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N. W. Bagley
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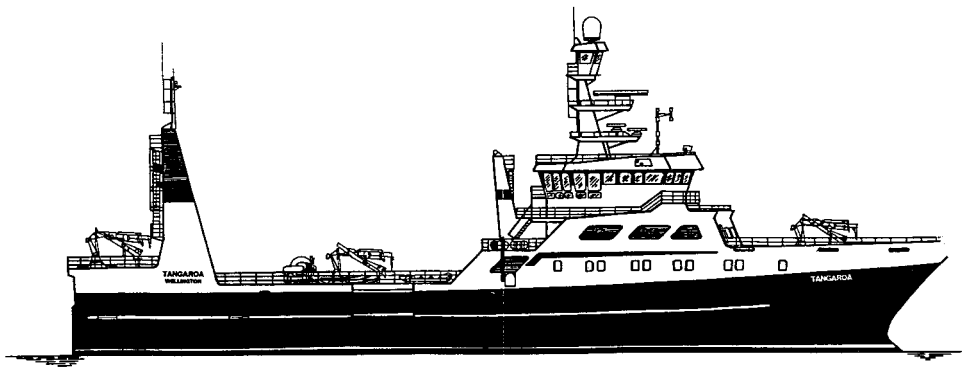


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# Contents

# Introduction

This report summarises the results of the seventh random trawl survey in a time series by RV *Tangaroa* providing annual relative biomass indices for adult and juvenile (particularly age 2+) hoki, hake, ling, and other commercially important species at depths of 200–800 m on the Chatham Rise. Results of acoustic research conducted during the survey will be reported on elsewhere.

Earlier surveys in this time series were reported by Horn (1994a, 1994b), Schofield & Horn (1994), and Schofield & Livingston (1995, 1996, 1997). These surveys took place in late December to January. Earlier Chatham Rise random trawl surveys for hoki and middle depth species were listed by Schofield & Livingston (1995).

This work was funded by the Ministry of Fisheries under contract HOK9702.

## Programme objective

1. To estimate the abundance of hoki, hake, and ling on the Chatham Rise from trawl surveys.

## Objectives for 1997–98

1. To continue the time series of relative abundance indices of recruited hoki (eastern stock), hake (HAK 4), and ling (LIN 3 & 4) on the Chatham Rise using trawl surveys. The survey will be optimised on hake (target coefficient of variation (*c.v.*) of the estimate of 20%), with target *c.v.* for recruited hoki and ling of 15%.

2. To determine the relative year class strengths of juveniles [hoki] (1, 2, and 3 year olds) on the Chatham Rise, with a target *c.v.* of 20%, for the number of 2 year olds.

3. To further investigate the potential of acoustics for estimating juvenile hoki abundance by age.

## Additional survey objectives

1. To estimate relative abundance of commercially important middle depth species on the Chatham Rise.
2. To collect biological data and otoliths from hoki and other middle depth species for studies on ageing, growth, and stock separation.
3. To define major water mass characteristics by measuring surface and bottom temperature within the survey area.
4. To collect bathymetric data to refine stratum boundaries.

## Timetable and personnel

Trawling was carried out from 2 to 24 January 1998. R. Hurst was the project leader and N. Bagley was the voyage leader and responsible for the final database editing. The ship's master was A. Leachman.

# Methods

## Survey area and design

As in previous years, the survey was of a two-phase random design (*after* Francis 1984). The survey area (Figure 1) was divided into 21 strata based on the design in previous surveys from 1996. This included subdivision of stratum 11 into two strata (11 and 21) because hake was a target species for this survey and stratum 21 often has high catch rates of hake.

Phase 1 station allocation was optimised to achieve the target *c.v.*s on the key species, hoki (recruited and 2+), hake, and ling. Data used to simulate optimal allocation were stratum areas and catch rates from the six previous *Tangaroa* trawl surveys. Optimisation used bootstrap simulation to allocate stations to strata with high catch rates, based on the same principle as the phase 2 station allocation of Francis (1984). Ninety stations were planned for phase 1. Additional stations for phase 2 were to be allocated to improve the *c.v.*s for target species as required.

All station positions were selected randomly using the NIWA Random Stations Generation Program (version 1.6). Trawl paths were always separated by a minimum of 3 n. miles.

## Vessel specifications

RV *Tangaroa* is a purpose-built research stern trawler with the following specifications: length overall, 70 m; beam, 14 m; gross tonnage, 2282 t; power, 3000 kW (4000 hp).

## Gear specifications

The net was the same as that used on the first six surveys of this series, i.e., an eight-seam hoki bottom trawl with a 58.8 m groundrope, 45 m headrope (*see* Hurst and Bagley 1994 for the net plan and rigging details), and a codend mesh size of 60 mm. It was rigged with 100 m long sweeps, 50 m bridles, and 12 m backstrops. The trawl doors were Super Vee type with an area of 6.1 $m^2$. The doorspread and headline height were recorded every 5 min during the tow (from the Scanmar system and the Kaijo Denki or Furuno net monitor, respectively) and an average was calculated. Doorspread readings were recorded from 82 tows. Missing values were calculated from an average for the appropriate depth range from doorspread data collected on the survey.

## Trawling procedure

Trawling was conducted in daylight. If time was running short at the end of the day, the vessel steamed towards the last station and the trawl was shot on that transect line in time to ensure completion of the tow by sunset as long as 50% of the distance between stations was travelled. At each station it was planned to tow for 3 n. miles at a speed over the ground of 3.5 knots. If a station occurred in an area of foul ground, then an area within 3 n. miles of the position was searched for trawlable bottom. If suitable ground was not found, the station was abandoned and another random position chosen. If foul ground was encountered during trawling, the tow was considered valid only if a distance of at least 2 n. miles

had been covered. Tows less than 2 n. miles long were replaced with another random station in the same stratum. The average speed over the ground was calculated at the end of each tow.

Gear configuration was maintained as constant as possible during the survey and within the ranges described as desirable by Hurst *et al.* (1992).

## Hydrology

Surface temperatures were obtained at the start of each tow from a temperature sensor mounted on the hull at a depth of about 5 m. Bottom temperatures were obtained from the average of recordings taken every 5 min from the Furuno net monitor or from temperature recorded from the CTD datalogger. Both monitors were mounted on the trawl headline about 6.8 m above the bottom. The CTD datalogger was used at the beginning of the voyage but discontinued as some temperatures recorded were unbelievable. A calibration error had occurred and the raw datafiles were reprocessed at Greta Point using the correct calibration.

The CTD datalogger averaged differences of – 0.3 °C at the surface (n = 16) and + 0.3 °C near the bottom (n = 3), compared with the ship's equipment. No adjustment for this difference has been made.

## Catch sampling

The catch at each station was sorted into species and weighed on motion-compensating electronic scales accurate to ± 0.3 kg. For large catches of mixed rattails, the weights of individual species were estimated by sub-sample, i.e., the sub-sample was sorted and weighed by species and the total catch was apportioned according to the percentage weight of each species in the sub-sample.

Samples of up to 200 hoki and 50–200 of other commercial species were randomly selected from the catch to measure length and determine sex. At almost every station they occurred, up to 20 each of hoki, ling, hake, ribaldo, silver warehou, and white warehou were selected for detailed biological analysis and otolith removal. Data collected were fish length (total, fork, mantle (squid), and chimera (tip of snout to posterior end of dorsal fin)) weight, sex, gonad stage and weight, and also included stomach fullness, stomach contents, and prey condition.

Length, weight, and sex data were also collected from samples of alfonsino, dark and pale ghost shark, lookdown dory, rough and smooth skates, scampi, shovelnose dogfish, sea perch, spiky oreo, and giant stargazer for calculation of length-weight relationships to enable more accurate scaling of the length frequencies for these species.

## Data analysis

Doorspread biomass was estimated by the area-swept method of Francis (1984), the standardised approach being adopted (Francis 1989). The *c.v.* is a measure of the precision of the biomass estimate, and is calculated by:

$$c.v.\ (\%) = S_B / B \times 100$$

where $S_B$ is the standard error of the biomass ($B$).

The catchability coefficient (an estimate of the proportion of fish in the survey area available to be caught in the net) is the product of vulnerability ($v$), vertical availability ($u_v$), and areal availability ($u_a$) as defined by Francis (1989). These factors were all set to 1 in these analyses, the assumptions being that fish were randomly distributed over the bottom within a stratum; fish distribution did not extend above the headline height of the net; all fish in the path of the doors were caught; and the herding effect of the doors, sweeps, and bridles was constant.

Data from all stations with satisfactory gear performance (codes 1 or 2) were used to estimate biomass. Acoustic trawl stations were also excluded from the analysis to enable biomass to be estimated from trawl survey random stations only.

Scaled length frequencies were calculated for the main species with the Trawlsurvey Analysis Program version 3.2 (documented by Vignaux (1994)). The data from each station were scaled by the percentage of the catch sampled (to represent each catch) and by the ratio of the area swept to stratum area (to represent the total population). A further correction (usually minor) was made to ensure that the biomass calculated from the scaled length frequencies equated to the biomass calculated from catch data.

Biomass by stratum and catch rate plots for 2+ hoki and 3+ and older hoki were calculated by using the PC biomass program (Version 1.1). As the size frequencies of the 2+ and 3+ fish overlapped, the catch weight at each 1 cm length interval was adjusted by the percentage of hoki at each age calculated from otolith readings. The distinct 1 year old cohort was extracted from the trawl survey database using the Trawlsurvey Analysis Program.

# Results

## Survey area

Ninety phase 1 stations were successfully completed (Table 1). One additional phase 2 station was put into stratum 21 in an attempt to improve the *c.v.* for hake (station 44). The station density in individual strata ranged from 1:288 in stratum 17 to 1:3918 $km^2$ in stratum 2 (*see* Table 1). Mean station density over the whole survey area was 1:1533 $km^2$. The positions of all trawl survey stations occupied are given in Figure 1, and individual station data, foul shots, and acoustic trawls are given in Appendix 1.

## Gear performance

Gear parameters by depth zone are summarised in Table 2. Gear configuration remained relatively constant over the 200–800 m depth range. Mean doorspread measurements by 200 m depth interval ranged from 115.2 to 122.5 m and headline height from 6.8 to 6.9 m, all falling within the accepted range (Hurst *et al.* 1992). The mean doorspread of individual tows ranged from 97.0 to 131.5 m and the desirable range (100–130 m) was exceeded slightly on 2 of 91 occasions. This was not considered to be a problem and these tows were not excluded from the biomass calculations. Stations 23, 104, 108 had poor gear performance (i.e., came fast) and were excluded from the analysis.

## Hydrology

Surface temperatures from the hull-mounted sensor were recorded on the 91 biomass stations and ranged from 10.5 to 16.2 °C (Figure 2). Bottom temperatures were recorded from 56 biomass stations from the Furuno net monitor and from 16 stations using the portable CTD datalogger. They ranged from 6.6 to 10.1 °C (*see* Figure 2).

Warmer surface temperatures were recorded from strata in the northern part of the survey area with the coldest temperatures (below 11 °C) from the south west (stratum 6). Higher bottom temperatures were generally associated with shallower depths. A warm (9 °C) area was found to the east of Mernoo Bank (stratum 19), as in previous years. Warmer water was also recorded in strata to the west and north of the Chatham Islands.

## Catch composition

One hundred and forty species were recorded: 26 elasmobranchs, 85 teleosts, 8 cephalopods, 6 crustaceans, and assorted benthic and pelagic organisms. A full list of species caught, and the number of stations at which they occurred, is given in Appendix 2.

The total catch for the trawl survey was 95.0 t, of which 44.2 t (46.5%) was hoki, 5.3 t (5.6%) was black oreo, 4.4 t (4.6 %) was dark ghost shark, and 3.4 t (3.6%) was ling (Table 3).

## Biomass estimation

Estimates of the biomass of the major commercial and non-commercial species are given in Table 3 and biomass by stratum for hoki in the 1+, 2+, and adult cohorts in Table 4. Estimates of biomass by stratum of the next 18 most abundant species are presented in Table 5. Parameters of length-weight relationships used in the Trawlsurvey Analysis Program to scale length frequencies and to calculate hoki biomass by cohort are given in Table 6.

Hoki was the most abundant species: 71% of the biomass was below 70 cm TL. Black oreo, ling, silver warehou, spiky oreo, hake, alfonsino, smooth oreo, and giant stargazer were other important commercial Individual Transferable Quota (ITQ) species caught in reasonable quantities. Most of the alfonsino and oreos caught were of a size considered too small by commercial fishers. The most abundant commercial non-ITQ species were lookdown dory, dark ghost shark, spiny dogfish, pale ghost shark, and sea perch (*see* Table 3). A substantial biomass of non-commercial species, primarily rattails, also occurs on the Chatham Rise (*see* Table 3).

## Species distribution

Catch rates for hoki by cohort are given in Figure 3. Catch rates for the next most abundant 20 species are given by stratum in Table 7 and by station in Figure 4.

Hoki were taken on all successful biomass stations: the largest single catch (8980 $kg.km^{-2}$) was taken in stratum 17. Most of the 1+ fish were taken in strata between 200 and 400 m in the western part of the survey area, strata 17, 18, 19, and 20, although the largest single catch of 628 $kg.km^{-2}$ came from

stratum 9. Two year old hoki were also most abundant in 200–400 m to the west in stratum 17. Catches of 3+ and older hoki were taken on every successful biomass station with larger catches taken in the western part of the survey area between 200 and 600 m.

Catches of hake were mostly taken between 400 and 600 m with the largest haul coming from stratum 21. Few hake were taken in depths between 200 and 400 m. Ling, lookdown dory, bigeyed rattail, sea perch, and javelinfish were widely distributed across the survey area and were taken in larger quantities in depths between 200 and 600 m. Black oreo were exclusively taken from 600–800 m strata on the south Chatham Rise while spiky oreo and shovelnosed dogfish were taken in the same depth range on the north Chatham Rise. Dark ghost shark occurred mainly in the 200–400 m strata, while pale ghost shark were taken in depths greater than 400 m with larger catches on the south Chatham Rise. Silver warehou were patchily distributed and predominantly taken between 200 and 400 m. Sea perch were taken on most stations with larger catches taken between 200 and 400 m. Occasional catches of alfonsino and common roughy were made in strata around the Chatham Islands with the largest haul of alfonsino taken in stratum 3. Smooth oreo were mainly taken in one large haul in stratum 4 with small catches between 600 and 800 m. Oliver's rattail was present along the Chatham Rise in waters deeper than 400 m and was taken in quantity in strata 16 and 6 in the southeast of the survey area.

## Biological measurements

The numbers of fish of each species from which length or more detailed biological data were collected are given in Table 8. Length frequencies for hoki by sex and depth (200–400, 400–600, and 600–800 m) are given in Figure 5a and by sex, depth, and area in Figure 5b. Length frequencies of hoki by stratum are given in Appendix 3. Length frequencies for all fish by sex and by depth range (200–400, 400–600, and 600–800 m) are given for hake (Figure 6) and ling (Figure 7). Otoliths taken from hoki, hake, and ling have been aged and calculated numbers at age are given in Appendix 4 (P. Horn, pers. comm.). Scaled length frequency histograms by sex of the other major commercial species are presented in Figure 8. These length frequencies represent the population structure for the survey area as sampled by bottom trawl.

Scaled length frequencies and calculated numbers at age for hoki show a strong 3+ cohort. The 2+ cohort does not form a distinct mode in the length frequency and appears as part of a slower growing 3+ mode. Of hoki in the 2+ length range (48–54 cm), 33% were age 3+. The 1+ cohort with a mode at 40 cm is similar in strength to that in the 1997 survey, but still weak compared with the 1996 survey.

Sex ratios were about even for most species, except giant stargazer, ribaldo, and spiny dogfish which had fewer males than females (sex ratios exceeded 1:1.5, M:F) and smooth oreo, alfonsino, and silver warehou, which were predominantly male (sex ratio exceeded 1.5:1).

Gonad stages of alfonsino, hoki, hake, ling, silver warehou, and white warehou are summarised in Table 9. All alfonsino and hoki were resting or immature; adult silver and white warehou were mostly resting or spent; adult hake were in active reproduction stages (63% of the males and 33% of the females) ripening to partially spent, stages 3–6; adult ling had 30% of the males and 3% of the females in active reproduction stages. Occasional observations on other species indicated ribaldo and sea perch as resting or spent, lookdown dory as resting, mature, and spent, and giant stargazers as mature or spent with no running ripe fish observed.

# Discussion

The allocation of phase 1 stations achieved the target precision levels required in the contract for all key species (*see* objectives, p.5).

Although the hake biomass was estimated with an acceptable level of precision, only 280 hake were caught. Also, the proportion of larger adult fish in the length frequency seems to have declined since 1996 when the station density in the deeper strata was more than halved. It is therefore possible that the recent survey may not have been sampling the hake population in a way comparable to that on surveys before 1996. This needs to be investigated further and may result in a revised survey design.

The 3 year old hoki cohort dominates the length frequency and accounts for 49% of hoki from calculated numbers at age. This year class has followed on from a strong 2+ cohort taken in the 1997 survey and strong 1+ cohort from the 1996 survey. Large numbers of this cohort appear to have remained on the Chatham Rise until age 3+.

At the request of the Ministry of Fisheries no allowance was programmed for bad weather. Weather conditions were poor at times and hampered the survey by either stopping operations or reducing steaming speeds and the number of stations sampled. From the programmed 21 days in the survey area about 2 days and 3 nights (acoustics work) were lost to bad weather. This may cause problems in the future if more phase 2 effort is required in an attempt to achieve acceptable *c.v.*s.

# Acknowledgments

Thanks to the scientific staff and the Master, officers, and crew of *Tangaroa* who contributed to the success of this voyage. Peter Horn (NIWA, Nelson) provided the data in Appendix 4. Thanks also to Malcolm Clark for providing constructive comments on an earlier draft of this manuscript. This work was carried out by NIWA under contract to the Ministry of Fisheries (contract no. HOK9702).

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**Table 1: Stratum description and station allocation***

| Stratum | Pre-1996 strata | Area ($km^2$) | Number of stations P1 | C1 | C2 | Station density ($km^2$ per station) | Depth range (m) |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 2 439 | 3 | 3 | 0 | 813 | 600-800 |
| 2 | 2 & 3 | 11 756 | 3 | 3 | 0 | 3 918 | 600-800 |
| 3 | 21 | 3 499 | 3 | 3 | 0 | 1 166 | 200-400 |
| 4 | 4 & 5 | 11 315 | 4 | 4 | 0 | 2 828 | 600-800 |
| 5 | 22 | 4 076 | 4 | 4 | 0 | 1 019 | 200-400 |
| 6 | 6 | 8 266 | 4 | 4 | 0 | 2 066 | 600-800 |
| 7 | 7 | 5 233 | 7 | 7 | 0 | 748 | 400-600 |
| 8 | 8 & 9 | 9 008 | 7 | 7 | 0 | 1 286 | 400-600 |
| 9 | 23 | 5 136 | 3 | 3 | 0 | 1 712 | 200-400 |
| 10 | 10 | 6 321 | 3 | 3 | 0 | 2 107 | 400-600 |
| 11 | 11 | 6 721 | 3 | 3 | 0 | 2 240 | 400-600 |
| 12 | 12 | 6 578 | 3 | 3 | 0 | 2 192 | 400-600 |
| 13 | 13 | 6 684 | 4 | 4 | 0 | 1 671 | 400-600 |
| 14 | 14 | 5 928 | 3 | 3 | 0 | 1 976 | 400-600 |
| 15 | 15 | 5 840 | 5 | 5 | 0 | 1 168 | 400-600 |
| 16 | 16 & 17 | 11 522 | 9 | 9 | 0 | 1 280 | 400-600 |
| 17 | 24 | 865 | 3 | 3 | 0 | 288 | 200-400 |
| 18 | 18 | 4 704 | 5 | 5 | 0 | 940 | 200-400 |
| 19 | 19 | 9 013 | 4 | 4 | 0 | 2 253 | 200-400 |
| 20 | 20 | 9 586 | 7 | 7 | 0 | 1 369 | 200-400 |
| 21 | 25 | 5 038 | 3 | 3 | 1 | 1 260 | 400-600 |
| Total | | 139 528 | 90 | 90 | 1 | (1 533) | |

* Number of stations; P1, proposed phase 1 stations; C1, completed phase 1 stations; C2, completed phase 2 stations.

**Table 2: Tow and gear parameters by depth range. Values shown are sample size (*n*), and for each parameter the mean, standard deviation (*s.d.*), and range**

| | *n* | Mean | *s.d.* | Range |
|---|---|---|---|---|
| Tow parameters | | | | |
| Tow length (n. mile) | 91 | 2.96 | 0.20 | 2.00-3.06 |
| Tow speed (knots) | 91 | 3.5 | 0.11 | 3.0-3.7 |
| Gear parameters (m) | | | | |
| 200–400 m | | | | |
| Headline height | 29 | 6.9 | 0.3 | 6.2-7.8 |
| Doorspread | 26 | 115.2 | 6.6 | 102.5–126.5 |
| 400–600 m | | | | |
| Headline height | 48 | 6.9 | 0.3 | 6.0-7.9 |
| Doorspread | 43 | 118.8 | 7.9 | 97.0–128.6 |
| 600–800 m | | | | |
| Headline height | 14 | 6.8 | 0.3 | 6.3-7.6 |
| Doorspread | 13 | 122.5 | 6.3 | 110.4–131.5 |
| Total depth range | | | | |
| Headline height | 91 | 6.8 | 0.3 | 6.0-7.9 |
| Doorspread | 82 | 118.1 | 7.5 | 97.0–131.5 |

**Table 3: Estimated biomass, with *c.v.* in parentheses, and catch of all ITQ species, important commercial non-ITQ species, and major non-commercial species. Dashes indicate that the fish were not sexed**

| | Species code | Total biomass (t) All fish* | | Females | | Males | | Catch (kg) |
|---|---|---|---|---|---|---|---|---|
| **ITQ species** | | | | | | | | |
| Hoki | HOK | 86 678 | (10.9) | 50 048 | (9.7) | 36 618 | (12.9) | 44 189 |
| Black oreo | BOE | 18 980 | (35.5) | 9 274 | (31.4) | 9 706 | (41.2) | 5 272 |
| Ling | LIN | 7 313 | (8.3) | 3 617 | (9.7) | 3 682 | (10.0) | 3 397 |
| Silver warehou | SWA | 4 708 | (47.8) | 2 045 | (55.5) | 2 655 | (44.5) | 2 472 |
| Spiky oreo | SOR | 4 265 | (33.3) | 1 798 | (30.6) | 2 467 | (36.2) | 1 104 |
| Hake | HAK | 2 873 | (18.4) | 1 827 | (15.9) | 1 043 | (29.7) | 1 110 |
| Alfonsino | BYS | 2 287 | (51.8) | 1 042 | (57.0) | 1 195 | (51.9) | 965 |
| Smooth oreo | SSO | 1 851 | (99.0) | 692 | (99.4) | 1 160 | (98.7) | 450 |
| Giant stargazer | STA | 1 702 | (13.6) | 1 373 | (13.6) | 329 | (23.5) | 952 |
| Slender mackerel | JMM | 714 | (63.1) | 362 | (62.0) | 352 | (64.4) | 335 |
| Arrow squid | NOS | 199 | (17.3) | 95 | (23.2) | 103 | (21.3) | 102 |
| School shark | SCH | 159 | (44.3) | 38 | (71.0) | 121 | (53.8) | 88 |
| Barracouta | BAR | 154 | (47.2) | 91 | (43.1) | 63 | (54.5) | 93 |
| Red cod | RCO | 150 | (33.1) | 73 | (31.4) | 76 | (37.9) | 122 |
| Lemon sole | LSO | 97 | (30.5) | 11 | (79.8) | 4 | (85.7) | 53 |
| Tarakihi | TAR | 95 | (72.3) | 17 | (80.0) | 78 | (71.5) | 49 |
| Scampi | SCI | 29 | (16.6) | 6 | (25.9) | 23 | (17.2) | 13 |
| Hapuku | HAP | 25 | (73.9) | 9 | (100) | 16 | (100) | 11 |
| Bluenose | BNS | 7 | (100) | 0 | (0) | 7 | (100) | 6 |
| **Commercial non-ITQ species** | | | | | | | | |
| Lookdown dory | LDO | 7 019 | (6.0) | 4 783 | (7.0) | 2 213 | (7.4) | 2 975 |
| Dark ghost shark | GSH | 6 716 | (14.1) | 3 988 | (14.2) | 2 728 | (15.3) | 4 385 |
| Spiny dogfish | SPD | 5 724 | (16.8) | 5 024 | (17.7) | 700 | (16.7) | 3 018 |
| Pale ghost shark | GSP | 4 052 | (9.3) | 2 015 | (9.9) | 2 037 | (12.8) | 1 568 |
| Sea perch | SPE | 3 448 | (13.6) | 1 350 | (14.4) | 2 083 | (13.7) | 1 606 |
| Shovelnose dogfish | SND | 2 776 | (26.9) | - | | - | | 764 |
| Smooth skate | SSK | 1 425 | (26.4) | - | | - | | 551 |
| White warehou | WWA | 1 017 | (23.3) | 439 | (20.6) | 576 | (27.1) | 529 |
| Ray's bream | RBM | 360 | (35.1) | 156 | (36.7) | 195 | (36.2) | 211 |
| Ribaldo | RIB | 510 | (14.3) | 397 | (16.9) | 114 | (23.2) | 177 |
| Southern blue whiting | SBW | 206 | (72.4) | 100 | (73.9) | 106 | (71.3) | 194 |
| **Non-commercial species** | | | | | | | | |
| Bigeyed rattail | CBO | 9 424 | (11.1) | - | | - | | 4 226 |
| Javelinfish | JAV | 8 015 | (12.4) | - | | - | | 3 086 |
| Common roughy | RHY | 2 041 | (67.6) | - | | - | | 760 |
| Oliver's rattail | COL | 1 780 | (28.9) | - | | - | | 699 |
| Oblique-banded rattail | CAS | 1 492 | (13.9) | - | | - | | 1 067 |
| Rudderfish | RUD | 1 436 | (21.7) | - | | - | | 470 |
| Silver dory | SDO | 1 298 | (59.6) | - | | - | | 491 |
| Banded bellow fish | BBE | 827 | (14.6) | - | | - | | 291 |
| Leafscaled gulper shark | CSQ | 609 | (85.6) | - | | - | | 112 |
| Orange perch | OPE | 462 | (80.9) | - | | - | | 169 |
| Swollen headed conger | SCO | 370 | (17.7) | - | | - | | 114 |
| Longnose chimaera | LCH | 360 | (16.9) | - | | - | | 120 |
| Banded rattail | CFA | 305 | (26.0) | - | | - | | 114 |

* Differences between the total biomass and the sum of males and females are juvenile fish unable to be sexed.

**Table 4: Estimated biomass (and *c.v.* %) of hoki by cohort and stratum**

| Stratum | Total hoki | | 1+ cohort (< 47 cm) | | *2+ cohort (47–56 cm) | | * 3+ cohort and older (50–56 and > 56 cm) | |
|---|---|---|---|---|---|---|---|---|
| 1 | 336 | (20) | 0 | | 0.1 | (100) | 336 | (20) |
| 2 | 3 018 | (54) | 0 | | 3 | (100) | 3 016 | (54) |
| 3 | 1 546 | (43) | 6 | (100) | 132 | (53) | 1 417 | (42) |
| 4 | 3 906 | (27) | 0 | | 0 | | 3 906 | (27) |
| 5 | 1 509 | (18) | 186 | (51) | 249 | (23) | 1 091 | (26) |
| 6 | 3 456 | (62) | 1 | (100) | 8 | (87) | 3 448 | (62) |
| 7 | 8 236 | (29) | 299 | (97) | 624 | (60) | 7 336 | (28) |
| 8 | 5 118 | (27) | 59 | (51) | 542 | (28) | 4 586 | (28) |
| 9 | 2 767 | (72) | 1 082 | (98) | 201 | (62) | 1 488 | (54) |
| 10 | 2 195 | (24) | 7 | (78) | 57 | (44) | 2 136 | (24) |
| 11 | 1 817 | (13) | 36 | (79) | 168 | (51) | 1 626 | (19) |
| 12 | 2 416 | (8) | 0 | | 19 | (94) | 2 397 | (8) |
| 13 | 4 793 | (10) | 0 | | 85 | (59) | 4 710 | (9) |
| 14 | 3 586 | (31) | 3 | (100) | 187 | (60) | 3 411 | (31) |
| 15 | 1 926 | (28) | 0 | | 16 | (66) | 1 910 | (28) |
| 16 | 12 605 | (37) | 3 | (79) | 978 | (85) | 11 650 | (34) |
| 17 | 2 735 | (94) | 61 | (99) | 298 | (97) | 2 402 | (93) |
| 18 | 5 987 | (52) | 533 | (76) | 1 072 | (43) | 4 412 | (63) |
| 19 | 6 905 | (68) | 620 | (82) | 465 | (48) | 5 826 | (80) |
| 20 | 10 622 | (23) | 1 534 | (46) | 1 691 | (31) | 7 469 | (26) |
| 21 | 1 197 | (42) | 49 | (100) | 123 | (87) | 1 043 | (37) |
| Total | 86 678 | (11) | 4 478 | (33) | 6 918 | (18) | 75 614 | (11) |

* Lengths of 2+ and 3+ hoki overlapped, so biomass by cohort was calculated using the following percentages at each 1 cm length interval (derived from the aged hoki).

| Total length (cm) | % of 2+ hoki | % of 3+ hoki |
|---|---|---|
| 48 | 100 | 0 |
| 49 | 100 | 0 |
| 50 | 90 | 10 |
| 51 | 77 | 23 |
| 52 | 68 | 32 |
| 53 | 63 | 37 |
| 54 | 37 | 63 |
| 55 | 7 | 93 |
| 56 | 7 | 93 |
| 57 | 0 | 100 |

**Table 5: Estimated biomass (and *c.v.* %) of the 18 most abundant species, other than hoki, by stratum***

| Stratum | Species code BOE | | CBO | | JAV | | LIN | | LDO | | GSH | | SPD | | SWA | | SOR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | | 87 | (31) | 198 | (52) | 95 | (35) | 37 | (38) | 0 | | 0 | | 0 | | 309 | (32) |
| 2 | 0 | | 141 | (34) | 1 499 | (19) | 351 | (31) | 139 | (21) | 7 | (100) | 0 | | 0 | | 2 554 | (42) |
| 3 | 0 | | 41 | (52) | 14 | (98) | 62 | (56) | 187 | (13) | 559 | (11) | 271 | (21) | 1 745 | (100) | 0 | |
| 4 | 11 229 | (55) | 338 | (41) | 504 | (23) | 387 | (49) | 93 | (45) | 0 | | 16 | (64) | 0 | | 84 | (69) |
| 5 | 0 | | 294 | (52) | 38 | (42) | 418 | (42) | 332 | (22) | 648 | (26) | 577 | (45) | 390 | (99) | 0 | |
| 6 | 7 003 | (38) | 314 | (65) | 593 | (41) | 215 | (28) | 63 | (84) | 0 | | 4 | (100) | 0 | | 0 | |
| 7 | 0 | | 489 | (46) | 238 | (49) | 422 | (41) | 50 | (14) | 4 | (100) | 141 | (89) | 38 | (92) | 12 | (100) |
| 8 | 0 | | 289 | (36) | 383 | (29) | 487 | (14) | 450 | (26) | 67 | (86) | 82 | (38) | 12 | (65) | 10 | (100) |
| 9 | 0 | | 40 | (47) | 52 | (64) | 158 | (51) | 339 | (28) | 675 | (58) | 161 | (29) | 15 | (57) | 0 | |
| 10 | 0 | | 60 | (36) | 178 | (41) | 117 | (53) | 245 | (17) | 0 | | 0 | | 0 | | 482 | (94) |
| 11 | 0 | | 103 | (56) | 97 | (43) | 291 | (55) | 207 | (38) | 185 | (87) | 62 | (59) | 0 | | 794 | (100) |
| 12 | 748 | (100) | 433 | (46) | 213 | (16) | 506 | (8) | 480 | (30) | 19 | (100) | 79 | (100) | 0 | | 20 | (100) |
| 13 | 0 | | 787 | (40) | 622 | (38) | 823 | (20) | 599 | (33) | 4 | (100) | 246 | (39) | 0 | | 0 | |
| 14 | 0 | | 1 589 | (22) | 858 | (36) | 564 | (39) | 1 292 | (2) | 2 | (100) | 380 | (13) | 0 | | 0 | |
| 15 | 0 | | 1 300 | (41) | 449 | (69) | 386 | (30) | 583 | (24) | 3 | (100) | 194 | (39) | 3 | (100) | 0 | |
| 16 | 0 | | 1 598 | (16) | 1 339 | (52) | 880 | (23) | 456 | (20) | 23 | (100) | 854 | (43) | 790 | (97) | 0 | |
| 17 | 0 | | 1 | (100) | 1 | (100) | 163 | (99) | 37 | (65) | 862 | (51) | 58 | (18) | 3 | (69) | 0 | |
| 18 | 0 | | 29 | (72) | 16 | (43) | 111 | (53) | 69 | (49) | 1 053 | (57) | 1 199 | (63) | 275 | (74) | 0 | |
| 19 | 0 | | 525 | (92) | 41 | (57) | 303 | (54) | 170 | (46) | 586 | (27) | 373 | (35) | 127 | (41) | 0 | |
| 20 | 0 | | 831 | (32) | 523 | (46) | 382 | (31) | 993 | (16) | 1 949 | (16) | 910 | (29) | 1 308 | (85) | 0 | |
| 21 | 0 | | 136 | (79) | 160 | (44) | 194 | (51) | 196 | (53) | 73 | (100) | 116 | (100) | 0 | | 0 | |
| Total | 18 980 | (36) | 9 424 | (11) | 8 015 | (12) | 7 313 | (8) | 7 019 | (6) | 6 716 | (14) | 5 724 | (17) | 4 708 | (48) | 4 265 | (33) |

**Table 5** — ***continued***

| Stratum | Species code GSP | | SPE | | HAK | | SND | | BYS | | RHY | | SSO | | COL | | STA | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 100 | (20) | 27 | (93) | 2 | (100) | 193 | (41) | 0 | | 0 | | 10 | (40) | 36 | (66) | 15 | (100) |
| 2 | 514 | (34) | 211 | (38) | 309 | (45) | 1 884 | (37) | 0 | | 0 | | 5 | (100) | 59 | (42) | 0 | |
| 3 | 0 | | 341 | (98) | 30 | (100) | 0 | | 864 | (82) | 0 | | 0 | | 0 | | 36 | (55) |
| 4 | 247 | (33) | 43 | (61) | 65 | (100) | 121 | (69) | 0 | | 0 | | 1 832 | (100) | 52 | (43) | 13 | (35) |
| 5 | 0 | | 69 | (47) | 14 | (100) | 0 | | 102 | (49) | 87 | (69) | 0 | | 0 | | 171 | (38) |
| 6 | 531 | (21) | 33 | (88) | 169 | (52) | 0 | | 0 | | 0 | | 4 | (100) | 900 | (52) | 0 | |
| 7 | 98 | (16) | 125 | (56) | 180 | (47) | 110 | (64) | 1 | (100) | 0 | | 0 | | 18 | (64) | 35 | (28) |
| 8 | 195 | (33) | 331 | (28) | 252 | (18) | 30 | (60) | 70 | (51) | 0 | | 0 | | 12 | (27) | 3 | (100) |
| 9 | 0 | | 75 | (76) | 0 | | 0 | | 87 | (70) | 1 943 | (71) | 0 | | 0 | | 159 | (58) |
| 10 | 94 | (40) | 78 | (11) | 577 | (26) | 322 | (61) | 7 | (59) | 0 | | 0 | | 5 | (43) | 20 | (100) |
| 11 | 18 | (100) | 77 | (53) | 58 | (100) | 27 | (100) | 82 | (64) | 9 | (91) | 0 | | 5 | (100) | 48 | (68) |
| 12 | 134 | (59) | 88 | (43) | 172 | (87) | 70 | (52) | 974 | (97) | 2 | (100) | 0 | | 2 | (20) | 90 | (50) |
| 13 | 260 | (32) | 140 | (37) | 22 | (61) | 0 | | 0 | | 0 | | 0 | | 1 | (100) | 64 | (77) |
| 14 | 785 | (31) | 208 | (46) | 114 | (54) | 0 | | 0 | | 0 | | 0 | | 68 | (69) | 67 | (54) |
| 15 | 353 | (11) | 205 | (33) | 110 | (52) | 0 | | 0 | | 0 | | 0 | | 67 | (59) | 17 | (62) |
| 16 | 582 | (18) | 124 | (34) | 176 | (34) | 0 | | 0 | | 0 | | 0 | | 529 | (35) | 142 | (24) |
| 17 | 0 | | 18 | (48) | 0 | | 0 | | 0 | | 0 | | 0 | | 0.1 | (100) | 82 | (22) |
| 18 | 4 | (100) | 153 | (41) | 36 | (100) | 0 | | 1 | (100) | 0 | | 0 | | 1 | (100) | 309 | (39) |
| 19 | 0 | | 282 | (17) | 85 | (65) | 0 | | 70 | (53) | 0.4 | (100) | 0 | | 0.4 | (100) | 125 | (50) |
| 20 | 41 | (58) | 768 | (30) | 37 | (67) | 0 | | 12 | (34) | 0 | | 0 | | 0 | | 304 | (37) |
| 21 | 94 | (39) | 51 | (20) | 465 | (89) | 19 | (100) | 18 | (50) | 0 | | 0 | | 7 | (63) | 0 | |
| Total | 4 152 | (9) | 3 448 | (14) | 2 873 | (18) | 2 776 | (27) | 2 287 | (52) | 2 041 | (68) | 1 851 | (99) | 1 760 | (29) | 1 702 | (14) |

* Species codes are given in Table 3.

**Table 6: Length-weight relationship parameters *a* and *b* used in the Trawlsurvey Analysis Program to calculate biomass by sex and length frequencies***

| | *a* | *b* | *n* | $r^2$ | Range | Data source |
|---|---|---|---|---|---|---|
| Alfonsino | 0.016244 | 3.089867 | 358 | 0.99 | 19–47 | This survey |
| Dark ghost shark | 0.001465 | 3.348698 | 356 | 0.98 | 30–61 | This survey |
| Giant stargazer | 0.009003 | 3.150386 | 208 | 0.97 | 27–82 | This survey |
| Hake | 0.001484 | 3.354876 | 280 | 0.98 | 42–130 | This survey |
| Hoki | 0.004059 | 2.922190 | 982 | 0.98 | 36–101 | This survey |
| Ling | 0.001890 | 3.309269 | 676 | 0.99 | 35–156 | This survey |
| Lookdown dory | 0.029443 | 2.911941 | 520 | 0.99 | 11–52 | This survey |
| Pale ghost shark | 0.005897 | 2.990722 | 284 | 0.96 | 18–90 | This survey |
| Ribaldo | 0.002371 | 3.394730 | 79 | 0.98 | 32–78 | This survey |
| Scampi | 0.719578 | 2.801255 | 114 | 0.82 | 3.1–6.7 | This survey |
| Sea perch | 0.010757 | 3.124765 | 235 | 0.99 | 14–51 | This survey |
| Silver warehou | 0.006479 | 3.281561 | 279 | 0.99 | 24–55 | This survey |
| White warehou | 0.017191 | 3.074470 | 264 | 0.99 | 16–60 | This survey |
| Spiky oreo | 0.028101 | 2.937984 | 78 | 0.97 | 19–40 | This survey |
| Shovelnose dogfish | 0.001229 | 3.259207 | 102 | 0.97 | 49–115 | This survey |
| Arrow squid | 0.0290 | 3.00 | - | - | - | Annala (1993) |
| Barracouta | 0.0091 | 2.88 | 730 | 0.95 | 25–95 | Hurst & Bagley (1987) |
| Black oreo | 0.0248 | 2.950 | 9 790 | 0.98 | 11–44 | DB, Chat. Rise, Nov-Mar |
| Bluenose | 0.00963 | 3.173 | - | - | - | Horn (1988) |
| Hapuku | 0.014230 | 2.998 | 1644 | - | 50–130 | Johnston (1983) |
| Lemon sole | 0.02323 | 2.833 | - | - | - | DB, IKA8003 |
| Orange perch | 0.016033 | 3.112655 | 114 | 0.98 | 17–35 | All records on DB |
| Orange roughy | 0.0687 | 2.792 | 7 880 | 0.99 | 9–44 | DB, Chat. Rise, Nov-Mar |
| Ray's bream | 0.012004 | 3.107050 | 107 | 0.97 | 28–49 | All records on DB |
| Red cod | 0.0092 | 3.003 | 923 | 0.98 | 13–72 | Beentjes (1992) |
| School shark | 0.00702 | 2.91 | 804 | - | 30–166 | Seabrook-Davison, Unp. |
| Slender mackerel | 0.0255 | 2.77 | 90 | 0.91 | 44–62 | Hurst & Bagley (1994) |
| Smooth oreo | 0.0309 | 2.895 | 9 147 | 0.98 | 10–57 | DB, Chat. Rise, Nov-Mar |
| Smooth skate | 0.017677 | 3.024078 | 54 | 0.98 | 61–155 | Survey TAN9701 |
| Southern blue whiting | 0.003 | 3.2 | 444 | - | 19–55 | Hatanaka *et al.* (1989) |
| Spiny dogfish | 0.001890 | 3.194061 | 170 | 0.97 | 53–106 | Survey TAN9601 |
| Tarakihi | 0.02 | 2.98 | - | - | - | Annala (1993) |

* $W = aL^b$ where $W$ is weight (g) and $L$ is length (cm); $n$, sample number; $r^2$ is correlation coefficient; Range, length range of fish (cm);
DB is the Ministry of Fisheries trawl survey database;
Unp., Unpublished data.

**Table 7: Catch rates (kg.km$^{-2}$) with standard deviations (in parentheses) by stratum for the 20 most abundant species ***

| | Species code | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stratum | HOK | BOE | CBO | JAV | LIN | LDO | GSH | SPD | SWA | SOR |
| 1 | 138 | 0 | 35 | 81 | 39 | 15 | 0 | 0 | 0 | 127 |
| | (48) | | (19) | (73) | (24) | (10) | | | | (71) |
| 2 | 257 | 0 | 12 | 128 | 30 | 12 | 0.6 | 0 | 0 | 217 |
| | (239) | | (7) | (42) | (16) | (4) | (1) | | | (159) |
| 3 | 442 | 0 | 12 | 4 | 18 | 54 | 160 | 78 | 499 | 0 |
| | (327) | | (11) | (7) | (17) | 13) | (30) | (29) | (864) | |
| 4 | 345 | 992 | 30 | 45 | 34 | 8 | 0 | 1 | 0 | 7 |
| | (185) | (1 085) | (25) | (20) | (34) | (8) | | (2) | | (10) |
| 5 | 370 | 0 | 72 | 9 | 103 | 81 | 159 | 142 | 96 | 0 |
| | (134) | | (75) | (8) | (86) | (36) | (83) | (128) | (190) | |
| 6 | 418 | 847 | 38 | 72 | 26 | 8 | 0 | 0.5 | 0 | 0 |
| | (515) | (649) | (49) | (59) | (15) | (13) | | (1) | | |
| 7 | 1 574 | 0 | 93 | 45 | 81 | 10 | 0.7 | 27 | 7 | 2 |
| | (1 208) | | (115) | (59) | (87) | (4) | (2) | (63) | (18) | (6) |
| 8 | 568 | 0 | 32 | 43 | 54 | 50 | 7 | 9 | 1 | 1 |
| | (405) | | (31) | (32) | (20) | (35) | (17) | (9) | (2) | (3) |
| 9 | 539 | 0 | 8 | 10 | 31 | 66 | 131 | 31 | 3 | 0 |
| | (669) | | (6) | (11) | (27) | (32) | (131) | (16) | (3) | |
| 10 | 347 | 0 | 9 | 28 | 18 | 39 | 0 | 0 | 0 | 76 |
| | (146) | | (6) | (20) | (17) | (12) | | | | (124) |
| 11 | 270 | 0 | 15 | 14 | 43 | 31 | 27 | 9 | 0 | 118 |
| | (59) | | (15) | (11) | (41) | (20) | (41) | (9) | | (205) |
| 12 | 367 | 0 | 66 | 32 | 77 | 73 | 3 | 12 | 0 | 3 |
| | (50) | | (52) | (9) | (10) | (38) | (5) | (21) | | (5) |
| 13 | 717 | 112 | 118 | 93 | 123 | 90 | 0.5 | 37 | 0 | 0 |
| | (143) | (224) | (93) | (71) | (49) | (59) | (1) | (29) | | |
| 14 | 605 | 0 | 268 | 145 | 95 | 218 | 0.3 | 64 | 0 | 0 |
| | (329) | | (104) | (89) | (64) | (6) | (1) | (15) | | |
| 15 | 328 | 0 | 223 | 77 | 66 | 100 | 1 | 33 | 1 | 0 |
| | (203) | | (206) | (119) | (44) | (54) | (1) | (29) | (1) | |
| 16 | 1 094 | 0 | 139 | 116 | 76 | 40 | 2 | 74 | 69 | 0 |
| | (1 219) | | (65) | (180) | (53) | (23) | (6) | (96) | (200) | |
| 17 | 3 161 | 0 | 1 | 0.2 | 188 | 43 | 996 | 67 | 4 | 0 |
| | (5 123) | | (2) | (0.4) | (321) | (48) | (874) | (21) | (4) | |
| 18 | 1 273 | 0 | 6 | 3 | 24 | 15 | 224 | 255 | 58 | 0 |
| | (1 493) | | (10) | (3) | (28) | (16) | (285) | (360) | (96) | |
| 19 | 766 | 0 | 58 | 4 | 34 | 19 | 65 | 41 | 14 | 0 |
| | (1 044) | | (107) | (5) | (37) | (17) | (36) | (29) | (12) | |
| 20 | 1 108 | 0 | 87 | 55 | 40 | 104 | 203 | 95 | 136 | 0 |
| | (668) | | (73) | (66) | (33) | (45) | (87) | (72) | (307) | |
| 21 | 238 | 0 | 27 | 32 | 38 | 39 | 14 | 23 | 0 | 0 |
| | (198) | | (43) | (28) | (39) | (41) | (29) | (46) | | |

**Table 7 — *continued***

| Stratum | Species code | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | GSP | SPE | HAK | SND | BYS | RHY | SSO | COL | STA | CAS |
| 1 | 41 | 11 | 1 | 79 | 0 | 0 | 4 | 15 | 6 | 0 |
| | (14) | (18) | (2) | (56) | | | (3) | (17) | (11) | |
| 2 | 44 | 18 | 26 | 160 | 0 | 0 | 0.4 | 5 | 0 | 0 |
| | (26) | (12) | (21) | (104) | | | (1) | (4) | | |
| 3 | 0 | 97 | 9 | 0 | 247 | 0 | 0 | 0 | 10 | 40 |
| | | (165) | (15) | | (350) | | | | (10) | (41) |
| 4 | 22 | 4 | 6 | 11 | 0 | 0 | 162 | 5 | 1 | 0.3 |
| | (14) | (5) | (12) | (15) | | | (324) | (4) | (2) | (1) |
| 5 | 0 | 17 | 3 | 0 | 25 | 21 | 0 | 0 | 42 | 36 |
| | | (16) | (7) | | (25) | (29) | | | (32) | (30) |
| 6 | 64 | 4 | 20 | 0 | 0 | 0 | 0.4 | 109 | 0 | 0 |
| | (27) | (7) | (21) | | | | (1) | (113) | | |
| 7 | 19 | 24 | 34 | 21 | 0.2 | 0 | 0 | 3 | 7 | 3 |
| | (8) | (35) | (43) | (36) | (1) | | | (6) | (5) | (5) |
| 8 | 22 | 37 | 28 | 3 | 8 | 0 | 0 | 1 | 0.4 | 1 |
| | (19) | (28) | (13) | (5) | (11) | | | (1) | (1) | (2) |
| 9 | 0 | 15 | 0 | 0 | 17 | 378 | 0 | 0 | 31 | 15 |
| | | (19) | | | (20) | (465) | | | (31) | (11) |
| 10 | 15 | 12 | 91 | 51 | 1 | 0 | 0 | 1 | 3 | 0 |
| | (10) | (2) | (41) | (53) | (1) | | | (1) | (5) | |
| 11 | 3 | 11 | 9 | 4 | 12 | 1 | 0 | 1 | 7 | 17 |
| | (5) | (10) | (15) | (7) | (13) | (2) | | (1) | (8) | (21) |
| 12 | 20 | 13 | 26 | 11 | 148 | 0.4 | 0 | 0.3 | 14 | 2 |
| | (21) | (10) | (39) | (10) | (248) | (1) | | (0.1) | (12) | (3) |
| 13 | 39 | 21 | 3 | 0 | 0 | 0 | 0 | 0.1 | 10 | 7 |
| | (25) | (16) | (4) | | | | | (0.2) | (15) | (10) |
| 14 | 132 | 35 | 19 | 0 | 0 | 0 | 0 | 11 | 11 | 8 |
| | (71) | (28) | (18) | | | | | (14) | (11) | (11) |
| 15 | 60 | 35 | 19 | 0 | 0 | 0 | 0 | 11 | 3 | 4 |
| | (14) | (26) | (22) | | | | | (15) | (4) | (5) |
| 16 | 50 | 11 | 15 | 0 | 0 | 0 | 0 | 46 | 12 | 1 |
| | (27) | (11) | (16) | | | | | (48) | (9) | (1) |
| 17 | 0 | 21 | 0 | 0 | 0 | 0 | 0 | 0.1 | 94 | 262 |
| | | (17) | | | | | | (0.2) | (36) | (210) |
| 18 | 1 | 33 | 8 | 0 | 0.2 | 0 | 0 | 0.2 | 66 | 14 |
| | (2) | (30) | (17) | | (1) | | | (0.5) | (57) | (12) |
| 19 | 0 | 31 | 9 | 0 | 8 | 0.1 | 0 | 0.1 | 14 | 4 |
| | | (11) | (12) | | (8) | (0.1) | | (0.1) | (14) | (5) |
| 20 | 4 | 80 | 4 | 0 | 1 | 0 | 0 | 0 | 32 | 49 |
| | (6) | (64) | (7) | | (1) | | | | (31) | (22) |
| 21 | 19 | 10 | 92 | 4 | 4 | 0 | 0 | 1 | 0 | 10 |
| | (14) | (4) | (165) | (7) | (4) | | | (2) | | (20) |

* Species codes are given in Table 3.

**Table 8: Species measured or selected for length frequencies and biological analysis, showing numbers of samples and numbers of fish examined**

| | Length frequency samples | | | | Biological samples | |
|---|---|---|---|---|---|---|
| | No. of fish measured | | | No. of | No. of | No. of |
| Species | Total† | Male | Female | samples | fish | samples |
| Alfonsino | 897 | 447 | 343 | 32 | 358 | 13 |
| Antarctic flying squid | 7 | - | 6 | 2 | - | |
| Arrow squid | 194 | 105 | 77 | 41 | - | |
| Banded bellowsfish | 71 | - | - | 1 | - | |
| Banded giant stargazer | 9 | 5 | 4 | 2 | 8 | 1 |
| Barracouta | 65 | 28 | 37 | 8 | - | |
| Black oreo | 803 | 400 | 403 | 8 | - | |
| Bluenose | 1 | 1 | - | 1 | - | |
| Blue mackerel | 2 | 1 | 1 | 1 | - | |
| Bollons's rattail | 195 | 61 | 34 | 6 | - | |
| Dark ghost shark | 1 925 | 907 | 1 018 | 42 | 356 * | 7 |
| Deepsea cardinalfish | 1 | - | 1 | 1 | - | |
| Frostfish | 1 | - | - | 1 | - | |
| Giant stargazer | 269 | 109 | 160 | 52 | 208 * | 34 |
| Hake | 280 | 137 | 142 | 55 | 280 | 55 |
| Hapuku, groper | 2 | 1 | 1 | 2 | 1 | 1 |
| Hoki | 16 450 | 7 070 | 9 376 | 91 | 982 | 48 |
| Jack mackerel | 2 | 1 | 1 | 2 | - | |
| Javelinfish | 262 | 78 | 129 | 5 | - | |
| Lemon sole | 110 | 6 | 14 | 12 | - | |
| Ling | 1 159 | 665 | 492 | 88 | 676 | 60 |
| Longfinned beryx | 1 | 1 | - | 1 | 1 * | 1 |
| Lookdown dory | 3 509 | 1 571 | 1 834 | 87 | 520 * | 8 |
| Lucifer dogfish | 10 | 3 | 7 | 1 | - | |
| Northern spiny dogfish | 10 | 10 | - | 5 | 2 * | 1 |
| Oblique-banded rattail | 188 | - | 42 | 3 | - | |
| Olivers rattail | 61 | 35 | 25 | 2 | - | |
| Pale ghost shark | 820 | 436 | 384 | 63 | 284 * | 18 |
| Ray's bream | 137 | 73 | 61 | 25 | - | |
| Red cod | 142 | 84 | 58 | 24 | - | |
| Ribaldo | 82 | 31 | 51 | 30 | 79 | 28 |
| Rough skate | 1 | - | 1 | 1 | 1 * | 1 |
| Rubyfish | 2 | 1 | 1 | 1 | - | |
| Rudderfish | 74 | 60 | 14 | 25 | - | |
| Scampi | 114 | 80 | 31 | 39 | 114 * | 39 |
| School shark | 7 | 5 | 2 | 5 | 2 * | 2 |
| Sea perch | 2 205 | 1 219 | 892 | 81 | 235 * | 12 |
| Shovelnosed dogfish | 309 | 135 | 174 | 15 | 102 * | 2 |
| Silver dory | 99 | - | - | 1 | - | |
| Silver warehou | 796 | 470 | 323 | 31 | 279 | 17 |
| Slender mackerel | 171 | 85 | 86 | 11 | - | |
| Smooth oreo | 138 | 86 | 52 | 6 | - | |
| Smooth skate | 28 | 13 | 15 | 21 | 28 * | 21 |
| Southern blue whiting | 170 | 93 | 77 | 3 | - | |
| Spiky oreo | 657 | 378 | 279 | 14 | 78 * | 1 |
| Spineback eel | 8 | 1 | 7 | 1 | - | |
| Spiny dogfish | 1 107 | 210 | 960 | 63 | - | |
| Tarakihi | 35 | 29 | 6 | 2 | - | |
| Trumpeter | 1 | 1 | - | 1 | - | |
| White warehou | 342 | 176 | 160 | 44 | 264 | 35 |

* Length, sex, and weight data only collected.

† Total is sometimes greater than the sum of male and female fish due to the sex of some fish not being recorded.

**Table 9: Numbers of male and female hoki, hake, ling, and silver warehou at each reproductive stage***

| | Alfonsino | | Hoki | | Hake | |
|---|---|---|---|---|---|---|
| Stage | Male | Female | Male | Female | Male | Female |
| 1 | 1 | 3 | 171 | 183 | 11 | 13 |
| 2 | 66 | 71 | 199 | 394 | 38 | 75 |
| 3 | 0 | 0 | 1 | 0 | 17 | 39 |
| 4 | 0 | 0 | 0 | 0 | 46 | 5 |
| 5 | 0 | 0 | 0 | 0 | 23 | 1 |
| 6 | 0 | 0 | 0 | 0 | 0 | 2 |
| 7 | 0 | 0 | 0 | 2 | 1 | 7 |
| Total | 67 | 74 | 371 | 579 | 136 | 142 |

| | Ling | | Silver warehou | | White warehou | |
|---|---|---|---|---|---|---|
| Stage | Male | Female | Male | Female | Male | Female |
| 1 | 99 | 50 | 33 | 33 | 60 | 66 |
| 2 | 155 | 213 | 73 | 45 | 41 | 30 |
| 3 | 40 | 7 | 0 | 3 | 1 | 10 |
| 4 | 71 | 0 | 0 | 0 | 0 | 0 |
| 5 | 0 | 1 | 1 | 0 | 0 | 0 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 1 | 0 | 56 | 33 | 30 | 8 |
| Total | 366 | 271 | 163 | 114 | 132 | 114 |

* Stage: 1, immature; 2, resting; 3, ripening; 4, ripe; 5, running ripe; 6, partially spent; 7, spent. Reproductive stages were described in detail by Hurst *et al.* (1992).

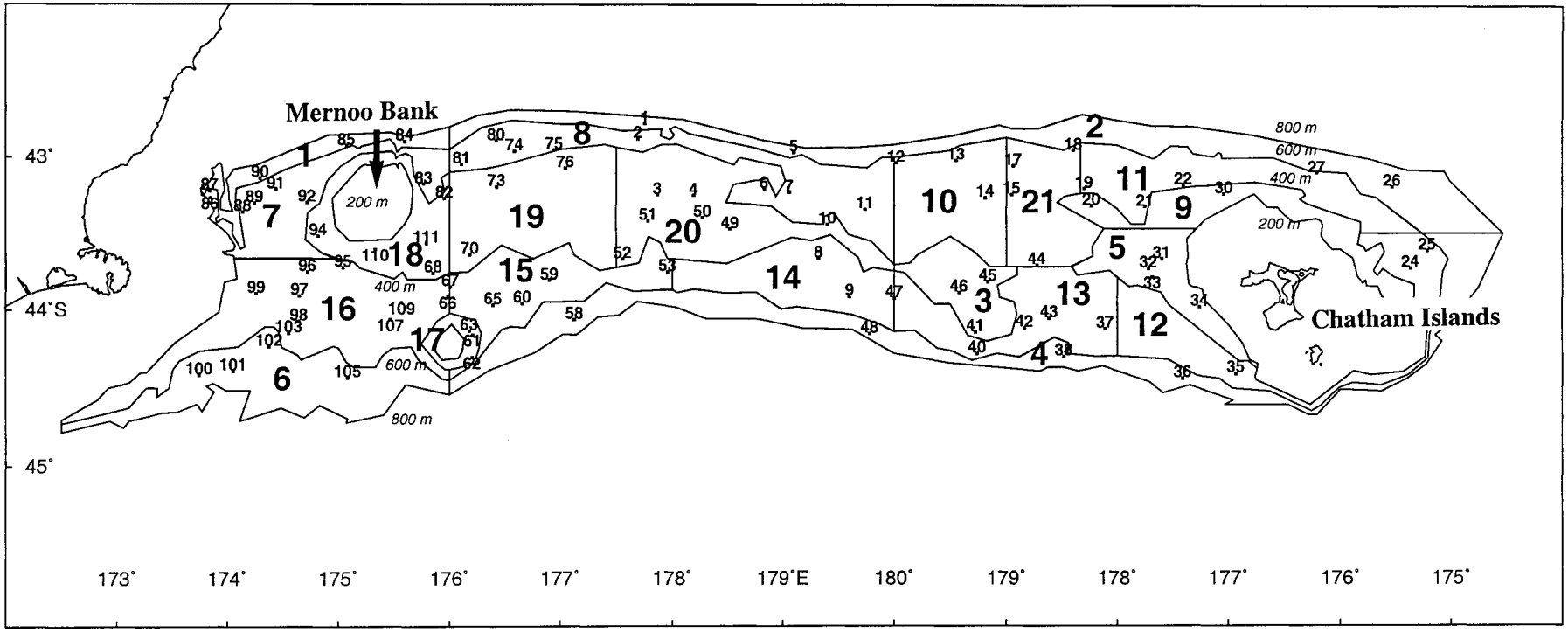



**Figure 1: Chatham Rise showing survey area, strata and trawl survey station positions.**

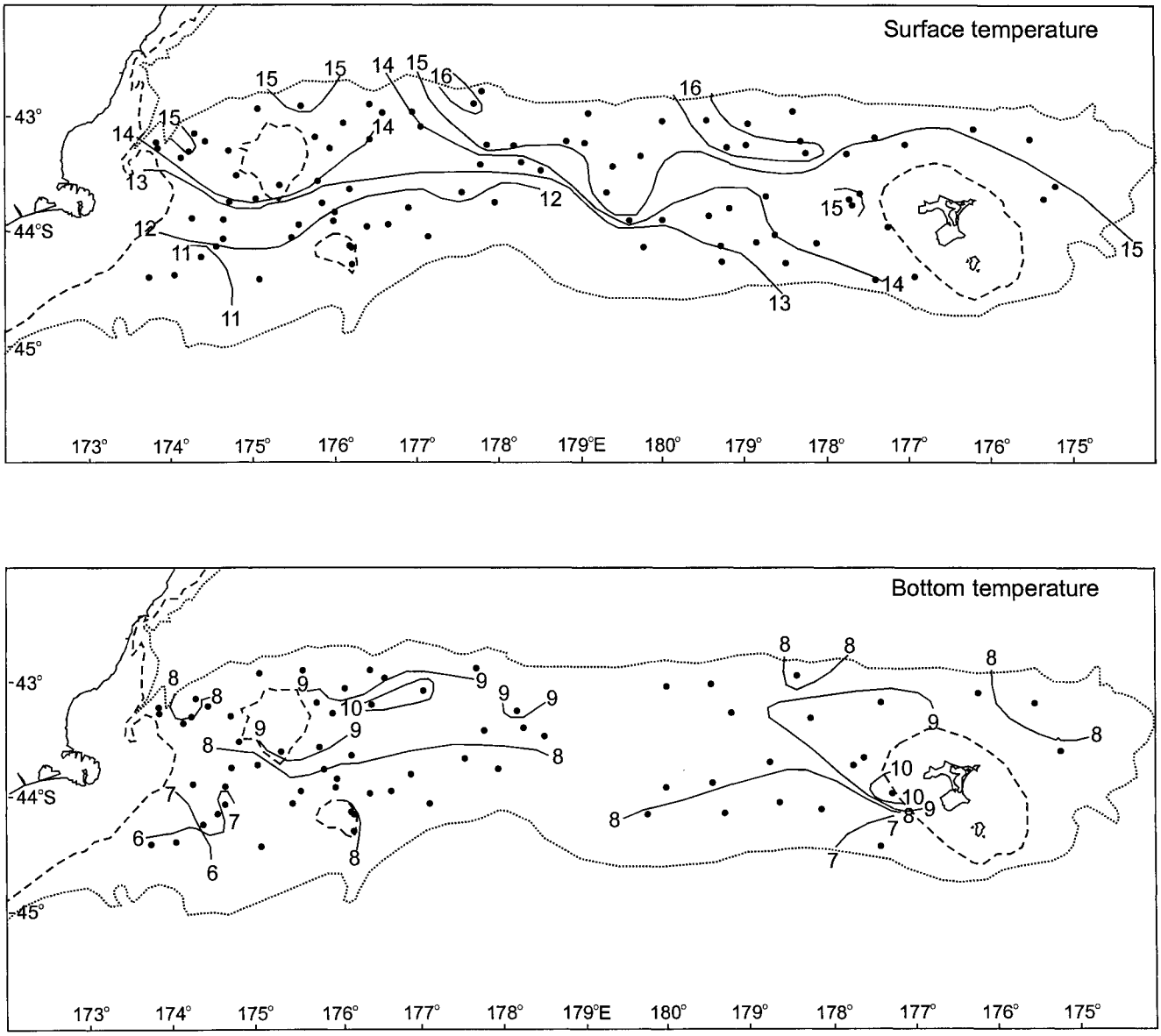



**Figure 2: Positions of surface and bottom temperature recordings and isotherms estimated from these data.**

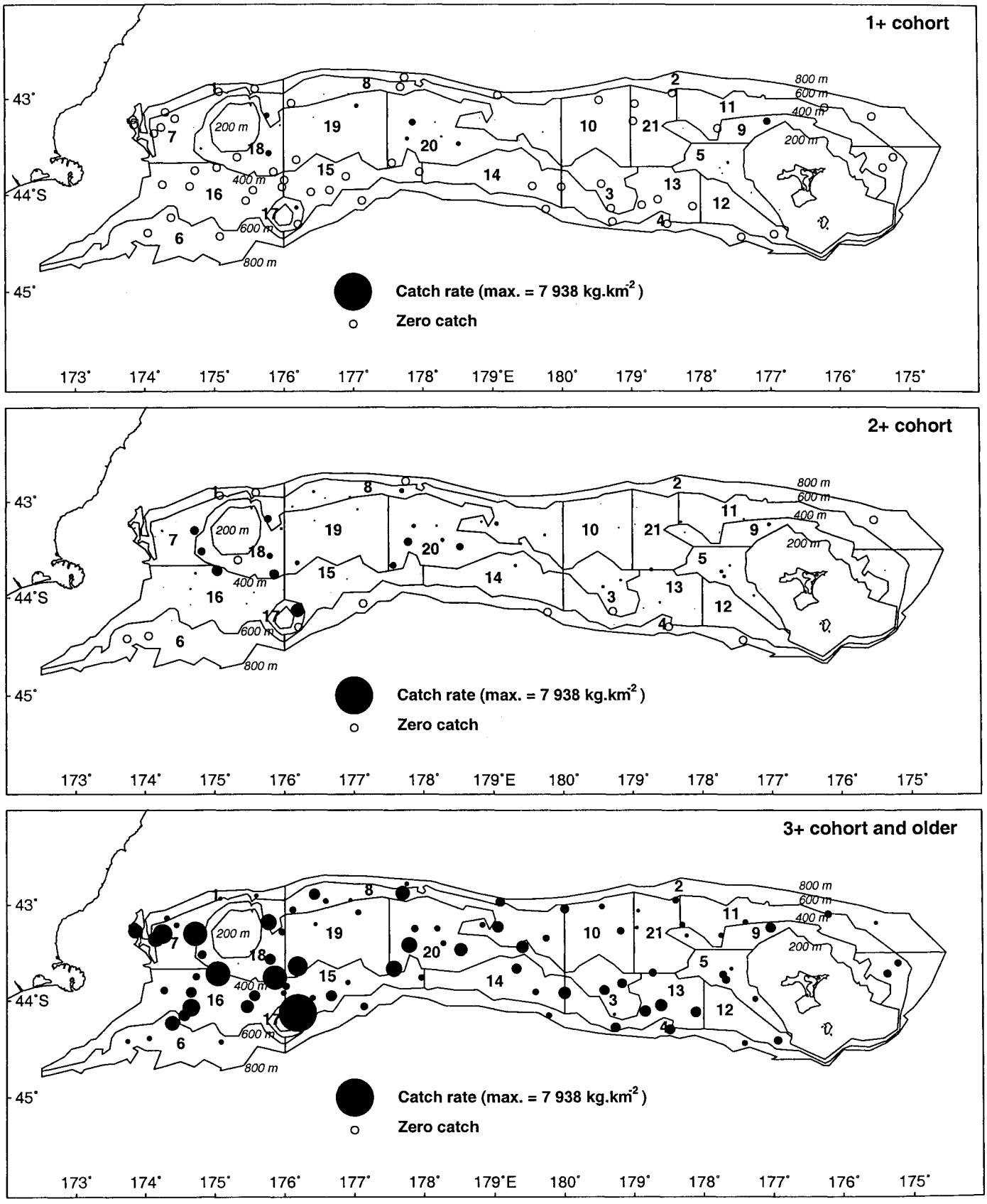



**Figure 3: Catch rates (kg.km$^{-2}$) of cohort 1, cohort 2, and cohort 3 and older hoki. Circle area is proportional to catch rate. Max, maximum catch rate.**

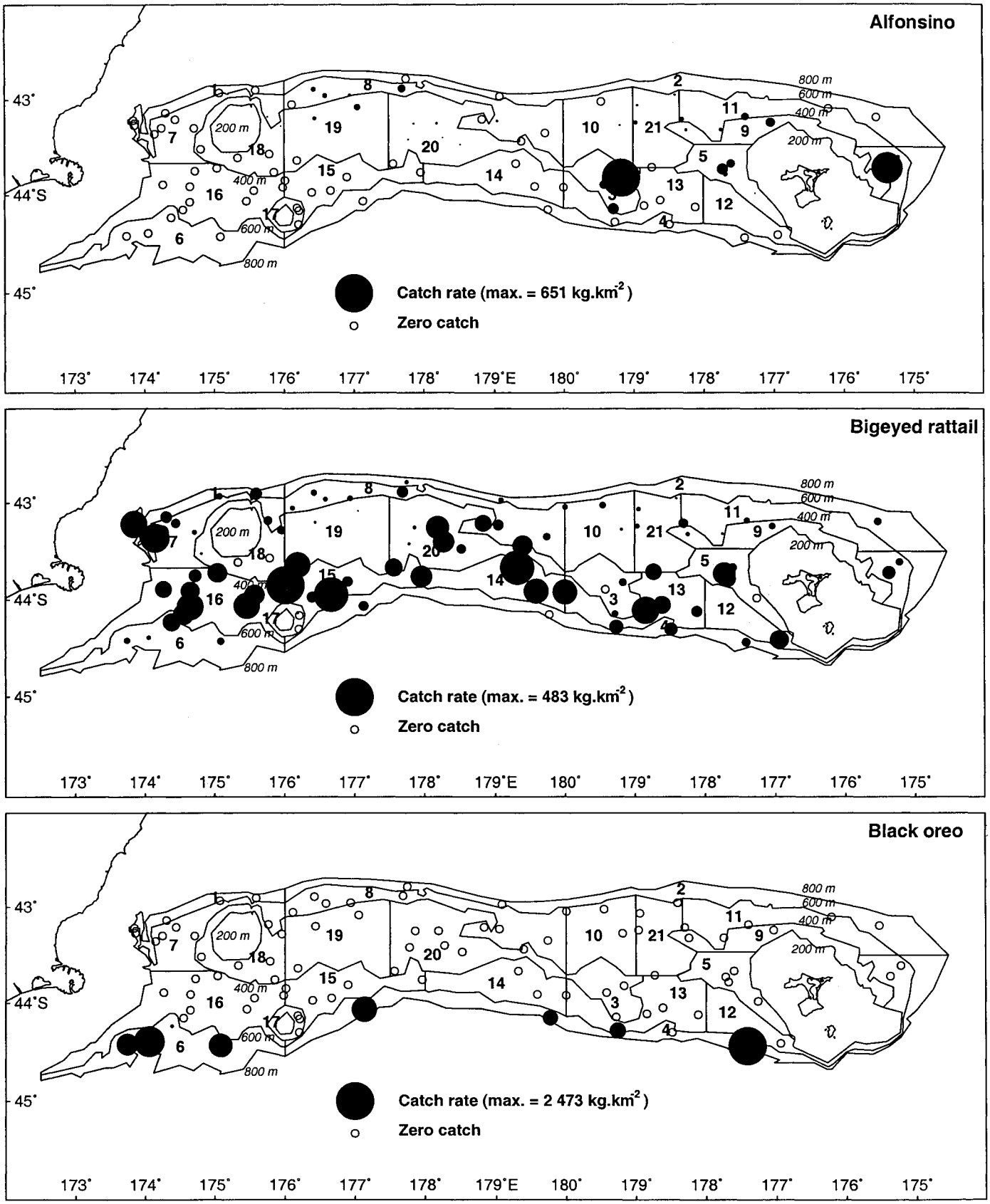



**Figure 4: Catch rates (kg.km$^{-2}$) of the most abundant species. Circle area is proportional to catch rate. Max, maximum catch rate.**

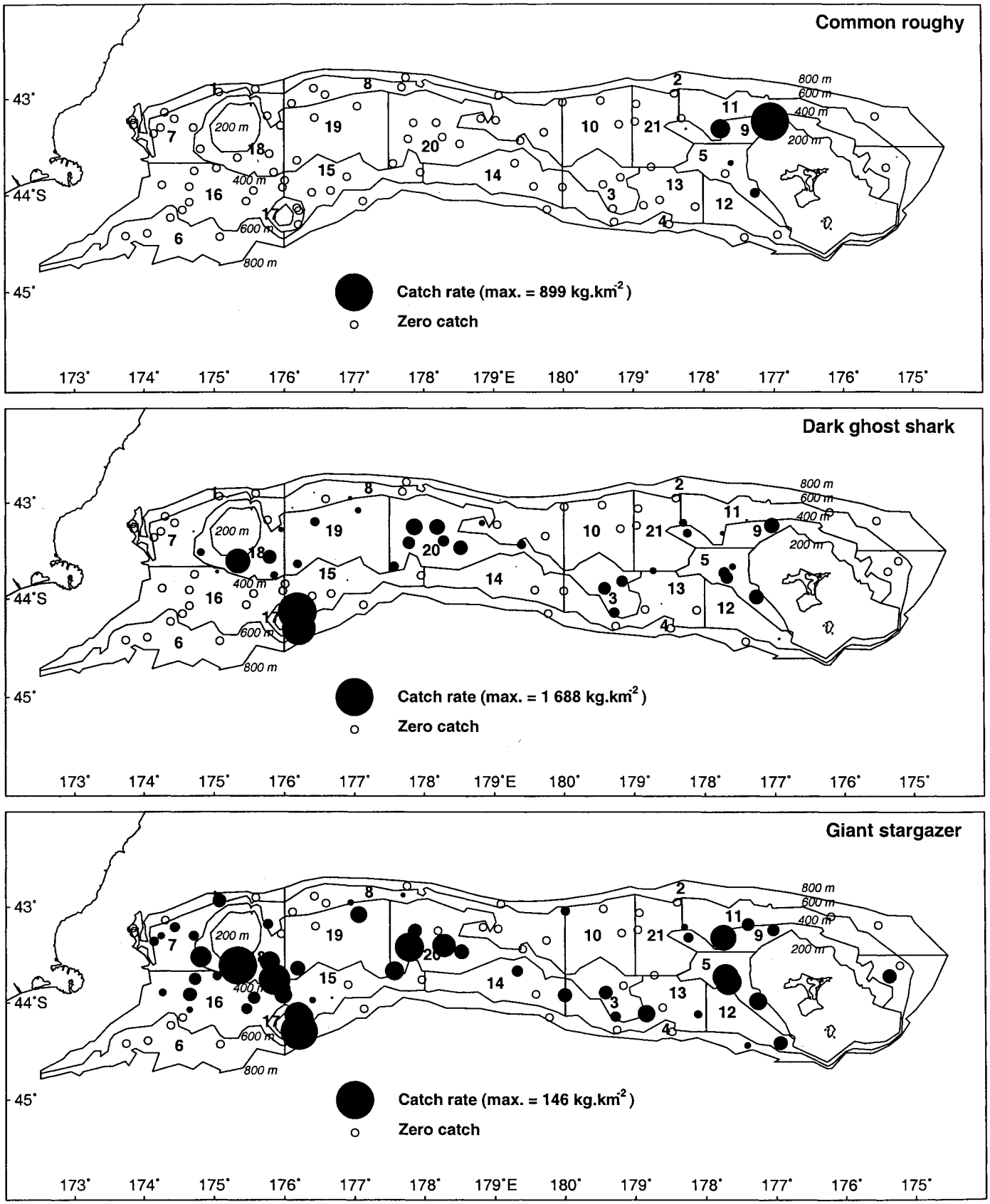



Figure 4 — *continued*

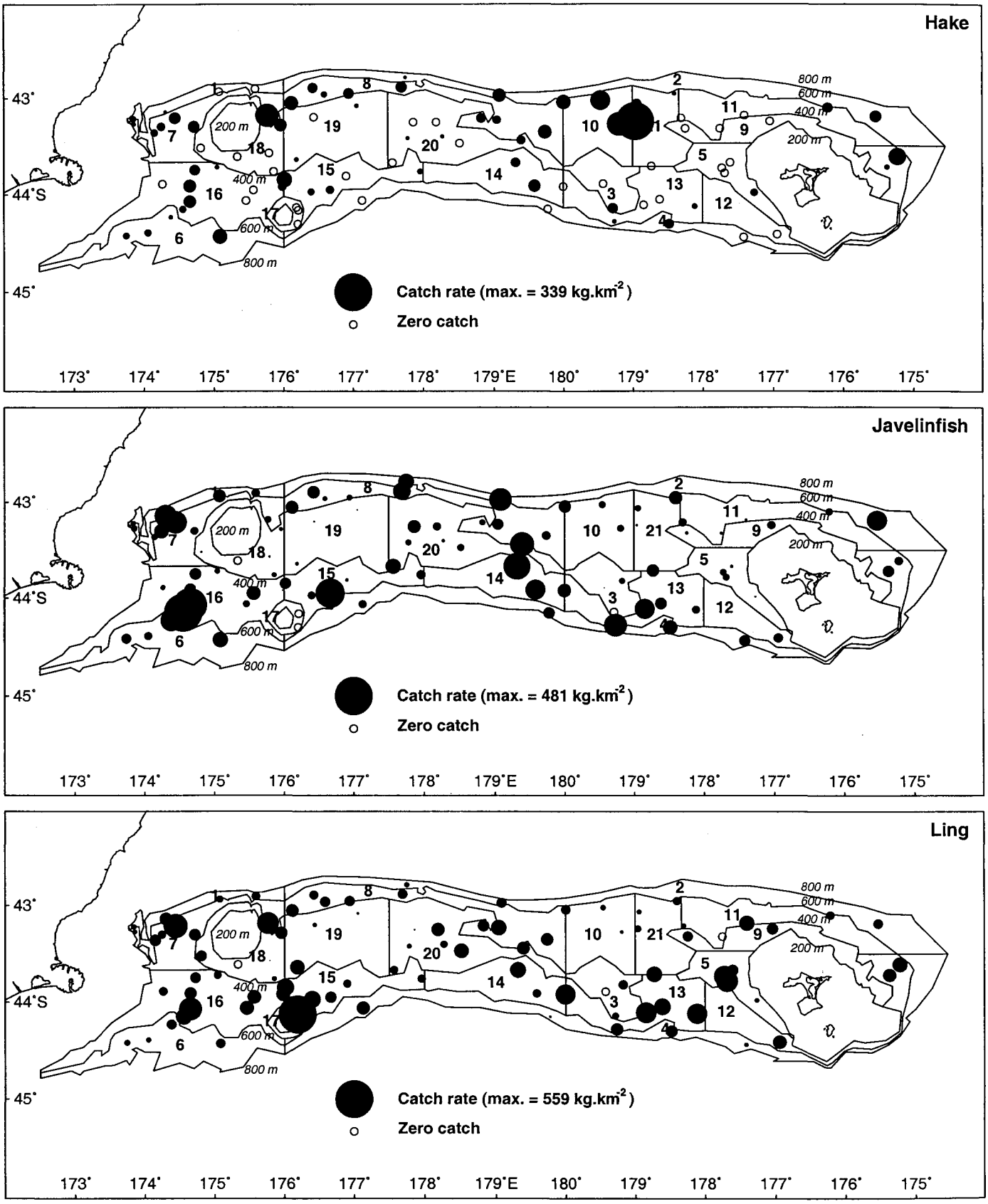



**Figure 4** — *continued*

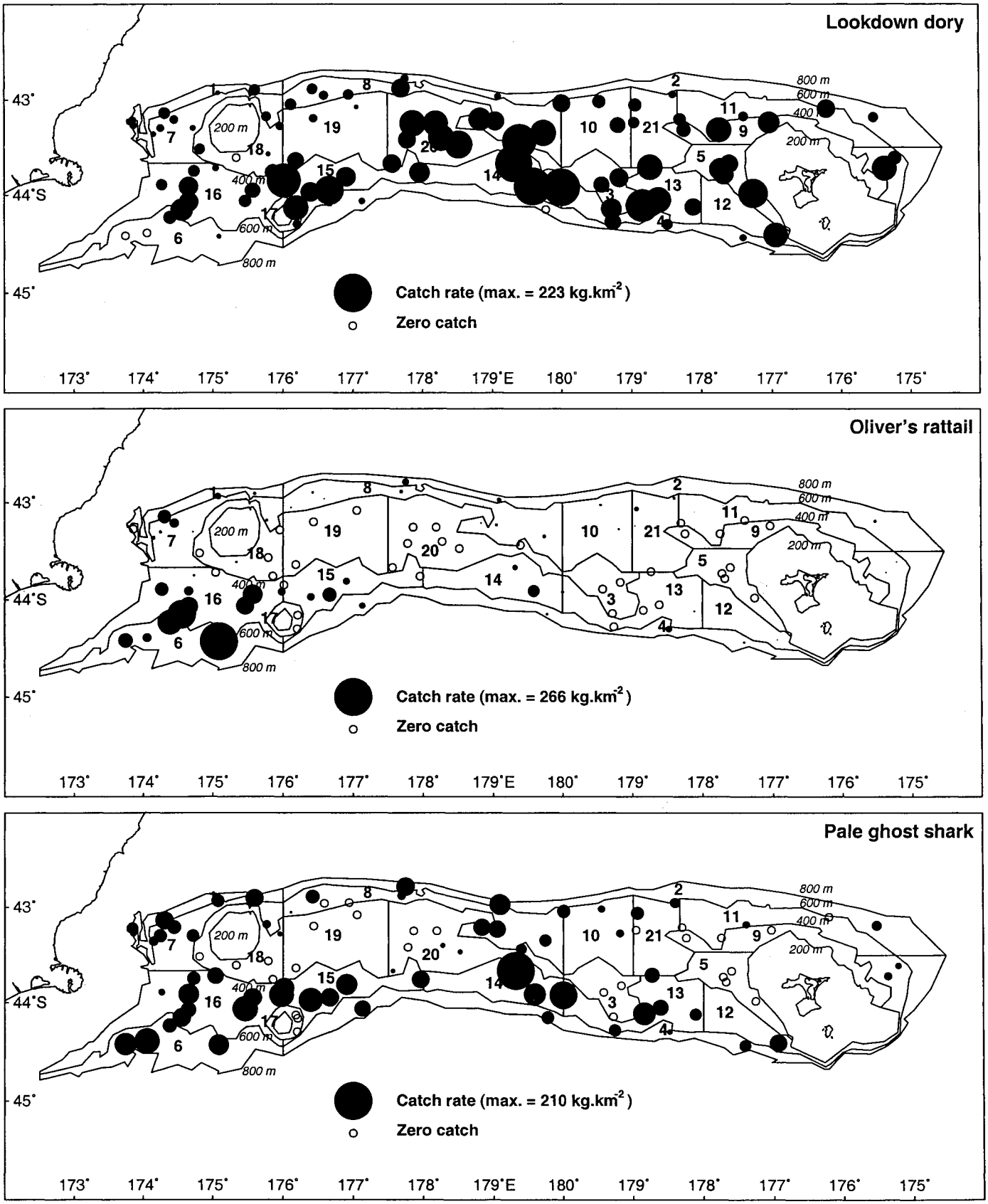



**Figure 4** — *continued*

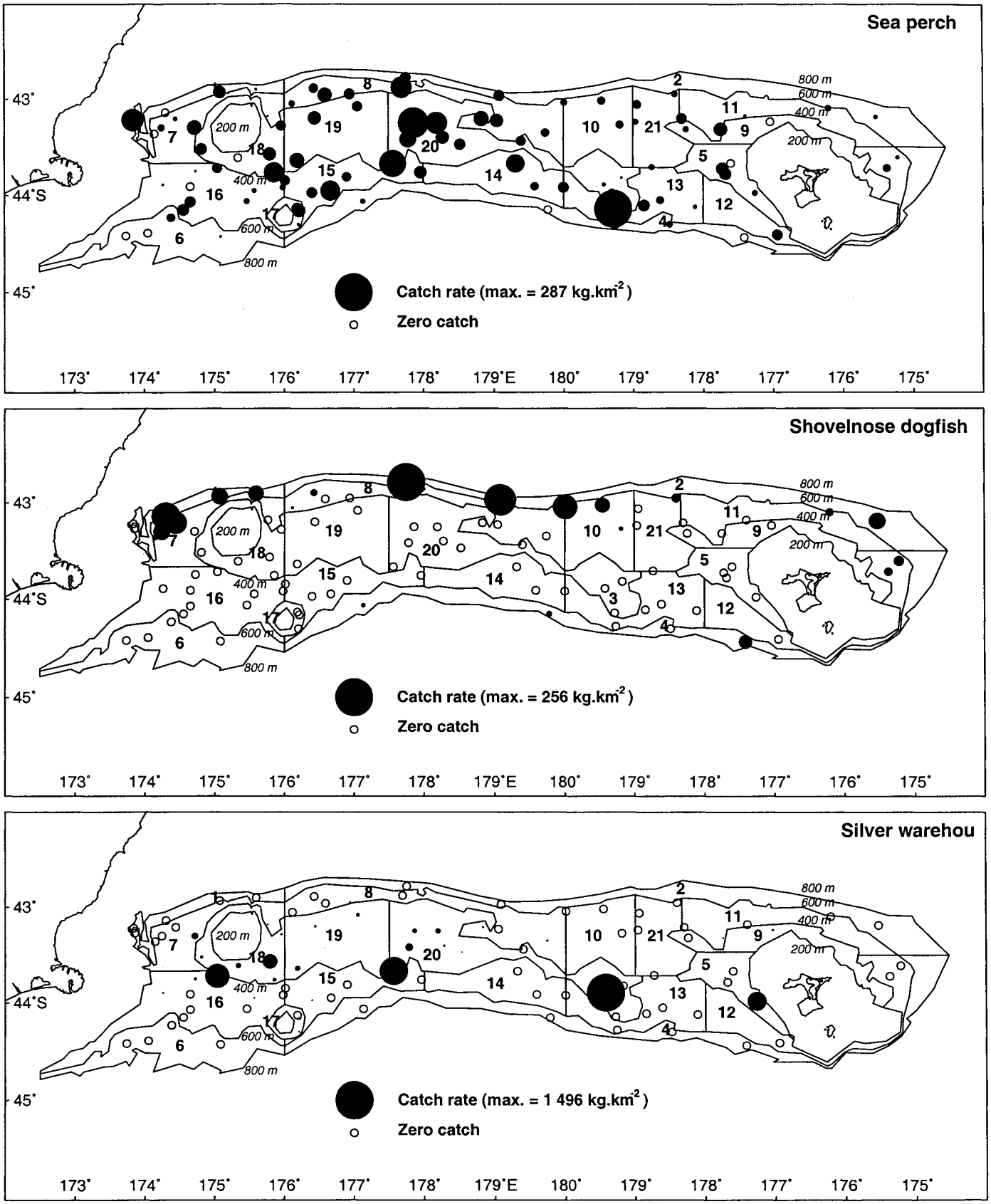



**Figure 4** — *continued*

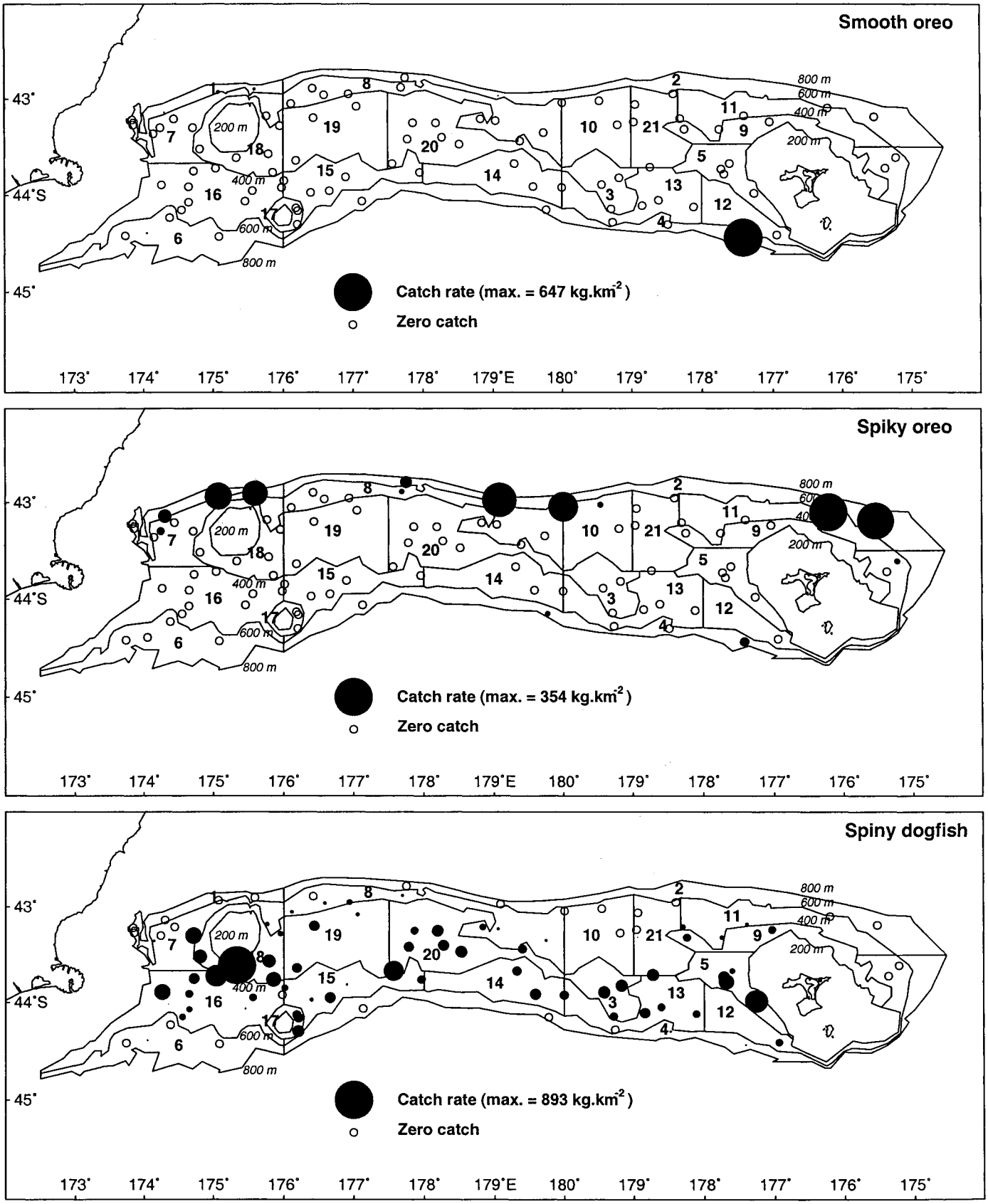



**Figure 4** — *continued*

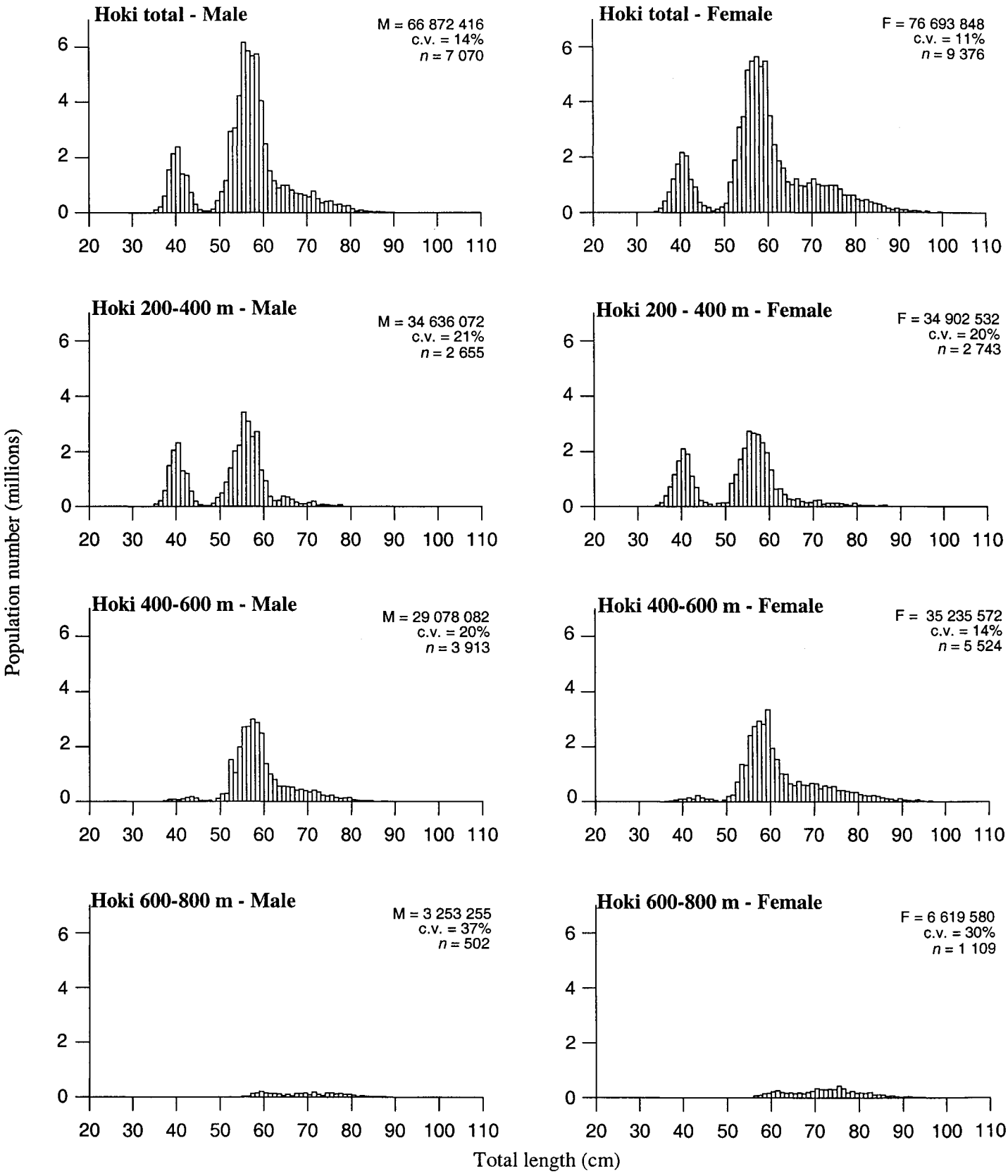



**Figure 5a: Scaled length frequencies for hoki, by sex and depth zone (200–400, 400–600, 600–800 m). (M, estimated male population; F, estimated female population; c.v., coefficient of variation of the estimated numbers of fish; *n*, number of fish measured).**

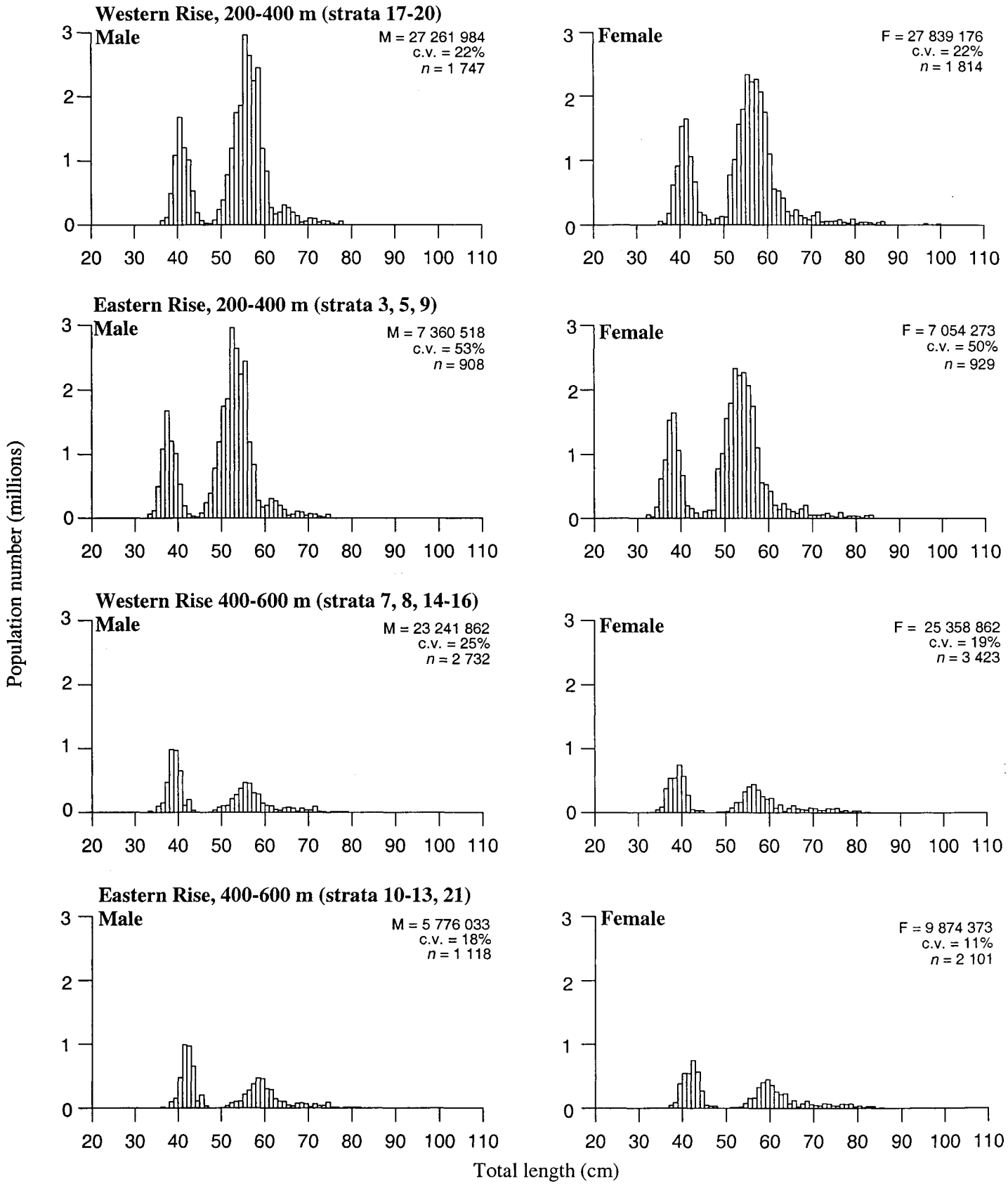



**Figure 5b: Scaled length frequencies for hoki, by sex, depth zone (200–400, 400–600 m), and area. (M, estimated male population; F, estimated female population; c.v., coefficient of variation of the estimated numbers of fish; *n*, number of fish measured).**

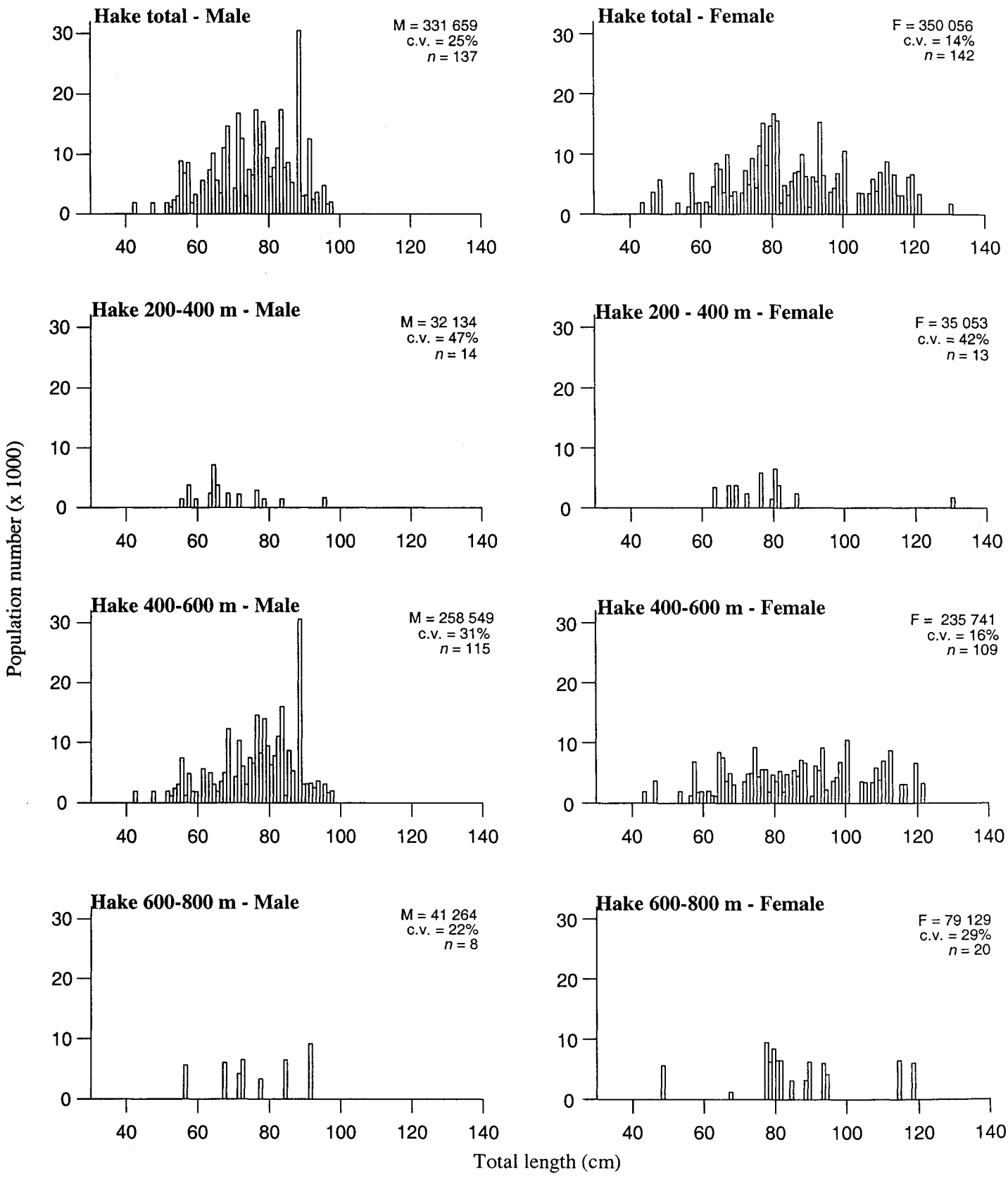



**Figure 6: Scaled length frequencies for hake, by sex and depth zone (200–400, 400–600, 600–800 m). (M, estimated male population; F, estimated female population; c.v., coefficient of variation of the estimated numbers of fish; *n*, number of fish measured).**

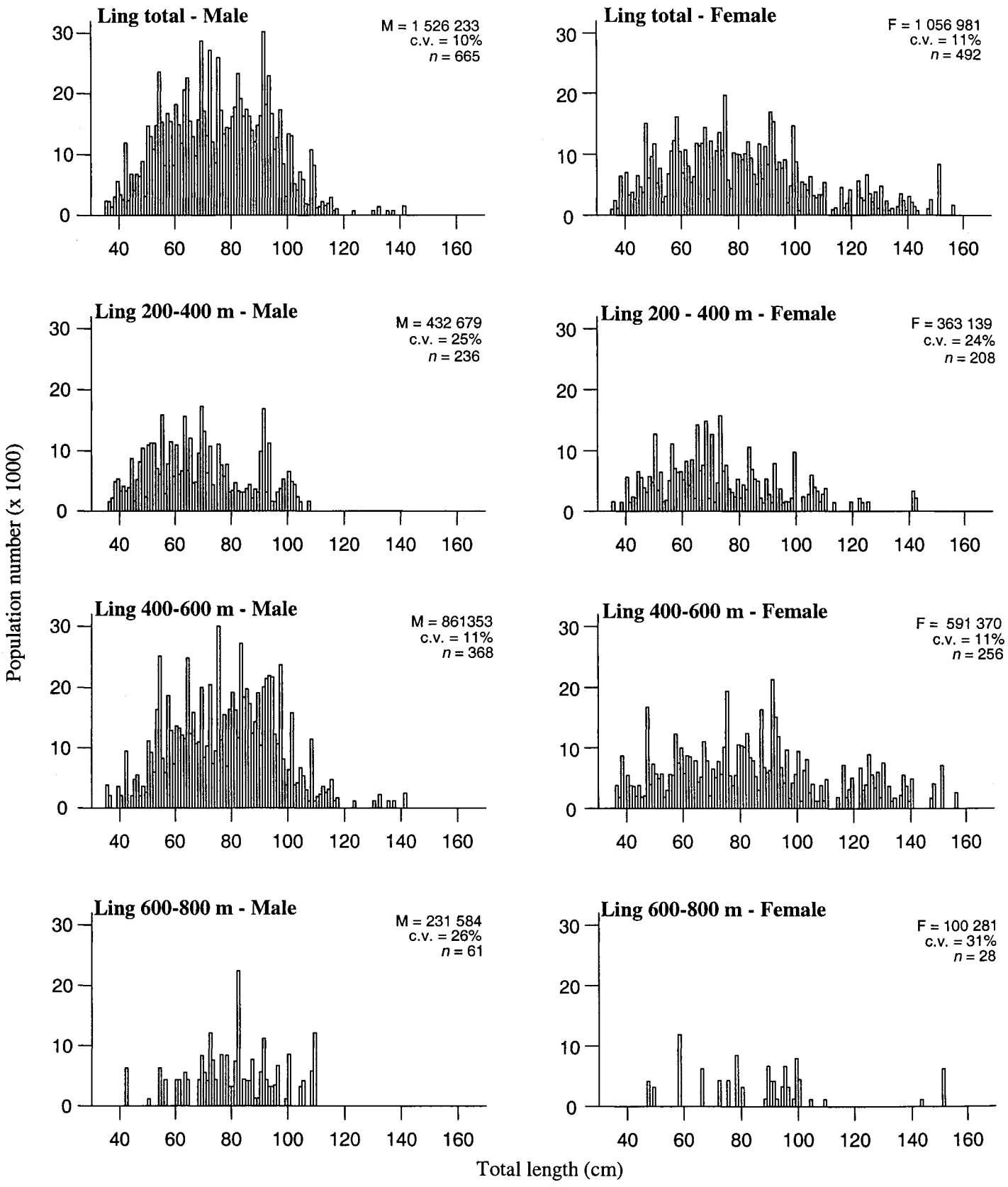



**Figure 7: Scaled length frequencies for ling, by sex and depth zone (200–400, 400–600, 600–800 m). (M, estimated male population; F, estimated female population; c.v., coefficient of variation of the estimated numbers of fish; *n*, number of fish measured).**

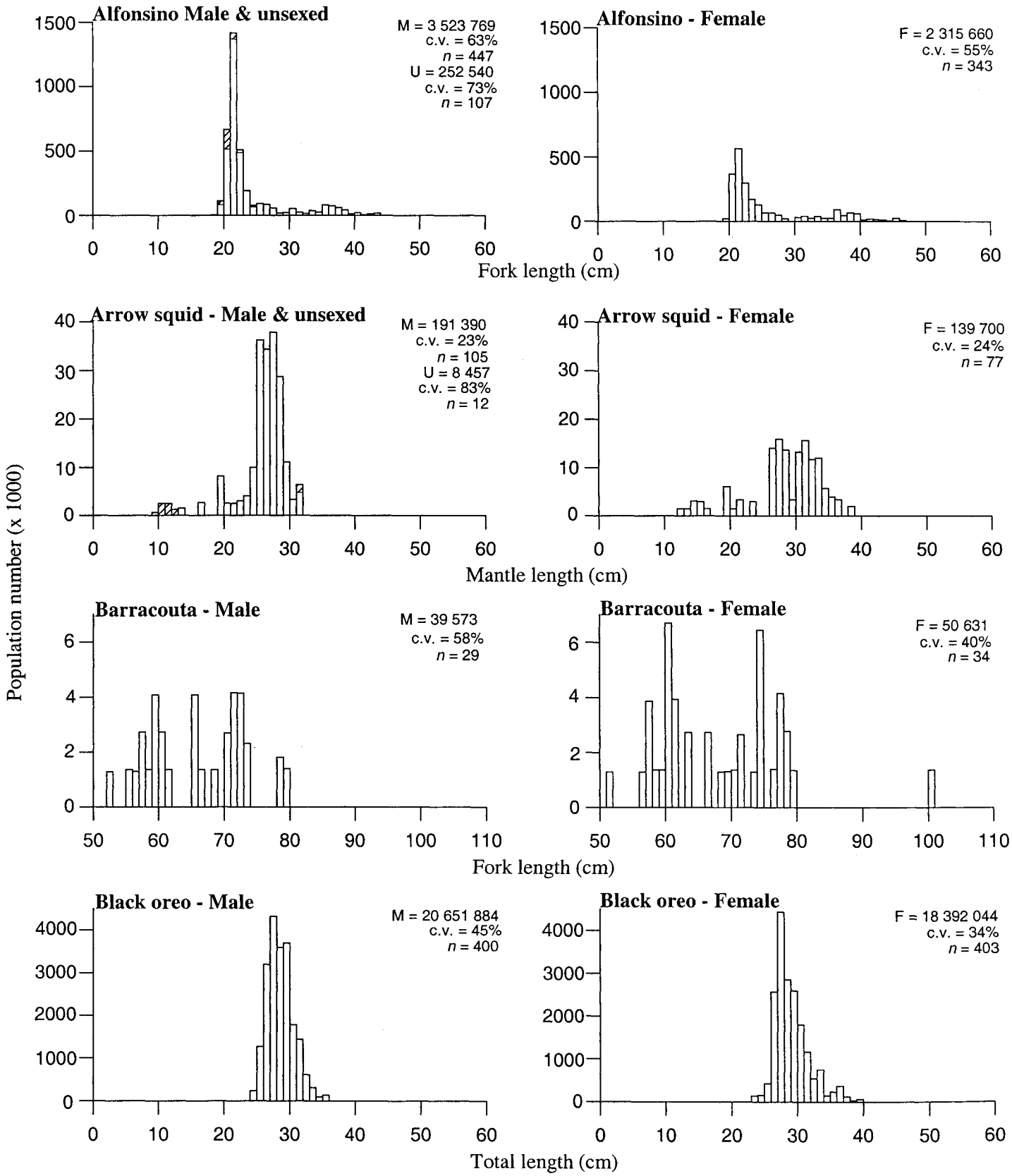



**Figure 8: Scaled length frequencies for the major species, by sex. (M, estimated male population; F, estimated female population; U, estimated unsexed population (hatched bars); c.v., coefficient of variation of the estimated numbers of fish; *n*, number of fish measured).**

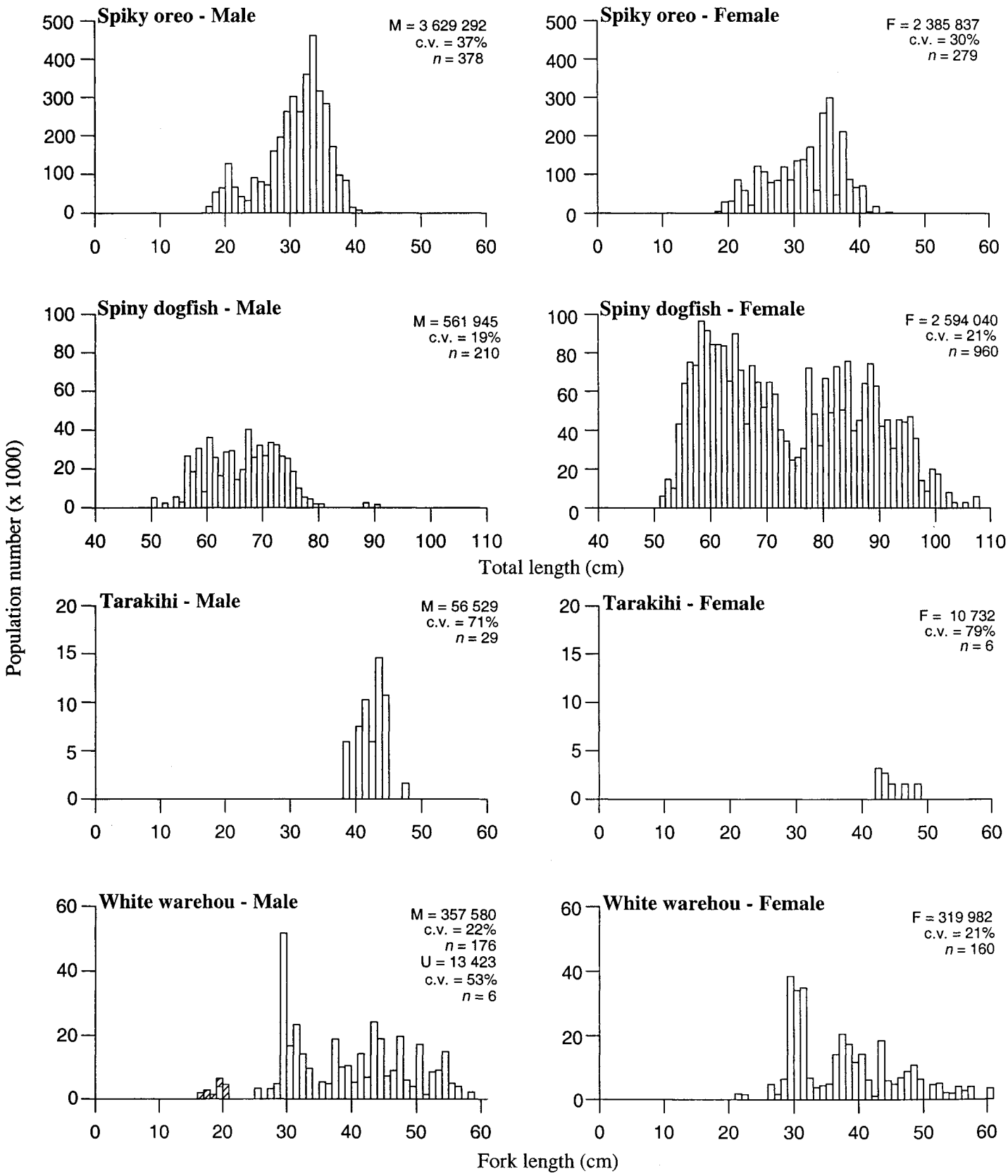



**Figure 8** — ***continued***

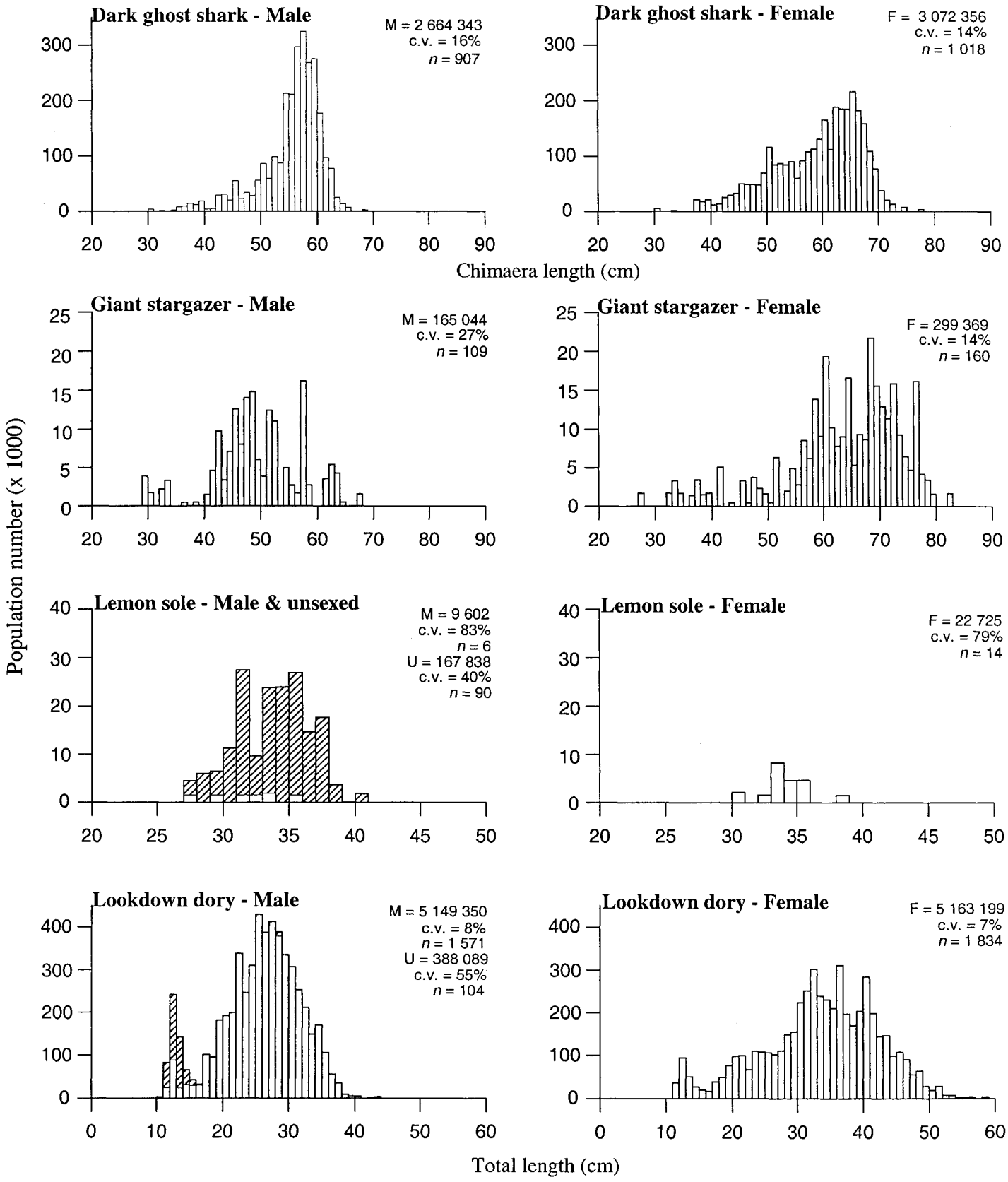



**Figure 8** — ***continued***

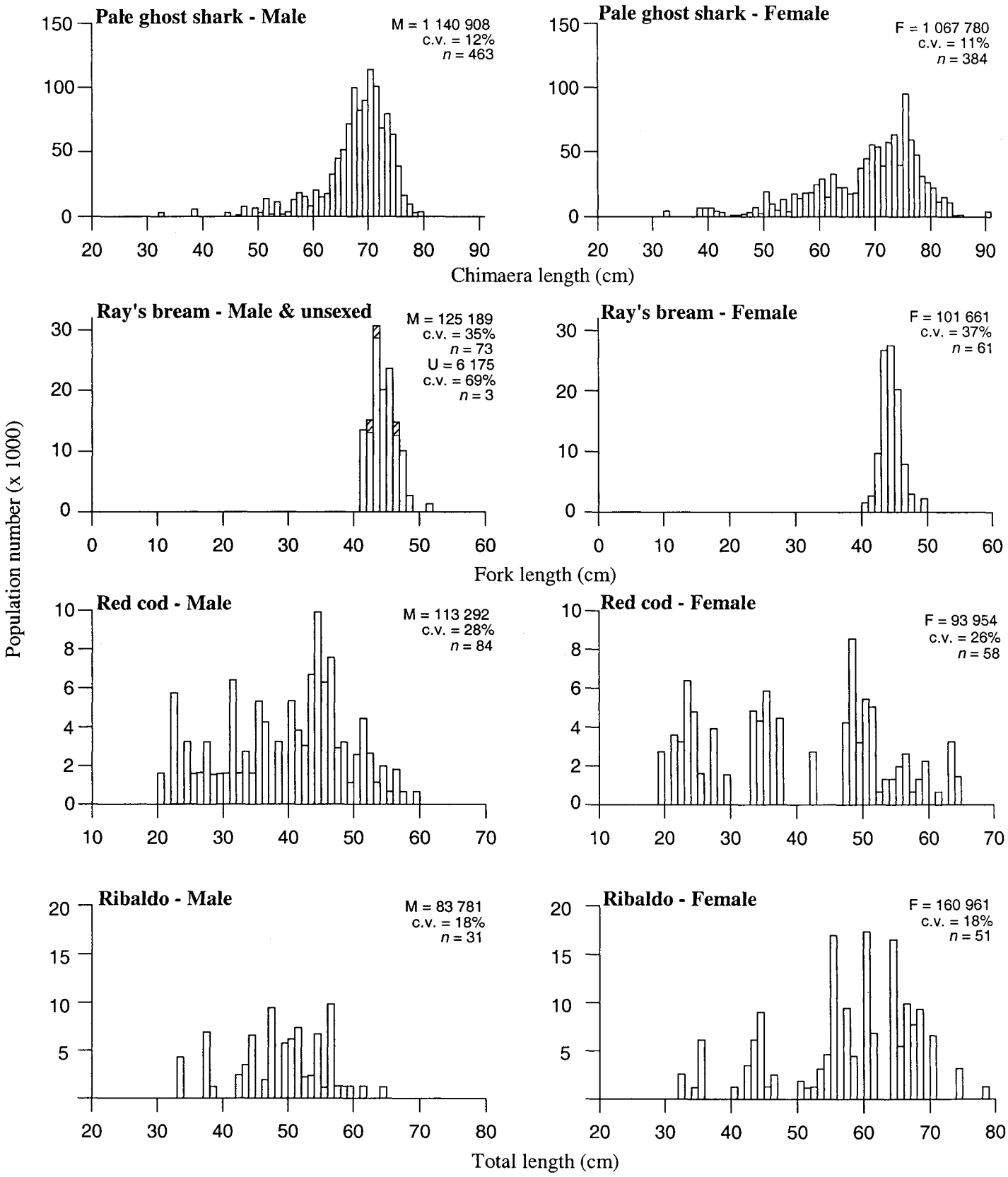



**Figure 8** — ***continued***

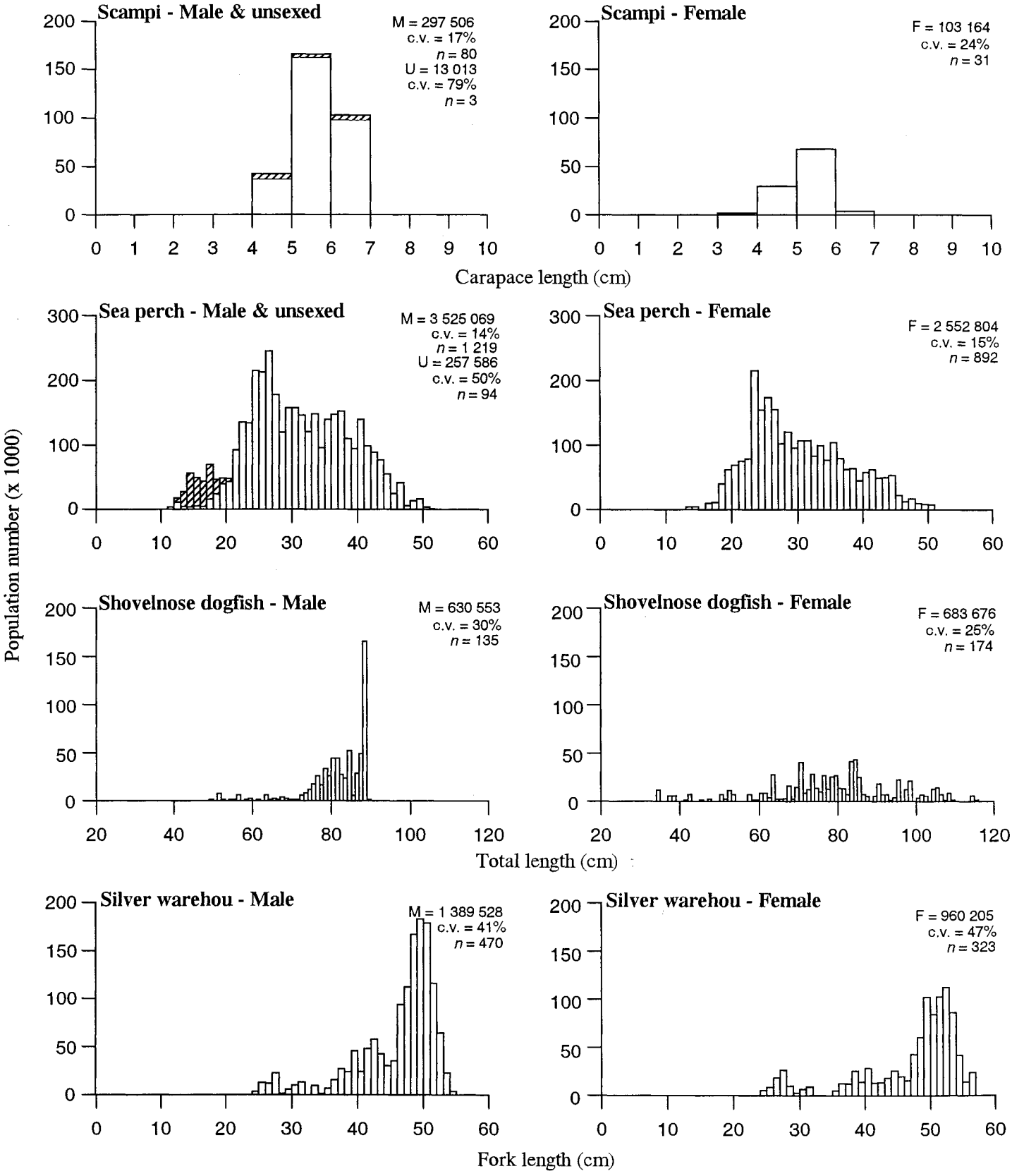



**Figure 8** — ***continued***

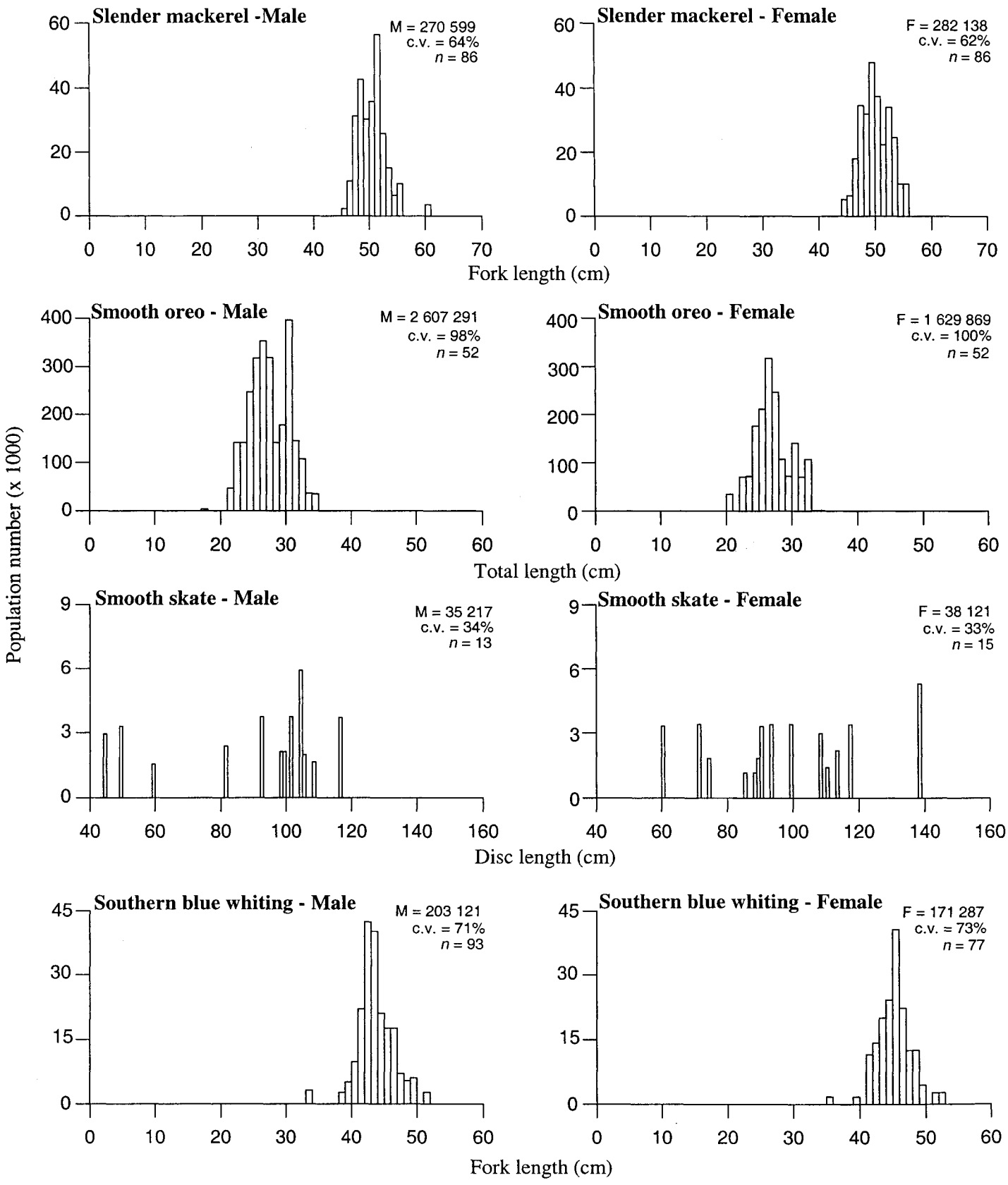



**Figure 8** — ***continued***

**Appendix 1: Individual station data from all stations attempted during the survey. BIO, trawl survey biomass stations; AC, acoustic bottom or midwater trawl stations**

| | | | Start of tow | | | | Depth (m) | | Dist. | Catch (kg) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type | Stn. | Stratum | Date | Time NZDT | Latitude ° ´S | Longitude ° ´ E/W | min. | max. | towed (n.mile) | Hoki | Hake | Ling |
| BIO | 1 | 0002 | 3 Jan 98 | 952 | 42 46.86' | 177 45.25' E | 709 | 743 | 3.02 | 99.7 | 2.3 | 8.3 |
| BIO | 2 | 0008 | 3 Jan 98 | 1307 | 42 52.69' | 177 41.56' E | 448 | 460 | 3.02 | 860.0 | 19.8 | 25.5 |
| BIO | 3 | 0020 | 3 Jan 98 | 1548 | 43 15.04' | 177 51.82' E | 302 | 308 | 3.02 | 578.7 | 0 | 0.9 |
| BIO | 4 | 0020 | 3 Jan 98 | 1807 | 43 15.26' | 178 11.44' E | 332 | 340 | 2.99 | 186.7 | 0 | 43.9 |
| BIO | 5 | 0002 | 4 Jan 98 | 454 | 42 58.08' | 179 05.70' E | 612 | 636 | 3.01 | 351.2 | 28.3 | 26.6 |
| BIO | 6 | 0008 | 4 Jan 98 | 847 | 43 12.74' | 178 49.69' E | 406 | 414 | 3.00 | 146.1 | 15.7 | 32.7 |
| BIO | 7 | 0008 | 4 Jan 98 | 1056 | 43 13.91' | 179 03.26' E | 425 | 437 | 3.00 | 542.4 | 11.3 | 61.1 |
| BIO | 8 | 0014 | 4 Jan 98 | 1440 | 43 40.10' | 179 18.97' E | 452 | 475 | 3.00 | 346.7 | 12.1 | 53.4 |
| BIO | 9 | 0014 | 4 Jan 98 | 1721 | 43 54.69' | 179 35.58' E | 503 | 509 | 2.97 | 145.4 | 19.9 | 16.3 |
| BIO | 10 | 0020 | 5 Jan 98 | 500 | 43 26.57' | 179 23.80' E | 394 | 399 | 2.98 | 525.8 | 11.1 | 38.4 |
| BIO | 11 | 0008 | 5 Jan 98 | 739 | 43 20.73' | 179 44.28' E | 462 | 469 | 3.01 | 213.9 | 26.7 | 37.0 |
| BIO | 12 | 0010 | 5 Jan 98 | 1058 | 43 02.28' | 179 59.14' W | 570 | 585 | 3.01 | 295.7 | 29.3 | 22.4 |
| BIO | 13 | 0010 | 5 Jan 98 | 1406 | 43 01.10' | 179 27.02' W | 534 | 535 | 3.00 | 130.8 | 59.0 | 8.2 |
| BIO | 14 | 0010 | 5 Jan 98 | 1659 | 43 16.06' | 179 11.62' W | 475 | 500 | 3.03 | 223.7 | 87.1 | 3.2 |
| BIO | 15 | 0021 | 5 Jan 98 | 1906 | 43 14.69' | 178 57.31' W | 467 | 482 | 2.00 | 37.1 | 140.6 | 8.0 |
| AC | 16 | | 6 Jan 98 | 127 | 43 14.75' | 178 57.54' W | 467 | 475 | 1.02 | 69.2 | 59.1 | 1.7 |
| BIO | 17 | 0021 | 6 Jan 98 | 432 | 43 03.38' | 178 56.37' W | 510 | 512 | 3.01 | 58.1 | 17.7 | 7.2 |
| BIO | 18 | 0021 | 6 Jan 98 | 753 | 42 57.06' | 178 23.79' W | 546 | 549 | 3.01 | 157.0 | 2.7 | 15.7 |
| BIO | 19 | 0011 | 6 Jan 98 | 1051 | 43 12.38' | 178 18.14' W | 419 | 430 | 3.01 | 160.6 | 0 | 6.9 |
| BIO | 20 | 0009 | 6 Jan 98 | 1241 | 43 19.14' | 178 14.20' W | 376 | 387 | 3.03 | 77.7 | 0 | 26.0 |
| BIO | 21 | 0009 | 6 Jan 98 | 1605 | 43 19.45' | 177 44.91' W | 343 | 369 | 2.98 | 107.8 | 0 | 0 |
| BIO | 22 | 0011 | 6 Jan 98 | 1843 | 43 10.91' | 177 24.29' W | 417 | 431 | 2.03 | 94.2 | 0 | 39.2 |
| BIO* | 23 | 0012 | 7 Jan 98 | 704 | 43 56.14' | 175 10.62' W | 492 | 505 | 1.00 | NR | NR | NR |
| BIO | 24 | 0012 | 7 Jan 98 | 821 | 43 43.47' | 175 22.15' W | 503 | 543 | 2.99 | 254.2 | 4.5 | 44.9 |
| BIO | 25 | 0012 | 7 Jan 98 | 1027 | 43 36.74' | 175 13.10' W | 570 | 579 | 3.00 | 199.2 | 45.8 | 56.8 |
| BIO | 26 | 0002 | 7 Jan 98 | 1423 | 43 11.58' | 175 32.07' W | 688 | 699 | 3.02 | 60.9 | 20.3 | 23.2 |
| BIO | 27 | 0011 | 7 Jan 98 | 1820 | 43 06.19' | 176 12.80' W | 548 | 562 | 3.01 | 220.5 | 17.0 | 19.1 |
| AC | 28 | | 7 Jan 98 | 123 | 43 15.19' | 177 94.19' W | 108 | 137 | 1.97 | 0 | 0 | 0 |
| AC | 29 | | 7 Jan 98 | 242 | 43 14.94' | 177 03.61' W | 172 | 200 | 1.37 | 0 | 0 | 0 |
| BIO | 30 | 0009 | 8 Jan 98 | 429 | 43 14.48' | 177 02.55' W | 310 | 327 | 3.02 | 818.9 | 0 | 31.6 |
| BIO | 31 | 0005 | 8 Jan 98 | 833 | 43 40.04' | 177 35.95' W | 373 | 388 | 3.02 | 158.0 | 0 | 32.5 |
| BIO | 32 | 0005 | 8 Jan 98 | 1013 | 43 43.79' | 177 43.06' W | 379 | 391 | 3.02 | 319.1 | 0 | 113.0 |
| BIO | 33 | 0005 | 8 Jan 98 | 1201 | 43 47.09' | 177 41.08' W | 384 | 390 | 3.00 | 329.9 | 0 | 121.8 |
| BIO | 34 | 0005 | 8 Jan 98 | 1455 | 43 58.60' | 177 15.65' W | 331 | 340 | 2.99 | 169.4 | 8.7 | 5.9 |
| BIO | 35 | 0012 | 9 Jan 98 | 435 | 44 24.43' | 176 56.14' W | 461 | 500 | 3.01 | 267.5 | 0 | 48.7 |
| BIO | 36 | 0004 | 9 Jan 98 | 814 | 44 26.33' | 177 24.76' W | 671 | 704 | 3.02 | 143.6 | 0 | 5.6 |
| BIO | 37 | 0013 | 9 Jan 98 | 1311 | 44 07.08' | 178 06.49' W | 482 | 484 | 3.00 | 445.7 | 5.6 | 108.8 |
| BIO | 38 | 0004 | 9 Jan 98 | 1737 | 44 17.86' | 178 28.87' W | 615 | 628 | 3.00 | 416.7 | 15.9 | 38.5 |
| AC | 39 | | 9 Jan 98 | 2127 | 44 17.56' | 178 25.60' W | 616 | 617 | 1.01 | 98.5 | 13.1 | 12.8 |
| BIO | 40 | 0013 | 10 Jan 98 | 513 | 44 16.82' | 179 15.79' W | 555 | 568 | 2.85 | 383.7 | 3.3 | 40.1 |
| BIO | 41 | 0003 | 10 Jan 98 | 745 | 44 08.52' | 179 16.63' W | 344 | 364 | 3.03 | 45.9 | 17.6 | 12.9 |
| BIO | 42 | 0013 | 10 Jan 98 | 1319 | 44 06.75' | 178 50.34' W | 448 | 454 | 2.23 | 366.7 | 0 | 81.7 |
| BIO | 43 | 0013 | 10 Jan 98 | 1637 | 44 03.08' | 178 36.82' W | 441 | 452 | 3.04 | 602.0 | 0 | 72.7 |
| BIO | 44 | 0021 | 11 Jan 98 | 458 | 43 42.39' | 178 43.53' W | 424 | 445 | 2.99 | 315.7 | 0 | 60.6 |
| BIO | 45 | 0003 | 11 Jan 98 | 756 | 43 49.03' | 179 10.10' W | 346 | 369 | 3.02 | 384.7 | 0 | 22.6 |
| BIO | 46 | 0003 | 11 Jan 98 | 1007 | 43 53.13' | 179 25.34' W | 284 | 307 | 3.03 | 408.5 | 0 | 0 |
| BIO | 47 | 0014 | 11 Jan 98 | 1350 | 43 55.29' | 180 00.00' W | 438 | 448 | 3.02 | 617.7 | 0 | 106.6 |

**Appendix 1 — *continued***

| Type | Stn. | Stratum | Start of tow Date | Time NZDT | Latitude ° ′S | Longitude ° ′E/W | Depth (m) min. | Depth (m) max. | Dist. towed (n.mile) | Catch (kg) Hoki | Catch (kg) Hake | Catch (kg) Ling |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIO | 48 | 0004 | 11 Jan 98 | 1740 | 44 09.20' | 179 46.55' E | 711 | 733 | 3.00 | 155.1 | 0 | 2.1 |
| BIO | 49 | 0020 | 12 Jan 98 | 508 | 43 28.49' | 178 31.10' E | 331 | 346 | 3.02 | 1002.0 | 0 | 54.7 |
| BIO | 50 | 0020 | 12 Jan 98 | 712 | 43 23.92' | 178 16.10' E | 336 | 346 | 3.05 | 236.6 | 2.9 | 14.8 |
| BIO | 51 | 0020 | 12 Jan 98 | 1029 | 43 25.32' | 177 47.06' E | 297 | 324 | 3.06 | 1279.4 | 2.5 | 6.4 |
| BIO | 52 | 0020 | 12 Jan 98 | 1345 | 43 40.15' | 177 33.49' E | 337 | 377 | 3.00 | 1123.8 | 0 | 17.7 |
| BIO | 53 | 0015 | 12 Jan 98 | 1648 | 43 45.33' | 177 57.31' E | 476 | 480 | 3.00 | 172.1 | 6.1 | 19.2 |
| AC | 54 | | 12 Jan 98 | 2202 | 43 34.10' | 178 02.84' E | 0 | 180 | 1.91 | 3.2 | 0 | 0 |
| AC | 55 | | 13 Jan 98 | 2205 | 43 56.80' | 177 26.13' E | 0 | 295 | 2.09 | 0 | 0 | 0 |
| AC | 56 | | 13 Jan 98 | 2340 | 43 57.79' | 177 25.25' E | 64 | 81 | 3.50 | 0 | 0 | 0 |
| AC | 57 | | 14 Jan 98 | 117 | 43 57.15' | 177 28.88' E | 0 | 122 | 2.23 | 0 | 0 | 0 |
| BIO | 58 | 0004 | 14 Jan 98 | 519 | 44 03.69' | 177 07.75' E | 670 | 686 | 3.02 | 248.3 | 0 | 49.7 |
| BIO | 59 | 0015 | 14 Jan 98 | 810 | 43 48.47' | 176 53.88' E | 485 | 490 | 2.93 | 116.2 | 0 | 17.1 |
| BIO | 60 | 0015 | 14 Jan 98 | 1052 | 43 57.25' | 176 39.37' E | 497 | 512 | 3.00 | 476.8 | 11.4 | 35.3 |
| BIO | 61 | 0017 | 14 Jan 98 | 1449 | 44 09.45' | 176 12.50' E | 289 | 368 | 2.92 | 243.5 | 0 | 0.9 |
| BIO | 62 | 0017 | 14 Jan 98 | 1734 | 44 18.18' | 176 12.19' E | 338 | 360 | 3.03 | 5.2 | 0 | 2.3 |
| BIO | 63 | 0017 | 14 Jan 98 | 1932 | 44 07.99' | 176 10.72' E | 345 | 382 | 2.07 | 3951.1 | 0 | 243.3 |
| AC | 64 | | 15 Jan 98 | 158 | 44 06.60' | 176 08.57' E | 340 | 343 | 0.54 | 79.4 | 0 | 7.2 |
| BIO | 65 | 0015 | 15 Jan 98 | 505 | 43 58.02' | 176 23.54' E | 511 | 532 | 3.05 | 155.1 | 8.8 | 80.5 |
| BIO | 66 | 0016 | 15 Jan 98 | 754 | 43 54.96' | 175 59.01' E | 512 | 554 | 3.02 | 132.3 | 13.0 | 53.9 |
| BIO | 67 | 0015 | 15 Jan 98 | 952 | 43 50.90' | 176 00.32' E | 446 | 476 | 3.02 | 223.3 | 38.3 | 77.4 |
| BIO | 68 | 0018 | 15 Jan 98 | 1213 | 43 45.80' | 175 50.85' E | 352 | 375 | 3.05 | 2594.0 | 0 | 7.1 |
| AC | 69 | | 15 Jan 98 | 1639 | 43 54.36' | 175 48.22' E | 385 | 421 | 2.55 | 1.2 | 0 | 0 |
| BIO | 70 | 0019 | 15 Jan 98 | 1841 | 43 38.42' | 176 10.95' E | 362 | 367 | 2.99 | 1602.4 | 3.8 | 56.5 |
| AC | 71 | | 15 Jan 98 | 2115 | 43 38.04' | 176 11.74' E | 334 | 346 | 2.00 | 18 | 0 | 0 |
| AC | 72 | | 15 Jan 98 | 2246 | 43 36.98' | 176 14.37' E | 146 | 164 | 1.99 | 0 | 0 | 0 |
| BIO | 73 | 0019 | 16 Jan 98 | 1040 | 43 11.89' | 176 25.57' E | 321 | 350 | 3.02 | 91.4 | 0 | 5.3 |
| BIO | 74 | 0008 | 16 Jan 98 | 1348 | 42 57.66' | 176 35.03' E | 430 | 441 | 3.05 | 153.4 | 7.1 | 30.6 |
| BIO | 75 | 0019 | 16 Jan 98 | 1619 | 42 57.13' | 176 56.66' E | 380 | 399 | 2.99 | 92.9 | 16.9 | 26.3 |
| BIO | 76 | 0019 | 16 Jan 98 | 1833 | 43 04.56' | 177 02.93' E | 291 | 331 | 2.98 | 323.0 | 3.3 | 2.0 |
| AC | 77 | | 16 Jan 98 | 2240 | 42 57.68' | 176 35.01' E | 440 | 441 | 0.99 | 57.9 | 5.0 | 4.3 |
| AC | 78 | | 17 Jan 98 | 21 | 42 57.12' | 176 35.36' E | 407 | 414 | 1.00 | 1.7 | 5.5 | 0 |
| AC | 79 | | 17 Jan 98 | 159 | 42 57.99' | 176 34.54' E | 230 | 253 | 1.50 | 0 | 0 | 0 |
| BIO | 80 | 0008 | 17 Jan 98 | 515 | 42 53.53' | 176 25.15' E | 486 | 521 | 3.00 | 534.2 | 17.4 | 22.2 |
| BIO | 81 | 0008 | 17 Jan 98 | 804 | 43 03.02' | 176 06.35' E | 454 | 473 | 3.03 | 220.4 | 32.8 | 44.4 |
| BIO | 82 | 0018 | 17 Jan 98 | 1036 | 43 16.54' | 175 56.88' E | 365 | 394 | 2.85 | 250.3 | 25.7 | 40.6 |
| BIO | 83 | 0007 | 17 Jan 98 | 1238 | 43 10.82' | 175 45.61' E | 449 | 451 | 3.01 | 1440.5 | 85.0 | 121.7 |
| BIO | 84 | 0001 | 17 Jan 98 | 1530 | 42 53.87' | 175 35.53' E | 612 | 623 | 3.02 | 90.4 | 0 | 22.4 |
| BIO | 85 | 0001 | 17 Jan 98 | 1859 | 42 55.51' | 175 04.26' E | 615 | 638 | 3.03 | 70.8 | 0 | 14.7 |
| BIO | 86 | 0007 | 18 Jan 98 | 530 | 43 16.31' | 173 50.84' E | 433 | 463 | 3.02 | 809.9 | 3.7 | 6.4 |
| BIO | 87 | 0007 | 18 Jan 98 | 727 | 43 13.50' | 173 50.51' E | 519 | 554 | 2.78 | 196.9 | 7.0 | 7.4 |
| BIO | 88 | 0007 | 18 Jan 98 | 951 | 43 21.71' | 174 08.40' E | 572 | 572 | 2.99 | 866.8 | 8.8 | 34.5 |
| BIO | 89 | 0007 | 18 Jan 98 | 1146 | 43 18.16' | 174 14.61' E | 583 | 591 | 3.02 | 1403.7 | 11.7 | 18.1 |
| BIO | 90 | 0001 | 18 Jan 98 | 1356 | 43 08.57' | 174 17.81' E | 611 | 616 | 3.02 | 128.9 | 2.0 | 44.3 |
| BIO | 91 | 0007 | 18 Jan 98 | 1601 | 43 12.80' | 174 26.28' E | 564 | 572 | 3.00 | 122.5 | 21.2 | 147.5 |
| BIO | 92 | 0007 | 18 Jan 98 | 1856 | 43 18.00' | 174 42.88' E | 407 | 418 | 2.99 | 2408.1 | 21.1 | 34.7 |
| AC | 93 | | 19 Jan 98 | 54 | 43 21.67' | 174 41.68' E | 363 | 384 | 1.52 | 6.6 | 0 | 6.0 |
| BIO | 94 | 0018 | 19 Jan 98 | 519 | 43 31.27' | 174 48.84' E | 348 | 362 | 2.99 | 544.2 | 0 | 29.7 |
| BIO | 95 | 0016 | 19 Jan 98 | 740 | 43 43.47' | 175 02.41' E | 414 | 428 | 3.01 | 2816.6 | 3.5 | 17.0 |
| BIO | 96 | 0016 | 19 Jan 98 | 1036 | 43 45.28' | 174 43.33' E | 491 | 511 | 3.01 | 249.9 | 18.8 | 31.7 |

**Appendix 1 — *continued***

| Type | Stn. | Stratum | Date | Start of tow Time NZDT | Latitude ° ′S | Longitude ° ′ E/W | Depth (m) min. | Depth (m) max. | Dist. towed (n.mile) | Catch (kg) Hoki | Catch (kg) Hake | Catch (kg) Ling |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIO | 97 | 0016 | 19 Jan 98 | 1251 | 43 54.45' | 174 39.00' E | 512 | 517 | 3.03 | 484.5 | 27.9 | 41.8 |
| BIO | 98 | 0016 | 19 Jan 98 | 1459 | 44 04.29' | 174 38.81' E | 529 | 541 | 2.99 | 1256.5 | 25.5 | 142.4 |
| BIO | 99 | 0016 | 19 Jan 98 | 1833 | 43 53.57' | 174 15.51' E | 500 | 506 | 2.76 | 209.6 | 0 | 19.0 |
| BIO | 100 | 0006 | 20 Jan 98 | 526 | 44 25.05' | 173 44.65' E | 700 | 711 | 2.99 | 94.5 | 7.4 | 9.7 |
| BIO | 101 | 0006 | 20 Jan 98 | 746 | 44 23.50' | 174 03.20' E | 703 | 706 | 3.02 | 109.1 | 8.5 | 7.8 |
| BIO | 102 | 0006 | 20 Jan 98 | 1027 | 44 14.06' | 174 22.74' E | 600 | 607 | 3.00 | 810.1 | 3.4 | 27.5 |
| BIO | 103 | 0016 | 20 Jan 98 | 1230 | 44 08.84' | 174 33.08' E | 560 | 574 | 3.01 | 436.5 | 7.3 | 58.7 |
| BIO* | 104 | 0006 | 21 Jan 98 | 1600 | 44 25.46' | 175 01.02' E | 652 | 665 | 3.00 | NR | NR | NR |
| BIO | 105 | 0006 | 20 Jan 98 | 1800 | 44 26.02' | 175 04.86' E | 667 | 672 | 2.99 | 112.8 | 35.1 | 24.7 |
| AC | 106 | | 21 Jan 98 | 319 | 44 01.67' | 175 29.98' E | 440 | 480 | 3.03 | 8.1 | 0 | 2.3 |
| BIO | 107 | 0016 | 21 Jan 98 | 517 | 44 03.62' | 175 27.87' E | 502 | 512 | 2.98 | 590.4 | 0 | 47.0 |
| BIO* | 108 | 0016 | 21 Jan 98 | 708 | 43 57.19' | 175 32.90' E | 476 | 501 | 2.00 | NR | NR | NR |
| BIO | 109 | 0016 | 21 Jan 98 | 916 | 43 57.10' | 175 33.77' E | 474 | 498 | 2.02 | 485.9 | 0 | 50.1 |
| BIO | 110 | 0018 | 21 Jan 98 | 1230 | 43 36.51' | 175 19.76' E | 229 | 248 | 3.01 | 6.8 | 0 | 0 |
| BIO | 111 | 0018 | 21 Jan 98 | 1504 | 43 34.08' | 175 47.24' E | 273 | 287 | 2.98 | 791.9 | 0 | 0.2 |
| AC | 112 | | 21 Jan 98 | 1817 | 43 30.26' | 175 49.28' E | 200 | 228 | 2.09 | 0 | 0 | 0 |
| AC | 113 | | 21 Jan 98 | 1935 | 43 31.11' | 175 49.95' E | 217 | 250 | 2.01 | 1.7 | 0 | 0 |
| AC | 114 | | 22 Jan 98 | 51 | 43 29.58' | 175 48.47' E | 235 | 259 | 2.99 | 11.1 | 0 | 0 |
| AC | 115 | | 22 Jan 98 | 228 | 43 32.79' | 175 51.51' E | 144 | 162 | 3.07 | 1.5 | 0 | 0 |
| AC | 116 | | 22 Jan 98 | 1349 | 43 49.55' | 175 36.57' E | 380 | 430 | 3.79 | 47.2 | 0 | 0 |
| AC | 117 | | 22 Jan 98 | 1648 | 43 49.26' | 175 36.92' E | 300 | 400 | 2.78 | 98.5 | 0 | 0 |
| AC | 118 | | 22 Jan 98 | 1903 | 43 51.10' | 175 40.42' E | 300 | 317 | 2.22 | 0 | 0 | 0 |
| AC | 119 | | 23 Jan 98 | 432 | 43 43.74' | 175 46.07' E | 180 | 202 | 1.00 | 0.8 | 0 | 0 |
| AC | 120 | | 23 Jan 98 | 536 | 43 48.75' | 175 44.17' E | 224 | 317 | 2.38 | 1.2 | 0 | 0 |
| AC | 121 | | 23 Jan 98 | 720 | 43 49.57' | 175 43.37' E | 305 | 413 | 2.04 | 160.2 | 0 | 0 |
| AC | 122 | | 23 Jan 98 | 2102 | 43 18.88' | 174 50.84' E | 130 | 223 | 2.67 | 0.4 | 0 | 0 |
| AC | 123 | | 23 Jan 98 | 2259 | 43 19.35' | 174 56.32' E | 119 | 212 | 4.65 | 2.1 | 0 | 0 |
| AC | 124 | | 24 Jan 98 | 207 | 43 25.13' | 174 52.29' E | 150 | 269 | 2.11 | 8.1 | 0 | 0.8 |
| AC | 125 | | 24 Jan 98 | 1126 | 43 24.15' | 174 41.92' E | 141 | 153 | 1.84 | 0 | 0 | 0 |
| AC | 126 | | 24 Jan 98 | 1256 | 43 28.04' | 174 41.76' E | 210 | 243 | 0.98 | 0 | 0 | 0 |
| AC | 127 | | 24 Jan 98 | 1411 | 43 27.85' | 174 40.18' E | 234 | 250 | 1.06 | 0 | 0 | 0 |
| AC | 128 | | 24 Jan 98 | 1526 | 43 28.36' | 174 40.48' E | 300 | 335 | 1.77 | 2.5 | 0 | 0 |
| AC | 129 | | 24 Jan 98 | 1915 | 43 30.40' | 174 39.53' E | 163 | 172 | 0.30 | 0 | 0 | 0 |
| AC | 130 | | 24 Jan 98 | 2033 | 43 32.01' | 174 40.15' E | 160 | 179 | 0.79 | 12.5 | 0 | 0 |

* Foul trawl station
NR Catch not recorded on foul trawl stations

**Appendix 2: Scientific and common names and species codes of fish, squid, and other organisms caught during the voyage. The occurrence (Occ.) of each species in the 91 successful biomass tows is also shown**

| Scientific name | Common name | Code | Occ. |
|---|---|---|---|
| **Agnatha** | | | |
| Myxinidae: hagfishes | | | |
| *Eptatretus cirrhatus* | hagfish | HAG | 2 |
| **Chondrichthyes** | | | |
| Squalidae: dogfishes | | | |
| *Centrophorus squamosus* | deepwater spiny dogfish | CSQ | 4 |
| *Centroscymnus crepidater* | longnosedvelvet dogfish | CYP | 4 |
| *C. plunketi* | Plunket's shark | PLS | 4 |
| *Deania calcea* | shovelnose dogfish | SND | 22 |
| *Etmopterus baxteri* | Baxter's dogfish | ETB | 13 |
| *E. lucifer* | Lucifer dogfish | ETL | 59 |
| *Scymnorhinus licha* | seal shark | BSH | 26 |
| *Squalus acanthias* | spiny dogfish | SPD | 64 |
| *S. mitsukurii* | northern spiny dogfish | NSD | 5 |
| Oxynotidae: rough sharks | | | |
| *Oxynotus bruniensis* | prickly dogfish | PDG | 7 |
| Lamnidae: mackerel sharks | | | |
| *Lamna nasus* | porbeagle shark | POS | 1 |
| Scyliorhinidae: cat sharks | | | |
| *Apristurus* spp. | deepsea catsharks | APR | 5 |
| *Cephaloscyllium isabellum* | carpet shark | CAR | 1 |
| *Halaelurus dawsoni* | Dawson's catshark | DCS | 5 |
| Triakidae: smoothhounds | | | |
| *Galeorhinus galeus* | school shark | SCH | 5 |
| Torpedinidae: electric rays | | | |
| *Torpedo fairchildi* | electric ray | ERA | 1 |
| Narkidae: blind electric rays | | | |
| *Typhlonarke* sp. | numbfish | BER | 2 |
| Rajidae: skates | | | |
| *Pavoraja asperula* | smooth bluntnosed skate | BTA | 17 |
| *P. spinifera* | prickly bluntnosed skate | BTS | 3 |
| *Raja innominata* | smooth skate | SSK | 22 |
| *R. nasuta* | rough skate | RSK | 1 |
| Chimaeridae: chimaeras, ghost sharks | | | |
| *Hydrolagus novaezelandiae* | dark ghost shark | GSH | 42 |
| *Hydrolagus* sp. B | pale ghost shark | GSP | 63 |
| Rhinochimaeridae: longnosed chimaeras | | | |
| *Chimaera* sp. | brown chimaera | CHP | 1 |
| *Harriotta raleighana* | longnose chimaera | LCH | 35 |
| *Rhinochimaera pacifica* | widenose chimaera | RCH | 2 |
| **Osteichthyes** | | | |
| Notacanthidae: spiny eels | | | |
| *Notacanthus sexspinis* | spineback | SBK | 33 |
| Synaphobranchidae: cutthroat eels | | | |
| *Diastobranchus capensis* | basketwork eel | BEE | 1 |
| Congridae: conger eels | | | |
| *Bassanago bulbiceps* | swollenheaded conger | SCO | 28 |
| *B. hirsutus* | hairy conger | HCO | 25 |
| Gonorynchidae: sandfish | | | |
| *Gonorynchus gonorynchus* | sandfish | GON | 1 |
| Argentinidae: silversides | | | |
| *Argentina elongata* | silverside | SSI | 45 |

**Appendix 2 — *continued***

| Scientific name | Common name | Code | Occ. |
|---|---|---|---|
| Alepocephalidae: slickheads | | | |
| *Xenodermichthys socialis* | black slickhead | BSL | 1 |
| Gonostomatidae: lightfishes | | | |
| *Gonostoma elongatum* | elongate lightfish | GEL | 1 |
| Sternoptychidae: hatchetfishes | | | |
| *Argyropelecus* spp. | hatchetfish | HAT | 1 |
| Photichthyidae: lighthouse fishes | | | |
| *Photichthys argenteus* | lighthouse fish | PHO | 2 |
| Paralepididae: barracudinas | | | |
| *Magnisudis prionosa* | barracudina | BCA | 1 |
| Myctophidae: lanternfishes | | | |
| Species not identified | lanternfish | LAN | 3 |
| *Lampanyctus* spp. | lanternfish | LPA | 1 |
| Moridae: morid cods | | | |
| *Austrophycis marginata* | dwarf cod | DCO | 9 |
| *Halargyreus johnsoni* | slender cod | HJO | 4 |
| *Lepidion microcephalus* | small headed cod | SMC | 1 |
| *Lotella rhacinus* | rock cod | ROC | 1 |
| *Mora moro* | ribaldo | RIB | 30 |
| *Pseudophycis bachus* | red cod | RCO | 24 |
| Gadidae: true cods | | | |
| *Micromesistius australis* | southern blue whiting | SBW | 3 |
| Merlucciidae: hakes | | | |
| *Macruronus novaezelandiae* | hoki | HOK | 91 |
| *Merluccius australis* | hake | HAK | 55 |
| Macrouridae: rattails, grenadiers | | | |
| *Caelorinchus aspercephalus* | obliquebanded rattail | CAS | 52 |
| *C. biclinozonalis* | two saddle rattail | CBI | 4 |
| *C. bollonsi* | bigeyed rattail | CBO | 84 |
| *C. fasciatus* | banded rattail | CFA | 34 |
| *C. innotabilis* | notable rattail | CIN | 3 |
| *C. matamua* | Mahia rattail | CMA | 2 |
| *C. oliverianus* | Oliver's rattail | COL | 55 |
| *C. parvifasciatus* | small banded rattail | CCX | 8 |
| *Coryphaenoides serrulatus* | serrulate rattail | CSE | 2 |
| *C . subserrulatus* | fourrayed rattail | CSU | 1 |
| *Coryphaenoides* sp. B | long barbel rattail | CBA | 7 |
| *Lepidorhynchus denticulatus* | javelinfish | JAV | 87 |
| *Trachyrincus aphyodes* | unicorn rattail | WHX | 3 |
| *Ventrifossa nigromaculata* | blackspot rattail | VNI | 12 |
| Ophidiidae: cusk eels | | | |
| *Genypterus blacodes* | ling | LIN | 88 |
| Ceratiidae: seadevil | | | |
| *Cryptopsaras couesi* | seadevil | SDE | 2 |
| Himantolophidae: prickly anglerfishes | | | |
| *Himantolophus appelii* | prickly anglerfish | HIA | 1 |
| Trachipteridae: dealfishes | | | |
| *Trachipterus trachypterus* | dealfish | DEA | 1 |
| Trachichthyidae: roughies | | | |
| *Hoplostethus mediterraneus* | silver roughy | SRH | 20 |
| *Paratrachichthys trailli* | common roughy | RHY | 10 |
| Berycidae: alfonsinos | | | |
| *Beryx splendens* | slender beryx | BYS | 33 |
| *B. decadactylus* | longfinned beryx | BYD | 1 |

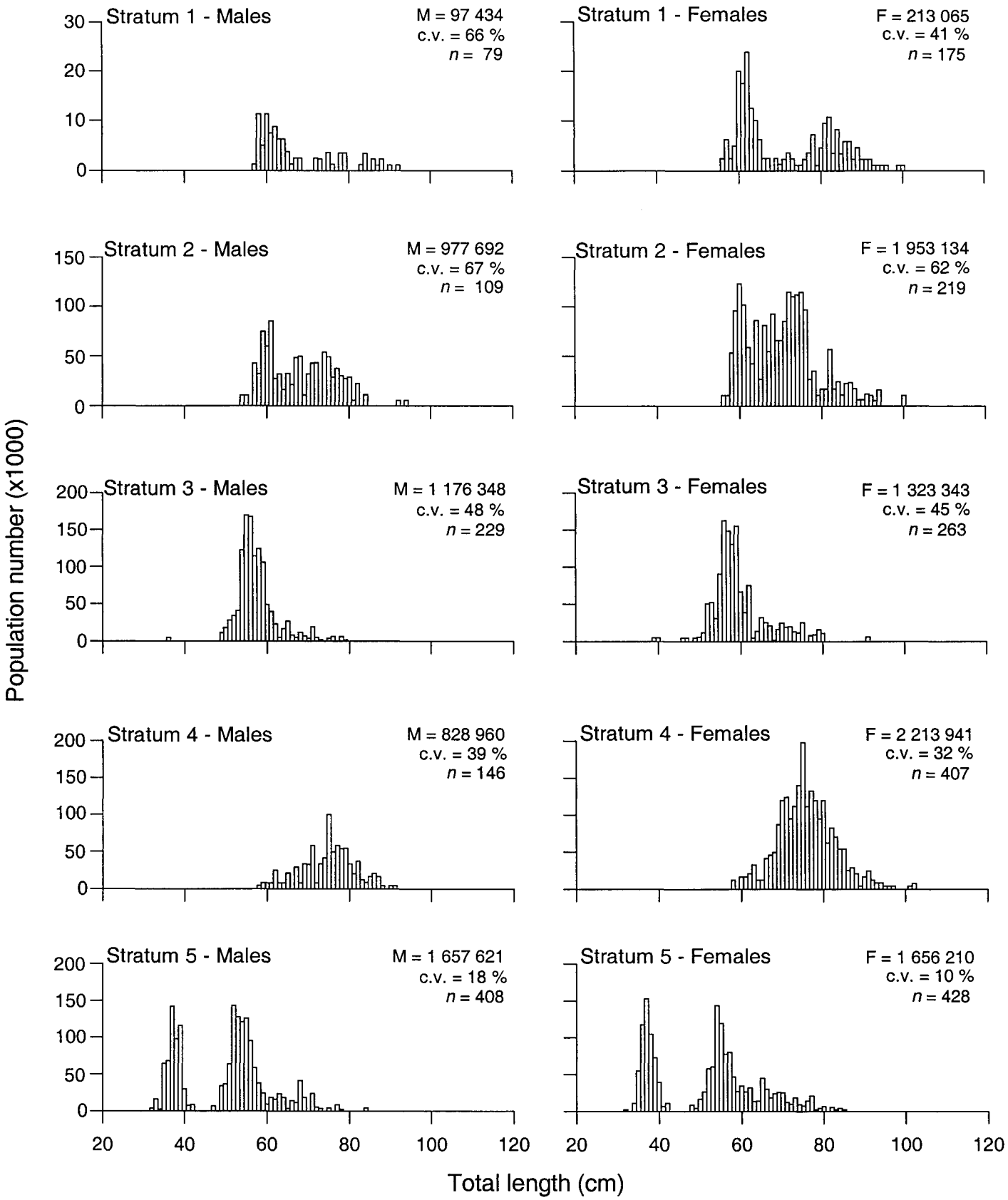
**Appendix 2 — *continued***

| Scientific name | Common name | Code | Occ. |
|---|---|---|---|
| Zeidae: dories | | | |
| *Capromimus abbreviatus* | capro dory | CDO | 7 |
| *Cyttus novaezelandiae* | silver dory | SDO | 12 |
| *C. traversi* | lookdown dory | LDO | 87 |
| Oreosomatidae: oreos | | | |
| *Allocyttus niger* | black oreo | BOE | 8 |
| *Neocyttus rhomboidalis* | spiky oreo | SOR | 14 |
| *Pseudocyttus maculatus* | smooth oreo | SSO | 6 |
| Macrorhamphosidae: snipefishes | | | |
| *Centriscops obliquus* | redbanded bellowsfish | BBE | 54 |
| Scorpaenidae: scorpionfishes | | | |
| *Helicolenus* spp. | sea perch | SPE | 81 |
| Congiopodidae: pigfishes | | | |
| *Congiopodus leucopaecilus* | southern pigfish | PIG | 2 |
| Triglidea: gurnards | | | |
| *Lepidotrigla brachyoptera* | scaly gurnard | SCG | 4 |
| Hoplichthyidae: ghostflatheads | | | |
| *Hoplichthys haswelli* | deepsea flathead | FHD | 32 |
| Psychrolutidae: toadfishes | | | |
| *Neophrynichthys angustus* | pale toadfish | TOP | 29 |
| *N. latus* | dark toadfish | TOD | 1 |
| *Psychrolutes* sp. | blobfish | PSY | 1 |
| Percichthyidae: temperate basses | | | |
| *Polyprion oxygeneios* | hapuku | HAP | 2 |
| Serranidae: sea perches | | | |
| *Lepidoperca aurantia* | orange perch | OPE | 12 |
| Apogonidae: cardinalfishes | | | |
| *Epigonus robustus* | cardinalfish | EPR | 10 |
| *E. telescopus* | black cardinalfish | EPT | 3 |
| Carangidae: jacks, trevallies, kingfishes | | | |
| *Trachurus murphyi* | slender mackerel | JMM | 11 |
| *T. declivis* | jack mackerel | JMD | 2 |
| Bramidae: pomfrets | | | |
| *Brama brama* | Ray's bream | RBM | 25 |
| *Taraticththys longipinnis* | big scaled pomfret | BSP | 2 |
| Emmelichthyidae: bonnetmouths, rovers | | | |
| *Plagiogeneion rubiginosus* | rubyfish | RBY | 1 |
| Pentacerotidae: boarfishes, armourheads | | | |
| *Pentaceros decacanthus* | yellow boarfish | YBO | 2 |
| Cheilodactylidae: tarakihi, morwongs | | | |
| *Nemadactylus macropterus* | tarakihi | TAR | 2 |
| *Latris lineata* | trumpeter | TRU | 1 |
| Uranoscopidae: armourhead stargazers | | | |
| *Kathetostoma giganteum* | giant stargazer | STA | 52 |
| *Kathetostoma* sp. | banded giant stargazer | BGZ | 2 |
| Gempylidae: snake mackerels | | | |
| *Thyrsites atun* | barracouta | BAR | 8 |
| Trichiuridae: cutlassfishes | | | |
| *Lepidopus caudatus.* | frostfish | FRO | 1 |
| Scombridae: mackerels, tunas | | | |
| *Scomber australasicus* | blue mackerel | EMA | 2 |
| *Centrolophus niger* | rudderfish | RUD | 33 |
| Centrolophidae: raftfishes, medusafishes | | | |
| *Hyperoglyphe antarctica* | bluenose | BNS | 1 |
| *Icichthys australis* | ragfish | RAG | 11 |

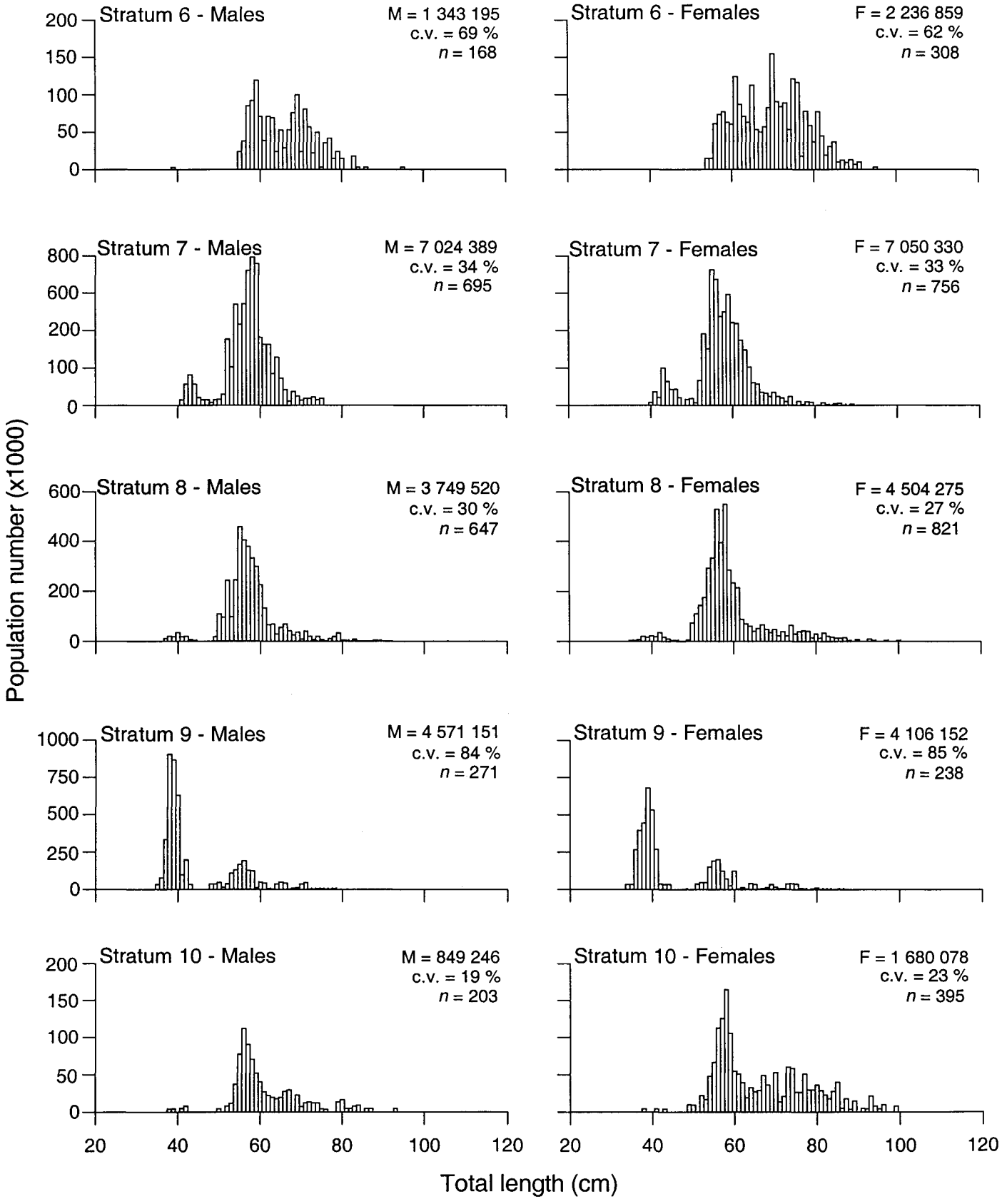
**Appendix 2 — *continued***

| Scientific name | Common name | Code | Occ. |
|---|---|---|---|
| Centrolophidae: raftfishes, medusafishes (*cont.*) | | | |
| *Seriolella caerulea* | white warehou | WWA | 44 |
| *S. punctata* | silver warehou | SWA | 31 |
| Bothidae: lefteyed flounders | | | |
| *Arnoglossus scapha* | witch | WIT | 13 |
| *Neoachiropsetta milfordi* | finless flounder | MAN | 2 |
| Pleuronectidae: righteyed flounders | | | |
| *Azygopus pinnifasciatus* | spotted flounder | SDF | 2 |
| *Pelotretis flavilatus* | lemon sole | LSO | 12 |
| **Cephalopoda** | | | |
| Histioteuthidae | | | |
| *Histioteuthis miranda* | violet squid | VSQ | 2 |
| Ommastrephidae | | | |
| *Nototodarus sloanii* | arrow squid | NOS | 41 |
| *Ommastrephes bartrami* | red squid | RSQ | 4 |
| *Todarodes filippovae* | Antarctic flying squid | TSQ | 12 |
| Onychoteuthidae | | | |
| *Moroteuthis ingens* | warty squid | MIQ | 29 |
| **Crustacea** | | | |
| Homolidae | | | |
| *Paromola petterdi* | antlered crab | ATC | 3 |
| Nephropsidae | | | |
| *Metanephrops challengeri* | scampi | SCI | 39 |
| Decapoda | | | |
| Species not identified | prawn | NAT | 1 |
| Species not identified | crab | CRB | 3 |
| *Lipkius holthuisi* | omega prawn | LHO | 4 |
| *Munidia gregaria* | lobster krill | MUN | 2 |
| **Other marine organisms** | | | |
| **Porifera** | sponges | ONG | 11 |
| **Coelenterata** | | | |
| Anthozoa | sea anemones | ANT | 13 |
| Anthozoa | coral | COU | 8 |
| Scyphozoa | jellyfish | JFI | 3 |
| **Mollusca** | | | |
| Octopoda | octopus | OCT | 5 |
| Opisthoteuthis | umbrella octopus | OPI | 1 |
| **Echinodermata** | | | |
| Asteroidea | starfish | SFI | 43 |
| Holothurian | sea cucumber | SCC | 14 |
| Ophiuroid | brittle star | OPH | 1 |
| **Cidaridae** | | | |
| Cidarid | cidarid urchin | CID | 1 |
| *Goniocidaris umbraculum* | cidarid urchin | GOU | 2 |
| **Echinidae** | | | |
| *Dermechinus horridus* | sea urchin | DHO | 2 |
| *Gracilechinus multidentatus* | sea urchin | GRM | 6 |
| *Spatangus multispinus* | heart urchin | SPT | 4 |
| *Paramaretia multituberculata* | heart urchin | PMU | 6 |
| **Echinothuriidae** | | | |
| *Phormosoma bursarium* | Tam O' Shanter urchin | PBU | 18 |
| **Thaliacea** | | | |
| Salpidae | salps | SAL | 5 |

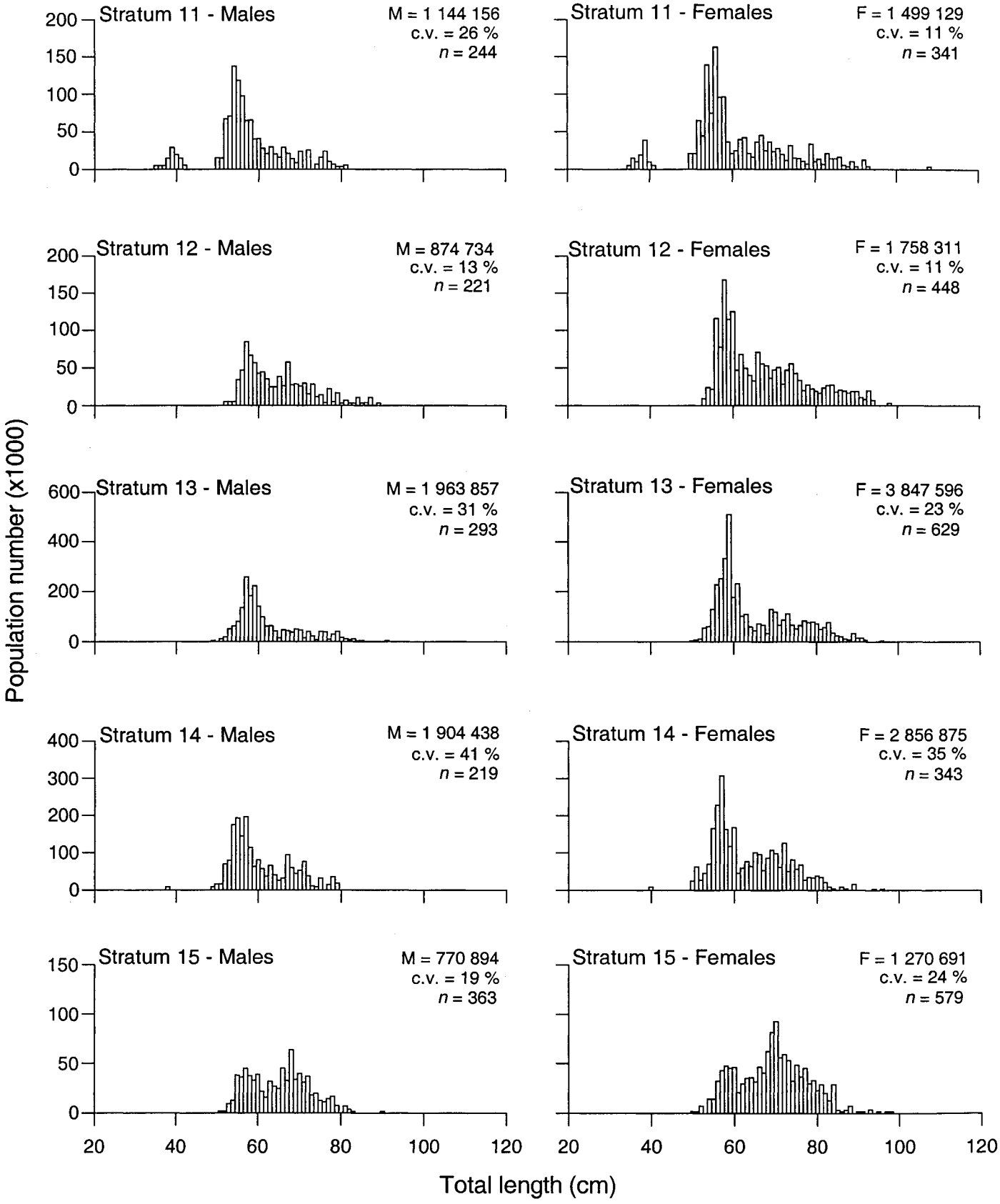
**Appendix 3: Scaled length frequencies of hoki, by stratum and sex. (M, estimated male population; F, estimated female population; c.v., coefficient of variation of the estimated numbers of fish; *n*, number of fish measured)**



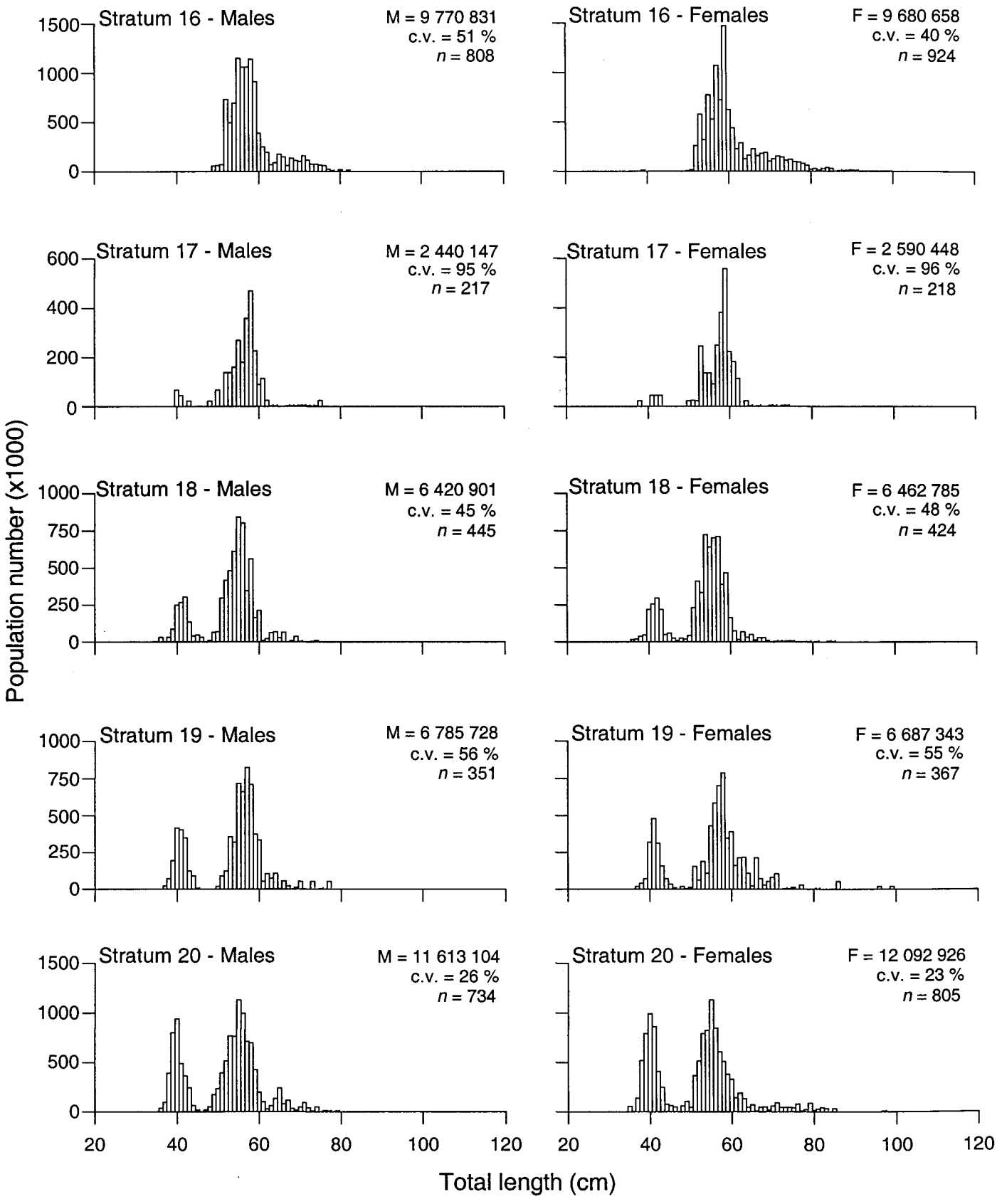
**Appendix 3 — *continued***



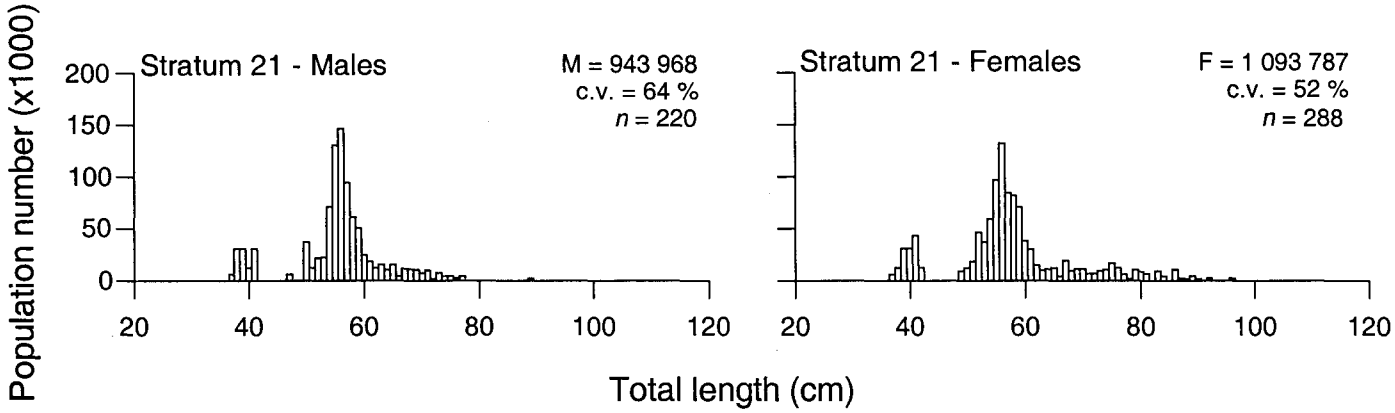
**Appendix 3 — *continued***



**Appendix 3 — *continued***



**Appendix 3 — *continued***



**Appendix 4: Calculated numbers at age ($n$) of the populations of hoki, hake, and ling in the survey area, by sex. Coefficients of variation are presented for individual year classes ($c.v.$) and as a mean weighted value for each species (Mean $c.v.$).**

| Age | Hoki | | | | Hake | | | | Ling | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Male | | Female | | Male | | Female | | Male | | Female | |
| | $n$ | $c.v.$ | $n$ | $c.v.$ | $n$ | $c.v.$ | $n$ | $c.v.$ | $n$ | $c.v.$ | $n$ | $c.v.$ |
| 1 | 10916693 | 0.098 | 11401062 | 0.085 | 4194 | 1.417 | 3269 | 2.061 | 0 | 0 | 0 | 0 |
| 2 | 8374663 | 0.156 | 6810671 | 0.158 | 13620 | 0.505 | 16973 | 0.677 | 4217 | 0.948 | 0 | 0 |
| 3 | 34727416 | 0.056 | 35748372 | 0.053 | 25878 | 0.295 | 12757 | 0.443 | 88103 | 0.367 | 78383 | 0.322 |
| 4 | 4148314 | 0.252 | 7050749 | 0.175 | 43374 | 0.382 | 39392 | 0.373 | 157520 | 0.174 | 105000 | 0.216 |
| 5 | 4048186 | 0.208 | 6208777 | 0.121 | 55726 | 0.301 | 43335 | 0.273 | 179312 | 0.189 | 130085 | 0.222 |
| 6 | 2388621 | 0.208 | 3676866 | 0.179 | 29421 | 0.525 | 53878 | 0.252 | 171326 | 0.226 | 106256 | 0.197 |
| 7 | 244443 | 0.530 | 975055 | 0.283 | 42770 | 0.340 | 46228 | 0.310 | 176377 | 0.204 | 127920 | 0.172 |
| 8 | 561153 | 0.349 | 1113508 | 0.251 | 22067 | 0.398 | 33883 | 0.325 | 123456 | 0.237 | 102782 | 0.212 |
| 9 | 820479 | 0.252 | 1369572 | 0.236 | 14150 | 1.191 | 18586 | 0.445 | 128088 | 0.251 | 56891 | 0.309 |
| 10 | 384747 | 0.591 | 969700 | 0.276 | 14384 | 0.675 | 11043 | 0.564 | 76769 | 0.247 | 72477 | 0.246 |
| 11 | 69731 | 0.858 | 346034 | 0.439 | 5587 | 0.717 | 22787 | 0.553 | 99737 | 0.258 | 75239 | 0.228 |
| 12 | 0 | 0 | 316504 | 0.477 | 11603 | 0.758 | 13920 | 0.699 | 57700 | 0.288 | 18073 | 0.451 |
| 13 | 0 | 0 | 81305 | 0.642 | 4372 | 1.122 | 6194 | 0.985 | 46211 | 0.310 | 32163 | 0.397 |
| 14 | 16869 | 1.086 | 273989 | 0.519 | 16667 | 0.547 | 3040 | 0.939 | 40772 | 0.829 | 32372 | 0.448 |
| 15 | 4163 | 1.877 | 39399 | 0.651 | 4358 | 0.848 | 2871 | 0.564 | 19060 | 0.626 | 25052 | 0.370 |
| 16 | 0 | 0 | 0 | 0 | 5450 | 0.841 | 2528 | 1.440 | 22998 | 0.484 | 10960 | 0.650 |
| 17 | 21246 | 0.857 | 36080 | 0.761 | 2672 | 0.960 | 6662 | 1.315 | 14499 | 0.757 | 6559 | 0.698 |
| 18 | 4211 | 3.365 | 9348 | 1.399 | 7593 | 1.274 | 4532 | 0.777 | 18921 | 0.552 | 17493 | 0.472 |
| 19 | 0 | 0 | 13715 | 1.139 | 0 | 0 | 0 | 0 | 23879 | 0.428 | 8977 | 0.571 |
| 20 | 0 | 0 | 0 | 0 | 4372 | 1.122 | 6473 | 1.129 | 15388 | 0.609 | 7802 | 0.695 |
| 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27362 | 0.405 | 4364 | 1.026 |
| 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7042 | 1.970 |
| 23 | 0 | 0 | 0 | 0 | 0 | 0 | 3393 | 1.649 | 12322 | 0.702 | 15978 | 0.627 |
| 24 | 0 | 0 | 0 | 0 | 2132 | 0.839 | 0 | 0 | 19802 | 0.563 | 2809 | 1.625 |
| 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3024 | 1.125 |
| 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1279 | 0.403 | 6445 | 1.366 |
| 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1768 | 1.565 |
| 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6308 | 0.919 | 0 | 0 |
| 29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1947 | 1.656 |
| No. aged | 280 | | 393 | | 132 | | 137 | | 349 | | 281 | |
| Mean $c.v.$ | | | | 0.111 | | | | 0.497 | | | | 0.296 |