31.62	169 18.79	43 28.95	169 17.01	125	132	2.96	4.8	80.3	16.1	12.7
72	16	08-04-05	1556	43 27.76	169 15.55	43 30.00	169 12.56	241	243	3.11	5	94.3	16.2	12.3
73	15	09-04-05	626	43 27.46	169 18.62	43 25.88	169 22.23	132	133	3.06	5	79.9	16.1	12.7
74	16	09-04-05	831	43 20.81	169 28.19	43 19.43	169 31.55	286	320	2.8	4.6	92.4	17	12.5
75	14	09-04-05	1047	43 27.35	169 35.91	43 25.49	169 39.40	47	47	3.14	5.2	71	15.6	14.8
76	14	09-04-05	1250	43 22.47	169 48.63	43 21.09	169 52.48	58	67	3.12	5	65.8	15.6	14.8
77	16	09-04-05	1503	43 16.56	169 44.42	43 13.46	169 44.90	201	218	3.11	4.8	90.7	16.2	12.5
78	14	10-04-05	628	43 35.33	169 28.87	43 33.44	169 32.37	25	29	3.16	5.4	69.8	15.6	15.7
79	14	10-04-05	800	43 31.43	169 31.96	43 28.92	169 34.64	43	47	3.17	4.8	69.9	15.6	15.5
80	13	10-04-05	1104	43 12.19	169 40.70	43 09.69	169 41.37	259	273	2.54	5.1	81.4	17.2	12
81	6	11-04-05	630	41 34.07	171 10.53	41 30.98	171 11.40	151	151	3.15	5.1	85.5	16.7	12.3
82	6	11-04-05	852	41 33.50	171 22.79	41 30.47	171 23.77	139	140	3.11	4.9	85	17	12.5
83	5	11-04-05	1117	41 33.38	171 35.27	41 31.19	171 38.27	89	91	3.13	4.9	73.3	17.5	13.6
84	5	11-04-05	1409	41 28.24	171 47.91	41 25.46	171 49.85	47	48	3.13	5	70.1	17.4	16
85	19	12-04-05	623	40 38.78	173 15.09	40 41.45	173 17.36	52	52	3.17	5.1	73.9	16.5	15.1
86	19	12-04-05	823	40 47.86	173 21.09	40 50.98	173 20.90	49	50	3.12	5.2	73.8	16.5	15.7

* Station not used for biomass calculations because of poor gear performance

Gear trial tow, not used for biomass estimates

Appendix 3: Species caught, total weight, percentage of total catch, occurrence (Occ.), and depth range of all species caught and weighed from all stations.

Species code	Common name	Scientific name	Catch (kg)	% of total catch	Occ.	Depth (m) Min.	Depth (m) Max.
ANC	Anchovy	*Engraulis australis*	0.8	*	7	25	52
ANT	Anemones	Anthozoa	0.7	*	5	145	273
ASR	Asteroidea (strafish)	Asteroidea	0.2	*	2	334	368
BAR	Barracouta	*Thyrsites atun*	4861.2	10.7	72	19	282
BCO	Blue cod	*Parapercis colias*	5.9	*	9	26	65
BRI	Brill	*Colistium guntheri*	1.9	*	1	30	31
BSH	Seal shark	*Dalatias licha*	11	*	1	241	243
BTA		*Pavoraja asperula*	1.3	*	1	388	396
BTS		*P. spinifera*	0.2	*	1	388	396
CAR	Carpet shark	*Cephaloscyllium isabella*	504.3	1.1	52	21	396
CBI	Two saddle rattail	*Caelorinchus biclinozonalis*	1909	4.2	36	27	396
CBO	Bollons's rattail	*C. bollonsi*	18.3	*	2	241	340
CCX	Small banded rattail	*C. parvifasciatus*	9.8	*	7	241	396
CDO	Capro dory	*Capromimus abbreviatus*	324.2	0.7	20	86	392
CON	Conger eel	*Conger* spp.	87.7	0.2	13	21	68
CRA	Rock lobster	*Jasus edwardsii*	7	*	10	27	368
CRU	Crustacean	Crustacea	0.1	*	1	50	52
CUC	Cucumberfish	*Chlorophthalmus nigripinnis*	9.8	*	15	86	276
DOS	Dredge oyster	*Tiostrea chilensis*	0.6	*	2	20	33
EGR	Eagle ray	*Myliobatis tenuicaudatus*	32.4	0.1	4	19	21
ELE	Elephantfish	*Callorhinchus milii*	121.4	0.3	10	27	85
EMA	Blue mackerel	*Scomber australasicus*	4.9	*	2	29	118
ERA	Electric ray	*Torpedo fairchildi*	121.8	0.3	13	19	85
ESO	N.Z. sole	*Peltorhamphus novaezelandiae*	55.7	0.1	13	26	47
FHD	Deepsea flathead	*Hoplichthys haswelli*	7.6	*	4	241	341
FRO	Frostfish	*Lepidopus caudatus*	690.7	1.5	31	47	340
GFL	Greenback flounder	*Rhombosolea tapirina*	1	*	2	19	25
GLB	Globefish	*Contusus richei*	2	*	3	22	31
GSH	Dark ghost shark	*Hydrolagus novaezelandiae*	982	2.2	43	50	396
GUR	Red gurnard	*Chelidonichthys kumu*	794.9	1.8	50	19	184
HAG	Hagfish	*Eptatretus cirrhatus*	1.6	*	1	286	320
HAK	Hake	*Merluccius australis*	3208.8	7.1	39	27	340
HAP	Hapuku	*Polyprion oxygeneios*	186.5	0.4	12	92	282
HEP	Sharpnose sevengill shark	*Heptranchias perlo*	2.6	*	1	201	218
HEX	Sixgill shark	*Hexanchus griseus*	13.8	*	1	268	282
HOK	Hoki	*Macruronus novaezelandiae*	1505.7	3.3	32	44	396
JAV	Javelinfish	*Lepidorhynchus denticulatus*	47.5	0.1	9	241	396
JDO	John dory	*Zeus faber*	239.4	0.5	32	21	197
JFI	Jellyfish	Anthazoa	6	*	3	25	51
JGU	Spotted gurnard	*Pterygotrigla picta*	0.8	*	1	352	368
JMD	N.Z. jack mackerel	*Trachurus declivis*	175.1	0.4	34	25	268
JMM	Chilean jack mackerel	*T. symmetricus murphyi*	15.4	*	9	57	181
JMN	N.Z. jack mackerel	*T. novaezelandiae*	253.8	0.6	21	19	93
KAH	Kahawai	*Arripis trutta*	5.1	*	3	25	67
LDO	Lookdown dory	*Cyttus traversi*	20.2	*	4	241	341
LEA	Leatherjacket	*Parika scaber*	190.7	0.4	11	25	65
LIN	Ling	*Genypterus blacodes*	975.7	2.2	44	21	341

Appendix 3—*continued*

Species code	Common name	Scientific name	Catch (kg)	% of total catch	Occ.	Depth (m) Min.	Depth (m) Max.
LSO	Lemon sole	*Pelotretis flavilatus*	43.8	0.1	23	19	320
MOK	Moki	*Latrisopsis ciliaris*	1.9	*	1	145	153
MSG	Green-lipped mussel	*Perna canaliculus*	14.2	*	4	19	33
NOS	Arrow squid	*Nototodarus sloanii*	1157.8	2.6	80	19	396
NSD	Northern spiny dogfish	*Squalus mitsukuri*	189.6	0.4	23	86	396
OCT	Octopus	*Octopus cordiformis*	13.4	*	7	21	65
ONG	Sponges	Porifera (Phylum)	4.3	*	5	25	156
OPA	Opalfish	*Hemerocoetes* spp.	0.7	*	4	115	193
OPE	Orange perch	*Lepidoperca aurantia*	10.7	*	3	184	276
PCO	Ahuru	*Auchenoceros punctatus*	0.9	*	7	25	70
PIG	Pigfish	*Congiopodus leucopaecilus*	1.1	*	5	125	276
PIL	Pilchard	*Sardinops neopilchardus*	0.1	*	1	21	23
PMU	Heart urchin	*Paramaretia multituberculata*	0.1	*	1	124	124
POP	Porcupine fish	*Allomycterus jaculiferus*	34.2	0.1	5	38	189
PRK	Prawn killer	*Ibacus alticrenatus*	1.7	*	16	50	276
PYR	Salp	*Pyrosoma atlanticum*	4	*	1	68	68
RBM	Rays bream	*Brama brama*	5.2	*	3	139	218
RBT	Redbait	*Emmelichthys nitidus*	1.2	*	5	86	147
RCO	Red cod	*Pseudophycis bachus*	4799.6	10.6	66	21	341
RHY	Common roughy	*Paratrachichthys trailli*	2219.1	4.9	8	108	341
RSK	Rough skate	*Raja nasuta*	102.1	0.2	17	27	396
RUD	Rudderfish	*Centrolophus niger*	8.6	*	1	241	243
SAL	Salps		6.2	*	3	50	368
SCG	Scaly gurnard	*Lepidotrigla brachyoptera*	59.1	0.1	46	25	197
SCH	School shark	*Galeorhinus galeus*	1186.9	2.6	69	19	340
SCI	Scampi	*Metanephrops challengeri*	0.1	*	1	286	320
SDO	Silver dory	*Cyttus novaezelandiae*	2498.6	5.5	36	68	392
SDR	Spiny seadragon	*Solegnathus spinosissimus*	0.4	*	3	57	181
SFI	Starfish	Asteroidea	0.3	*	2	25	33
SFL	Sand flounder	*Rhombosolea plebeia*	111.2	0.2	18	19	65
SKI	Gemfish	*Rexea solandri*	912.8	2.0	20	151	396
SNA	Snapper	*Pagrus auratus*	45.4	0.1	6	19	48
SPD	Spiny dogfish	*Squalus acanthias*	8869	19.5	72	19	341
SPE	Sea perch	*Helicolenus* spp.	240.5	0.5	42	26	396
SPO	Rig	*Mustelus lenticulatus*	303.2	0.7	36	19	276
SPR	Sprat	*Sprattus antipodum , S. muelleri*	5.8	*	18	25	99
SPS	Speckled sole	*Peltorhamphus latus*	0.2	*	2	20	33
SPZ	Spotted stargazer	*Genyagnus monopterygius*	0.8	*	2	20	23
SRH	Silver roughy	*Hoplostethus mediterraneus*	0.2	*	1	334	341
SSH	Slender smoothhound	*Gollum attenuatus*	48.5	0.1	6	268	396
SSI	Silverside	*Argentina elongata*	4	*	20	50	392
SSK	Smooth skate	*Raja innominata*	122.4	0.3	16	30	392
STA	Giant stargazer	*Kathetostoma giganteum*	2310	5.1	54	21	320
STY	Spotty	*Notolabrus celidotus*	22.8	0.1	6	19	41
SWA	Silver warehou	*Seriolella punctata*	93.6	0.2	38	25	276
TAR	Tarakihi	*Nemadactylus macropterus*	1971.2	4.3	60	21	396
THR	Thresher shark	*Alopias vulpinus*	95.6	0.2	5	20	70
UNI	Unidentified		18.9	*	16	19	368

Appendix 3—*continued*

Species code	Common name	Scientific name		Catch (kg)	% of total catch	Occ.	Depth (m) Min.	Depth (m) Max.
WAR	Blue warehou	*Seriolella brama*		315.4	0.7	29	20	218
WIT	Witch	*Arnoglossus scapha*		90.2	0.2	48	21	396
WWA	White warehou	*Seriolella caerulea*		0.3	*	1	80	87
YBO	Yellow boarfish	*Pentaceros decacanthus*		0.1	*	1	245	276
YEM	Yellow-eyed mullet	*Aldrichetta forsteri*		12.1	*	3	19	25
			Total	45 377				
				21739	0.479064			

* Less than 0.05 %

Appendix 4. Benthic macro-invertebrates taken as by catch during the survey

Taxon	No. of stations
Porifera (Demospongiae)	
Callyspongia (*Callyspongia*) sp. nov. 12	2
Dactylia n. sp. 1	1
Suberites affinis Brondsted, 1923	1
Callyspongia (Callyspongia) sp. nov. 11	2
Annelida:Terebellidae	
Nicolea armilla	1
Pseudopista rostrata	1
Annelida: Polynoidae	
Lepidonotus sp.	2
Annelida: Nereididae	
Neanthes kerguelensis	1
Annelida: Lumbrineridae	1
Lumbrineris sphaerocephala	
Cnidaria, Class Anthozoa	
Virgularia cf. gracillima Kolliker, 1880	6
Hydrozoa:Sertularioidea	
Synthecium sp A.	1
Symplectoscyphus sp A.	1
Symplectoscyphus sp B.	2
Symplectoscyphus sp C.	
Hydrozoa:Plumularioidea	
Halopreris or Plumularia	1
Halopreris or Plumularia	2
Plumulariidae	1
Echinodermata :Astreoidea	
Pilaster sp.	1
Coscinasterias muricata	4
Psilaster acuminatus	1
Echinodermata :Ophiuroidea	
Astrobrachion constrictum	1
Astrothorax waitei	2
Amphiura correcta	2
Ophiocentrus novaezealandiae	1
indet arms	3
Echinodermata:Echinoidea	
Pseudechinus albocinctus	1
Echinodermata: Holothuroidea	
Stichopus mollis	1

Appendix 4—continued

Taxon	No. of stations
Crustacea: Amphipoda	
Leucothoidae	1
Crustacea: Stomatopoda	
Squillidae	1
Mollusca: Bivalvia	
Chlamys dieffenbachi	1
Modiolarca impacta	1
Mollusca: Cephalopoda	
Octopus sp.	8
Tunicata: Ascidiacea	
Cnemidocarpa nisiotus	4
Cnemidocarpa nisiotus	1
Asterocarpa cerea	1
Pyura picta	1
Tunicata: Thaliacea	
Salpa sp.	1

Appendix 5: "Extreme" Year Analysis for west coast South Island inshore trawl sderies. Species used for analysis were LEA, BCO, ESO, LSO, and SFL in Tasman and Golden Bays (TBGB) and BAR, SPD, RCO, TAR, STA, SPE, GUR, GSH, RSK, SSK, CAR, SCH, SPO, JMD, JMM, LIN, SDO, and NSD on the west coast. (WCSI) (For species codes see Appendix 3).