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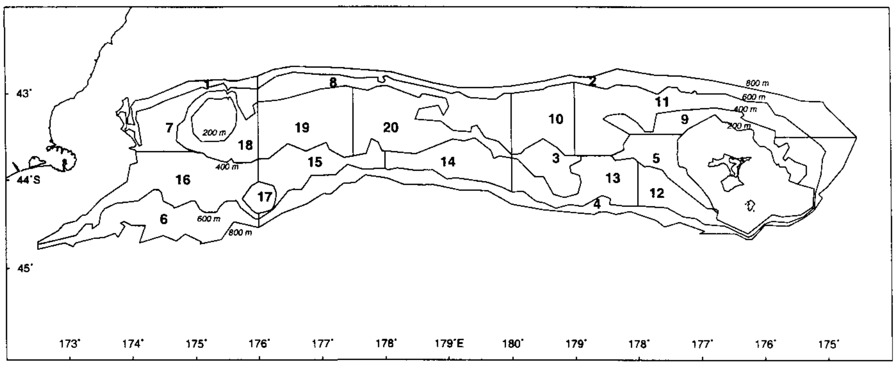

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Contents

Introduction

In January 1999, the eighth random trawl survey in a time series of annual surveys, initiated in January 1992, was completed on the Chatham Rise. The surveys were designed to sample hoki, hake, and ling and provide relative abundance indices of these and other middle depth species occurring in 200–800 m depths on the Chatham Rise.

Earlier surveys in this time series were documented by Horn (1994a, 1994b), Schofield & Horn (1994), Schofield & Livingston (1995, 1996, 1997), and Bagley & Hurst (1998). These surveys began in late December or early January. Comparisons with the first four surveys in the time series (1992 to 1995) were made by Livingston & Schofield (1996). Surveys of the Chatham Rise before the current time series were documented by Schofield & Livingston (1995).

The survey was part of an ongoing research programme to estimate the abundance of hoki and other middle depth species for stock assessment. It also provided information on the age structure of a range of species, and on their distribution across the Chatham Rise.

This report summarises the catch, distribution, length, and biomass estimates of the important species caught on the survey.

Objectives

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

To continue the time series of relative abundance indices of recruited hoki (eastern stock) and other middle depth species, particularly hake and ling, on the Chatham Rise using trawl surveys. The target *c.v.* for recruited hoki is 15%.

Additional survey objectives included collection of biological data and otoliths from hoki and other middle depth species for studies on ageing, growth, and stock separation and the definition of major water mass characteristics by measuring surface and bottom temperature within the survey area.

Timetable and personnel

The survey was carried out from 3 to 26 January 1999 using RV *Tangaroa*. N. Bagley (NIWA, Wellington) led the voyage and was responsible for data collection and the final database editing. M. Livingston (NIWA, Wellington) led the project.

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 the same 20 strata used in 1997 and excluded the additional subdivision of stratum 11 used in 1998 (Bagley & Hurst 1998). Phase 1 station allocation was optimised to achieve the target *c.v.*s of 15% for recruited hoki and 20% for 2+ hoki. Stratum areas and catch rates from the seven previous *Tangaroa* trawl surveys were used to simulate the optimal allocation. 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 allocated after the completion of phase 1 to improve the *c.v.* for target species or hoki age classes as required.

All station positions were selected randomly using the NIWA Random Stations Generation Program (version 1.6). Mid-tow positions 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 trawl gear was the same as that used on previous *Tangaroa* surveys in this series, i.e., an eight-seam hoki bottom trawl with a 58.8 m groundrope, 45 m headrope (*see* Hurst & 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 minutes during each tow (from the Scanmar system and either the Kaijo Denki or Furuno net monitor, respectively) and an average was calculated. Doorspread readings were recorded from 86 tows. Missing values were calculated from an average for the appropriate depth range from doorspread data collected during the survey.

Trawling procedure

Trawling was carried out during daylight, i.e., between sunrise and sunset. 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% or more of the distance between stations had been completed. At each station it was planned to tow for 3 n.miles at a speed of 3.5 knots over the ground. If a station occurred in an area of foul ground, then the area within 3 n. miles of that 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 invalid if less than 2 n.miles of the tow had been covered in total. 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 minutes from the Furuno net monitor or from temperature recorded from the CTD datalogger. Both monitors were mounted on the trawl headline about 6.5 m above the seabed during trawling.

Readings from the CTD datalogger differed from the vessel's equipment by - 0.3 °C at the surface (n = 35) and + 0.3 °C (near the bottom, n = 34). No adjustment for this difference was made.

Catch sampling

The catch at each station was sorted into species and weighed on motion-compensating electronic scales accurate to within ± 0.3 kg. For large catches of mixed rattails, the weights of individual species were estimated by sub-sampling, i.e., a sub-sample was sorted and weighed by species and the total catch was scaled 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 specimens of hoki, ling, hake, ribaldo, silver warehou, and white warehou were selected from the length frequency sample for detailed biological analysis and otolith removal. Data collected were fish length (total, fork, mantle (squid), and chimaera (tip of snout to posterior end of dorsal fin)), weight, sex, gonad stage and weight, and also included some observations on stomach fullness, stomach contents, and prey condition.

Length, weight, and sex data were also collected from samples of alfonsino, barracouta, dark and pale ghost shark, longfinned beryx, lookdown dory, rough and smooth skates, scampi, shovelnose dogfish, sea perch, slender mackerel, 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 (code 1 only) and categories matching RD (research daylight) were used to estimate biomass.

Scaled length frequencies were calculated for the main species with the Trawlsurvey Analysis Program, version 3.2 (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. Total biomass and biomass by stratum for 1+, 2+, and 3+ and older hoki were also calculated using the Trawlsurvey Analysis Programme.

Results

Survey coverage

Ninety phase 1 stations were successfully completed (Table 1). Ten additional phase 2 stations were put into strata 2, 9, 15, and 19 in an attempt to improve the *c.v.* for hoki and ling. The station density in individual strata ranged from 1:288 in stratum 17 to 1:2940 km^2 in stratum 11 (*see* Table 1). Mean station density over the whole survey area was 1:1395 km^2. The positions of all trawl survey stations successfully completed are given in Figure 1, and individual station data, foul shots, and acoustic trawls are given in Appendix 1.

Gear performance

Gear configuration remained relatively constant over the 200–800 m depth range: mean doorspread measurements by 200 m depth interval ranged from 114.5 to 120.4 m and headline height from 6.2 to 6.4 m, all falling within the accepted range (Hurst *et al.* 1992) (Table 2). The mean doorspread of individual tows ranged from 100.0 to 130.8 m and the desirable range (100–130 m) was exceeded only slightly on one occasion. Stations 19, 29, 52, 76, 87, and 125 were given a poor gear performance code (i.e., came fast; catch affected by a large quantity of sponge; tow hauled early due to foul ground) and were excluded from all analyses.

Hydrology

Surface temperatures were recorded on the 100 biomass stations and ranged from 13.8 to 19.2 °C: bottom temperatures were recorded from 95 biomass stations ranged from 5.7 to 10.5 °C (Figure 2).

Higher surface temperatures were recorded from strata in the northwestern part of the survey area with the lowest temperatures (below 14 °C) from the southwest in strata 6 and 16. Lower surface temperatures, below 16 °C, were recorded along the southernmost strata and around the Chatham Islands. Higher bottom temperatures were generally associated with shallower depths. Areas of warmer bottom temperatures (9.5–10.5 °C) were found to the east of Mernoo Bank (stratum 19), as in previous years, and to the west and east of the Chatham Islands.

Catch composition

One hundred and forty-four species were recorded: 26 elasmobranchs, 94 teleosts, 9 cephalopods, 6 crustaceans, and 1 agnathan, the remainder consisting of 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 was 141.0 t, of which 62.8 t (44.5%) was hoki, 13.4 t (9.5%) was dark ghost shark, 6.4 t (4.5%) was bigeyed rattail, and 5.2 t (3.7%) 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 18 next 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, with 39% of the biomass being smaller sized fish in the 1+ and 2+ age groups. Black oreo, dark ghost shark, ling, silver warehou, sea perch, alfonsino, spiky oreo, white warehou, hake, and giant stargazer were other commercial Individual Transferable Quota (ITQ) species with a biomass over 1500 t. Most of the alfonsino and oreos caught were pre-recruits. The most abundant commercial non-ITQ species were spiny dogfish, lookdown dory, and pale ghost shark. A substantial biomass of non-commercial species, primarily rattails were also estimated from the survey (*see* Table 3).

Species distribution

Catch rates for hoki from the 1+, 2+, and 3+ and greater cohorts are given in Figure 3. Catch rates for the 20 next most abundant species are given by stratum in Table 7 and distribution by station is shown in Figure 4.

Hoki were caught at 95 of the 100 successful biomass stations. The largest single catch of hoki (13 820 kg.km^{-2}) was caught in stratum 17 and mostly consisted of 1+ and 2+ fish. Stratum 19 (to the east of Mernoo Bank) yielded the highest catch rates of 1+ hoki and contributed to 62% of the biomass of this age group. Two year old hoki were also most abundant at 200–400 m to the west in strata 15, 16, 17, and 19. Larger catches of 3+ and older hoki were taken in southern strata in the western part of the survey area and to the southwest of the Chatham Islands between 200 and 600 m.

Catches of hake were small, with the largest haul of 87 kg.km^{-2} taken north of the Chatham Islands in stratum 2. Few hake were taken at depths of 200–400 m. One unusually large catch of ling (1786 kg.km^{-2}) was taken in stratum 9: the sex composition was 80% males. Other ling catches were evenly distributed across the Chatham Rise at depths between 200 and 600 metres.

Lookdown dory, seaperch, big eyed rattail, and javelinfish were widely distributed across the survey area and taken in larger quantities at depths between 200 and 600 m. Black oreo and Baxter's dogfish were taken from 600–800 m strata on the south Chatham Rise and spiky oreo and shovelnose dogfish were taken at the same depth range on the north Chatham Rise. Dark ghost shark occurred mainly in the 200–400 m strata with one large catch (10 692 kg.km-^{2}) taken in stratum 17, and pale ghost shark were mostly taken at depths greater than 400 m. Silver warehou and white warehou were patchily distributed and predominantly taken at depths of 200–400 m with the largest catches in stratum 3 and 20 respectively. Occasional catches of alfonsino and orange perch were made in shallower strata east of Mernoo Bank and around the Chatham Islands.

Biological data

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 all hoki by sex and depth 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 by sex and depth range (200–400 m, 400–600 m and 600–800 m) are given for hake (Figure 6) and ling (Figure 7). 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 are dominated by a relatively strong 1+ cohort with a mode at 41 cm total length (TL). The 1+ cohort was mostly caught in the 200–400 m depth range on the western side of the survey area. No 1+ and few 2+ hoki were caught deeper than 600 m. Overall sex ratios were 0.9:1 (males to females) with more females 0.4:1 in 600–800 m and 0.8:1 at 400–600 m. More males 1.1:1 were caught at 200–400 m depths.

Sex ratios were about even for most other species, except for spiny dogfish, for which there were fewer males than females (sex ratios exceeded 1:1.5 M:F), and ribaldo, scampi, silver warehou, slender jack mackerel, southern blue whiting, spiky oreo, and white warehou which were predominantly male (sex ratio exceeded 1.5:1).

Gonad stages of hake, hoki, ling, giant stargazer, silver warehou, and white warehou are summarised in Table 9. Hoki and white warehou were either resting or immature; adult silver warehou were mostly resting or spent; adult hake were in active reproduction stages (77% of males and 42% of females) ripening to partially spent (stages 3–6); adult ling showed 70% of males and 2% of females with active spawning reproduction stages. Occasional observations on other species indicated ribaldo as resting to maturing, barracouta and frostfish in active reproduction stages, and spiky oreos mature or spent.

Discussion

The allocation of phase 1 stations and phase 2 effort achieved the target precision levels of 20% (final *c.v.* 18.9 %) for 2+ hoki and 15% (final *c.v.* 9.9%) for adult hoki. Phase 2 was directed at 2+ hoki and ling. Hoki phase 2 stations were primarily in stratum 19 and had the overall effect of lowering the *c.v.* for 2+ hoki from 25% to 18.9%. Years for which a strong year class of 2+ hoki may be expected may require additional effort to achieve target *c.v.*s below 20%.

Two additional stations were put into stratum 9 (200–400 m) around the Chatham Islands during phase 1 of the survey in an attempt to lower the *c.v.* for ling. Because of the steaming distance required to return to this area after the completion of phase 1, additional stations were completed while in the area and had the effect of lowering the *c.v.* from 21% to 16%.

The 1+ hoki cohort dominated the hoki length frequency and accounted for 52% of hoki from the calculated numbers at length and 23% of the biomass.

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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	1	2 939	600–800
3	21	3 499	4	4	0	875	200–400
4	4 & 5	11 315	4	4	0	2 829	600–800
5	22	4 076	5	5	0	815	200–400
6	6	8 266	4	4	0	2 067	600–800
7	7	5 233	9	9	0	581	400–600
8	8 & 9	9 008	6	6	0	1 501	400–600
9	23	5 136	4	4	2	856	200–400
10	10	6 321	4	4	0	1 580	400–600
11	11 & 25	11 758	4	4	0	2 940	400–600
12	12	6 578	3	3	0	2 193	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	1	973	400–600
16	16 & 17	11 522	7	7	0	1 646	400–600
17	24	865	3	3	0	288	200–400
18	18	4 704	4	4	0	1 176	200–400
19	19	9 013	4	4	6	901	200–400
20	20	9 586	7	7	0	1 369	200–400
Total		139 527	90	90	10	1 395	

* 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)	100	2.91	0.26	2.00-3.11
Tow speed (knots)	100	3.5	0.07	3.3-3.7
Gear parameters (m)				
200–400 m				
Headline height	39	6.2	0.25	5.8-6.7
Doorspread	32	114.5	6.01	100.0–128.1
400–600 m				
Headline height	46	6.3	0.28	5.7-6.8
Doorspread	40	117.9	4.17	108.4–117.9
600–800 m				
Headline height	15	6.4	0.31	6.1-7.3
Doorspread	14	120.4	5.83	108.4–130.8
Total depth range				
Headline height	100	6.3	0.28	5.7-7.3
Doorspread	86	117.0	5.47	100.0–130.8

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, - not sexed**

	Species code	Total biomass (t)						Catch (kg)
		All fish*		Females		Males		
ITQ species								
Hoki	HOK	109 336	(11.6)	63 283	(10.4)	45 884	(13.6)	62 758
Black oreo	BOE	16 863	(31.7)	8 535	(30.9)	8328	(33.3)	4 575
Dark ghost shark	GSH	12 125	(23.4)	7 514	(25.4)	4 610	(20.6)	13 366
Ling	LIN	10 309	(16.1)	5 190	(10.7)	5 116	(24.7)	5 225
Silver warehou	SWA	6 760	(34.2)	2 953	(27.9)	3 823	(40.1)	4 517
Sea perch	SPE	4 842	(8.7)	2 215	(9.4)	2 481	(9.2)	2 557
Alfonsino	BYS	4 216	(50.8)	2 047	(53.5)	2 169	(48.7)	2 621
Spiky oreo	SOR	3 745	(29.8)	1 492	(25.6)	2 253	(32.9)	844
White warehou	WWA	3 136	(40.7)	1 205	(42.8)	1 930	(39.9)	1 486
Hake	HAK	2 302	(11.8)	1 686	(17.3)	616	(14.5)	945
Giant stargazer	STA	1 903	(12.7)	1 404	(16.1)	498	(12.9)	1 186
Red cod	RCO	1 227	(64.5)	634	(71.1)	562	(57.4)	925
Arrow squid	NOS	756	(36.1)	372	(39.9)	380	(33.4)	467
Barracouta	BAR	601	(75.2)	356	(82.0)	246	(65.7)	424
Ribaldo	RIB	395	(18.0)	204	(20.0)	192	(23.6)	158
Smooth oreo	SSO	385	(50.0)	169	(51.8)	213	(49.4)	93
School shark	SCH	344	(34.3)	45	(54.8)	299	(39.2)	237
Slender mackerel	JMM	312	(46.7)	113	(44.5)	198	(49.4)	193
Bluenose	BNS	105	(65.0)	85	(77.7)	19	(76.3)	29
Longfinned beryx	BYD	162	(100)	28	(100)	133	(100)	35
Tarakihi	TAR	91	(41.1)	46	(47.2)	46	(48.0)	65
Hapuku	HAP	63	(43.4)	41	(62.0)	22	(58.0)	38
Lemon sole	LSO	58	(22.0)	25	(25.1)	32	(29.9)	40
Frostfish	FRO	16	(100)	-		-		11
Black cardinalfish	EPT	15	(49.2)	-		-		9
Jack mackerel	JMD	7	(73.2)	2	(100)	5	(100)	4
Orange roughy	ORH	12	(69.6)	12	(69.6)	0		3
Red gurnard	GUR	2	(100)	2	(100)	0		1
Rubyfish	RBY	1	(100)	0		1	(100)	1
Commercial non-ITQ species (where biomass > 30 t)								
Spiny dogfish	SPD	8 551	(12.7)	7 672	(13.1)	845	(18.7)	4 776
Lookdown dory	LDO	7 417	(8.2)	5 124	(8.2)	2 274	(10.5)	3 516
Pale ghost shark	GSP	5 272	(9.7)	2 527	(10.0)	2 745	(11.4)	2 213
Shovelnose dogfish	SND	4 121	(26.4)	2362	(28.8)	1 653	(32.4)	1 443
Smooth skate	SSK	1 738	(19.8)	897	(23.5)	478	(43.8)	821
Ray's bream	RBM	405	(27.4)	179	(24.0)	221	(31.9)	213
Southern blue whiting	SBW	214	(93.1)	67	(91.8)	147	(93.7)	446
Scampi	SCI	42	(17.1)	10	(22.9)	32	(18.1)	21
Rough skate	RSK	34	(60.1)	27	(71.0)	7	(100)	22
Non-commercial species (where biomass > 800 t)								
Bigeyed rattail	CBO	13 621	(13.2)	-		-		6 402
Javelinfish	JAV	10 799	(11.7)	-		-		4 609
Orange perch	OPE	2 673	(49.8)	-		-		1 612
Longenose velvet dogfish	CYP	2 671	(77.4)	-		-		788
Baxter's dogfish	ETB	2 078	(31.7)	-		-		597
Oblique-banded rattail	CAS	1 746	(11.1)	-		-		1 409
Oliver's rattail	COL	1 168	(18.2)	-		-		525
Longnose chimaera	LCH	1 091	(21.9)	-		-		369
Rudderfish	RUD	894	(30.3)	-		-		246
Banded bellow fish	BBE	858	(13.0)	-		-		301
Silver dory	SDO	802	(30.6)	-		-		572
Total								141 289

* 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 (48–57 cm)		3+ cohort and older (> 58 cm)	
1	959	(48)	0		5	(79)	955	(48)
2	5 953	(19)	0		0		5 953	(19)
3	693	(40)	4	(60)	50	(38)	639	(40)
4	2 959	(34)	0		26	(71)	2 933	(34)
5	1 653	(27)	307	(37)	470	(34)	876	(27)
6	1 641	(23)	0		2	(100)	1 640	(23)
7	2 598	(36)	872	(97)	325	(42)	1 401	(19)
8	4 914	(13)	247	(65)	734	(42)	3 934	(14)
9	3 594	(67)	2 530	(95)	644	(84)	420	(56)
10	2 535	(12)	249	(51)	388	(33)	1 898	(7)
11	3 741	(9)	46	(91)	717	(39)	2 978	(5)
12	10 372	(20)	112	(100)	569	(89)	9 691	(16)
13	3 108	(16)	60	(65)	399	(58)	2 650	(26)
14	3 036	(23)	1	(100)	338	(42)	2 697	(25)
15	9 265	(24)	405	(80)	1 755	(33)	7 105	(21)
16	15 443	(47)	442	(66)	2 854	(57)	12 146	(45)
17	4 482	(84)	1 685	(100)	1 884	(97)	913	(33)
18	5 025	(79)	2 296	(97)	1 189	(84)	1 540	(53)
19	22 553	(33)	16 005	(43)	3 019	(39)	3 529	(53)
20	4 814	(34)	377	(33)	1 128	(36)	3 309	(36)
Total	109 336	(11.6)	25 637	(30.4)	16 494	(18.9)	67 206	(9.9)

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

Stratum	BOE		CBO		GSH		JAV		LIN		SPD		LDO		SWA		GSP	
																	Species code	
1	0		185	(44)	0		137	(34)	93	(48)	0		30	(10)	0		199	(30)
2	0		161	(35)	0		1 097	(39)	728	(22)	16	(100)	147	(31)	0		482	(39)
3	0		191	(55)	941	(23)	143	(90)	167	(38)	645	(32)	270	(38)	2 123	(97)	8	(100)
4	6 603	(61)	104	(39)	0		810	(20)	461	(61)	3	(100)	79	(47)	0		345	(14)
5	0		132	(39)	787	(31)	101	(45)	272	(25)	1 363	(38)	402	(18)	196	(41)	0	
6	10 261	(34)	202	(33)	0		290	(18)	354	(61)	0		30	(80)	0		602	(27)
7	0		394	(26)	29	(83)	439	(29)	669	(16)	103	(53)	109	(14)	272	(54)	336	(16)
8	0		1 235	(49)	16	(50)	1 416	(57)	736	(22)	263	(51)	900	(32)	32	(65)	426	(24)
9	0		18	(100)	1 000	(33)	77	(53)	1 600	(95)	464	(43)	179	(43)	1 663	(44)	0	
10	0		423	(52)	201	(73)	756	(45)	240	(18)	228	(82)	384	(29)	27	(100)	132	(23)
11	0		491	(28)	325	(66)	628	(38)	544	(18)	286	(67)	599	(22)	360	(89)	67	(58)
12	0		1 182	(36)	17	(100)	1 113	(27)	550	(23)	550	(71)	830	(37)	29	(58)	357	(45)
13	0		836	(32)	2	(100)	318	(34)	523	(17)	478	(35)	700	(12)	45	(67)	428	(48)
14	0		720	(68)	10	(50)	381	(23)	364	(33)	730	(82)	508	(36)	103	(56)	646	(34)
15	0		1 920	(40)	5	(75)	1 080	(49)	805	(28)	391	(43)	475	(25)	119	(53)	394	(10)
16	0		2 913	(38)	0		1 123	(19)	1 093	(28)	466	(56)	357	(38)	176	(60)	717	(32)
17	0		13	(100)	4 002	(68)	+	(100)	28	(61)	53	(3)	49	(39)	69	(89)	0	
18	0		185	(51)	581	(18)	141	(81)	165	(31)	792	(16)	252	(74)	168	(61)	0	
19	0		419	(74)	2 197	(15)	187	(59)	150	(58)	809	(13)	261	(39)	1 261	(47)	6	(100)
20	0		1 898	(31)	2 012	(25)	564	(44)	769	(28)	913	(25)	756	(11)	115	(50)	126	(65)
Total	16 863	(32)	13 621	(13)	12 125	(23)	10 799	(12)	10 309	(16)	8 551	(13)	7 417	(8)	6 760	(34)	5 272	(10)

Table 5 — *continued*

Stratum	SPE		BYS		SND		SOR		WWA		OPE		CYP		HAK		ETB	
1	12	(52)	0		920	(53)	91	(57)	0		0		556	(93)	25	(57)	39	(99)
2	117	(19)	0		2 636	(36)	2 303	(29)	0		0		2 000	(100)	522	(36)	0	
3	276	(33)	827	(100)	0		0		135	(71)	121	(88)	0		15	(65)	0	
4	47	(54)	0		245	(87)	310	(84)	0		0		45	(66)	73	(34)	567	(81)
5	111	(56)	150	(56)	0		+	(100)	164	(33)	55	(95)	0		0		0	
6	18	(74)	0		32	(48)	2	(100)	10	(100)	0		70	(89)	130	(41)	1 075	(38)
7	85	(24)	0		41	(54)	0		57	(72)	+	(100)	+	(100)	203	(17)	0	
8	413	(30)	9	(45)	53	(100)	10	(100)	3	(75)	0		0		186	(31)	0	
9	84	(76)	198	(54)	0		5	(100)	90	(61)	834	(70)	0		0		0	
10	97	(20)	278	(88)	29	(100)	0		9	(100)	1	(100)	0		202	(26)	0	
11	205	(25)	616	(89)	116	(100)	838	(100)	906	(77)	20	(61)	0		244	(35)	0	
12	261	(62)	8	(100)	37	(57)	184	(97)	24	(66)	5	(100)	0		88	(75)	0	
13	58	(25)	0		0		0		80	(46)	0		0		104	(44)	0	
14	241	(50)	0		0		0		4	(100)	0		0		74	(100)	131	(100)
15	290	(29)	0		3	(100)	0		67	(51)	0		0		135	(31)	10	(100)
16	216	(24)	0		10	(100)	0		163	(48)	0		0		198	(37)	255	(79)
17	+	(100)	0		0		0		11	(90)	0		0		0		0	
18	476	(13)	+	(100)	0		0		46	(80)	+	(100)	0		18	(58)	0	
19	914	(28)	2 112	(89)	0		0		166	(48)	457	(63)	0		44	(68)	0	
20	922	(16)	18	(83)	0		0		1 202	(88)	1 180	(98)	0		41	(49)	3	(100)
Total	4 842	(9)	4 216	(51)	4 121	(26)	3 745	(30)	3 136	(41)	2 673	(50)	2 671	(77)	2 302	(12)	2 078	(32)

Species code

* Species codes are given in Table 3.

+ Biomass less then 0.5 tonnes.

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	0.024253	2.982670	514	0.97	18-43	This survey
Barracouta	0.003929	3.026534	155	0.92	50-112	This survey
Dark ghost shark	0.002764	3.201944	429	0.98	28-71	This survey
Giant stargazer	0.008959	3.148286	266	0.99	19-81	This survey
Hake	0.002597	3.225967	264	0.98	40-122	This survey
Hoki	0.003788	2.940880	1 775	0.98	37-117	This survey
Longfinned beryx	0.015102	3.121924	36	0.98	27-41	This survey
Ling	0.001136	3.320987	996	0.99	25-164	This survey
Lookdown dory	0.028384	2.917760	551	0.99	12-55	This survey
Pale ghost shark	0.006195	2.994958	256	0.96	25-85	This survey
Ribaldo	0.002025	3.450293	58	0.98	30-70	This survey
Scampi	0.721579	2.749810	174	0.88	2.9-7.2	This survey
Sea perch	0.012720	3.091254	558	0.99	12-53	This survey
Shovelnose dogfish	0.001435	3.221695	343	0.99	31-126	This survey
Silver warehou	0.010953	3.143978	631	0.98	22-56	This survey
Spiky oreo	0.037289	2.854037	459	0.96	13-44	This survey
Spiny dogfish	0.001334	3.278974	368	0.96	51-103	This survey
Slender mackerel	0.139276	2.313501	48	0.73	45-55	This survey
White warehou	0.011986	3.168799	402	0.99	15-62	This survey
Arrow squid	0.0290	3.00	-	-	-	Annala (1993)
Banded stargazer	0.01300	3.25	143	0.98	22-69	Bagley & Hurst (1996)
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	1 644	-	50-130	Johnston (1983)
Jack mackerel	0.016500	2.93000	200	-	15-53	DB, COR9001
Lemon sole	0.007990	3.127847	524	-	14-41	Stevenson & Beentjes (1999)
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)
Red gurnard	0.001626	3.223728	846	-	13-54	Stevenson & Beentjes (1999)
Rough skate	0.033966	2.876666	336	-	14-70	Stevenson & Beentjes (1999)
Rubyfish	0.027018	2.906400	68	-	31-49	DB, WNK8503
School shark	0.00702	2.91	804	-	30-166	Seabrook-Davison, Unp.
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	DB, TAN9701
Southern blue whiting	0.003	3.2	444	-	19-55	Hatanaka *et al.* (1989)
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	GSH	JAV	LIN	SPD	LDO	SWA	GSP
1	393	0	76	0	56	38	0	13	0	82
	(330)		(58)		(33)	(31)		(2)		(42)
2	506	0	14	0	93	62	1	13	0	41
	(188)		(10)		(73)	(28)	(3)	(8)		(32)
3	198	0	55	269	41	48	184	106	607	2
	(158)		(60)	(121)	(73)	(37)	(118)	(81)	(1 180)	(5)
4	261	584	9	0	72	41	0.3	7	0	30
	(177)	(709)	(7)		(29)	(50)	(0.6)	(7)		(8)
5	406	0	32	193	25	67	334	99	48	0
	(244)		(28)	(132)	(25)	(38)	(287)	(39)	(44)	
6	199	1 241	25	0	35	43	0	4	0	73
	(93)	(853)	(16)		(13)	(52)		(6)		(39)
7	496	0	75	6	84	128	20	21	52	64
	(537)		(59)	(14)	(73)	(60)	(31)	(9)	(84)	(31)
8	546	0	137	2	157	82	29	100	4	47
	(169)		(164)	(2)	(219)	(45)	(37)	(79)	(6)	(27)
9	700	0	4	195	15	312	90	35	324	0
	(1 155)		(9)	(160)	(20)	(723)	(96)	(37)	(351)	
10	401	0	67	32	120	38	36	61	4	21
	(99)		(69)	(46)	(109)	(14)	(59)	(35)	(9)	(10)
11	318	0	42	28	53	46	24	51	31	6
	(56)		(23)	(37)	(41)	(16)	(33)	(22)	(55)	(7)
12	1 577	0	180	3	169	84	84	126	4	54
	(552)		(113)	(5)	(80)	(34)	(103)	(81)	(4)	(43)
13	465	0	125	0.2	48	78	72	105	7	64
	(151)		(80)	(0.5)	(33)	(26)	(51)	(26)	(9)	(61)
14	512	0	121	2	64	61	123	86	17	109
	(203)		(144)	(2)	(26)	(35)	(176)	(54)	(17)	(64)
15	1 586	0	329	1	185	138	67	81	20	68
	(919)		(325)	(1)	(224)	(96)	(70)	(50)	(27)	(17)
16	1 340	0	253	0	98	95	41	31	15	62
	(1 677)		(255)		(48)	(70)	(60)	(31)	(24)	(52)
17	5 181	0	15	4 627	0.2	32	62	57	79	0
	(7 496)		(26)	(5 442)	(0.4)	(34)	(3)	(38)	(122)	
18	1 068	0	39	123	30	35	168	54	36	0
	(1 684)		(40)	(44)	(49)	(22)	(55)	(79)	(44)	
19	2 502	0	46	244	21	17	90	29	140	0.7
	(2 607)		(109)	(113)	(39)	(30)	(36)	(36)	(208)	(2)
20	502	0	198	210	59	80	95	79	12	13
	(457)		(163)	(137)	(68)	(60)	(64)	(22)	(16)	(23)

Table 7 — continued

										Species code
Stratum	SPE	BYS	SND	SOR	WWA	OPE	CYP	HAK	ETB	STA
1	5	0	377	37	0	0	228	10	16	10
	(5)		(345)	(37)			(367)	(10)	(28)	(17)
2	10	0	224	196	0	0	170	44	0	0
	(4)		(160)	(113)			(340)	(32)		
3	79	236	0	0	39	35	0	4	0	19
	(52)	(472)			(55)	(61)		(6)		(9)
4	4	0	22	27	0	0	4	6	50	0
	(4)		(37)	(46)			(5)	(4)	(81)	
5	27	37	0	0.1	40	13	0	0	0	44
	(35)	(46)		(0.1)	(30)	(28)				(27)
6	2	0	4	0.3	1	0	8	16	130	0
	(3)		(4)	(0.6)	(2)		(15)	(13)	(99)	
7	16	0	8	0	11	0.1	0.1	39	0	5
	(12)		(13)		(24)	(0.1)	(0.2)	(19)		(9)
8	46	1	6	1	0.3	0	0	21	0	3
	(34)	(1)	(14)	(3)	(0.6)			(16)		(7)
9	16	39	0	0.9	17	162	0	0	0	76
	(31)	(51)		(2)	(26)	(277)				(42)
10	15	44	5	0	1	0.1	0	32	0	0.7
	(6)	(77)	(9)		(3)	(0.3)		(17)		(2)
11	17	52	10	71	77	2	0	21	0	12
	(9)	(93)	(20)	(143)	(119)	(2)		(15)		(8)
12	40	1	6	28	4	0.7	0	13	0	45
	(43)	(2)	(6)	(47)	(4)	(1)		(17)		(39)
13	9	0	0	0	12	0	0	16	0	12
	(4)				(11)			(14)		(14)
14	41	0	0	0	0.7	0	0	13	22	0
	(35)				(1)			(22)	(38)	
15	50	0	0.4	0	11	0	0	23	2	12
	(36)		(1)		(14)			(18)	(4)	(15)
16	19	0	0.8	0	14	0	0	17	22	4
	(12)		(2)		(18)			(17)	(46)	(6)
17	0.5	0	0	0	13	0	0	0	0	117
	(0.8)				(20)					(27)
18	101	0.1	0	0	10	0.1	0	4	0	36
	(26)	(0.1)			(16)	(0.2)		(5)		(42)
19	101	234	0	0	18	51	0	5	0	20
	(91)	(659)			(28)	(102)		(11)		(22)
20	96	2	0	0	125	123	0	4	0.3	10
	(40)	(4)			(291)	(319)		(6)	(0.9)	(16)

* 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, - no data**

Species	Length frequency samples				Biological samples	
	No. of fish measured			No. of	No. of	No. of
	Total†	Male	Female	samples	fish	samples
Alfonsino	1 326	766	560	36	517 *	10
Arrow squid	880	471	405	63	-	-
Banded bellowsfish	1	-	-	1	-	-
Banded giant stargazer	2	0	2	1	2 *	1
Barracouta	203	99	104	14	155 *	3
Black oreo	1 069	534	535	7	273 *	2
Bluenose	4	2	2	4	3 *	3
Bollons' rattail	115	-	-	1	-	-
Dark ghost shark	3 090	1 398	1 692	54	432 *	13
Deepsea cardinalfish	23	15	8	6	22	5
Frostfish	3	2	1	1	3	1
Giant stargazer	381	194	186	56	270	38
Hairy conger eel	2	-	-	1	-	-
Hake	236	94	142	62	236	62
Hapuku	8	4	4	8	1 *	1
Hoki	20 384	8 949	11 418	95	1 777	79
Jack mackerel	3	2	1	2	2 *	1
Javelinfish	122	-	-	1	-	-
Lemon sole	79	47	31	16	-	-
Ling	1 920	1 071	848	87	1 005	70
Longfinned beryx	36	32	4	1	36 *	1
Longnose chimera	2	-	2	1	-	-
Longnose velvet dogfish	169	140	29	1	-	-
Lookdown dory	4 444	1 929	2 410	89	553 *	12
Lucifer dogfish	2	-	2	1	-	-
Northern spiny dogfish	17	15	2	7	12 *	5
Oblique banded rattail	6	-	-	1	-	-
Oliver's rattail	103	-	-	1	-	-
Orange perch	464	40	37	10	-	-
Orange roughy	3	-	3	3	-	-
Pale ghost shark	1 105	616	489	63	259 *	15
Pale toadfish	1	-	1	1	-	-
Prickly bluntnosed skate	4	2	2	2	4 *	2
Prickly dogfish	3	1	2	2	1 *	1
Ray's bream	141	72	67	34	11 *	1
Redbait	99	23	24	7	-	-
Red cod	525	308	207	31	-	-
Red gurnard	1	-	1	1	-	-
Ribaldo	77	37	40	27	58	18
Rough skate	3	1	2	3	3 *	3
Rubyfish	1	1	-	1	-	
Scampi	197	141	56	42	189 *	39
School shark	16	13	3	9	9 *	5
Sea perch	3 151	1 376	1 232	90	567 *	17
Shovelnose dogfish	497	177	319	15	347 *	6
Silver roughy	56	-	-	2	56 *	2
Silverside	6	-	-	1	-	-
Silver warehou	1 491	828	622	60	634	19
Sixgill shark	1	1	-	1	1 *	1
Slender mackerel	190	119	71	14	48 *	2
Smooth bluntnosed skate	16	9	7	11	16 *	11
Smooth oreo	145	79	65	8	7 *	1
Smooth skate	38	14	24	27	36 *	26

Table 8 – (continued)

Species	Length frequency samples: No. of fish measured Total†	Male	Female	No. of samples	Biological samples: No. of fish	No. of samples
Southern blue whiting	118	84	34	4	-	
Spiky oreo	662	410	252	15	461 *	7
Spiny dogfish	1 892	284	1 605	73	370 *	14
Spiny flathead	1	-	-	1	-	-
Tarakihi	42	23	19	8	15 *	1
White warehou	825	491	328	55	402	19

* 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 recorded.

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

Stage	Hake Male	Hake Female	Hoki Male	Hoki Female	Ling Male	Ling Female
1	37	47	284	315	205	239
2	12	52	430	736	99	213
3	8	31	0	0	36	0
4	17	3	0	0	186	4
5	15	0	0	0	6	0
6	1	5	0	0	0	0
7	0	1	0	0	0	0
Total	90	139	714	1051	532	456

Stage	Giant stargazer Male	Giant stargazer Female	Silver warehou Male	Silver warehou Female	White warehou Male	White warehou Female
1	12	8	6	3	19	11
2	29	20	79	74	26	14
3	0	5	0	0	0	0
4	0	1	0	0	0	0
5	0	0	1	0	0	0
6	0	4	0	0	0	0
7	0	4	1	12	0	0
Total	41	42	86	89	45	25

* 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).

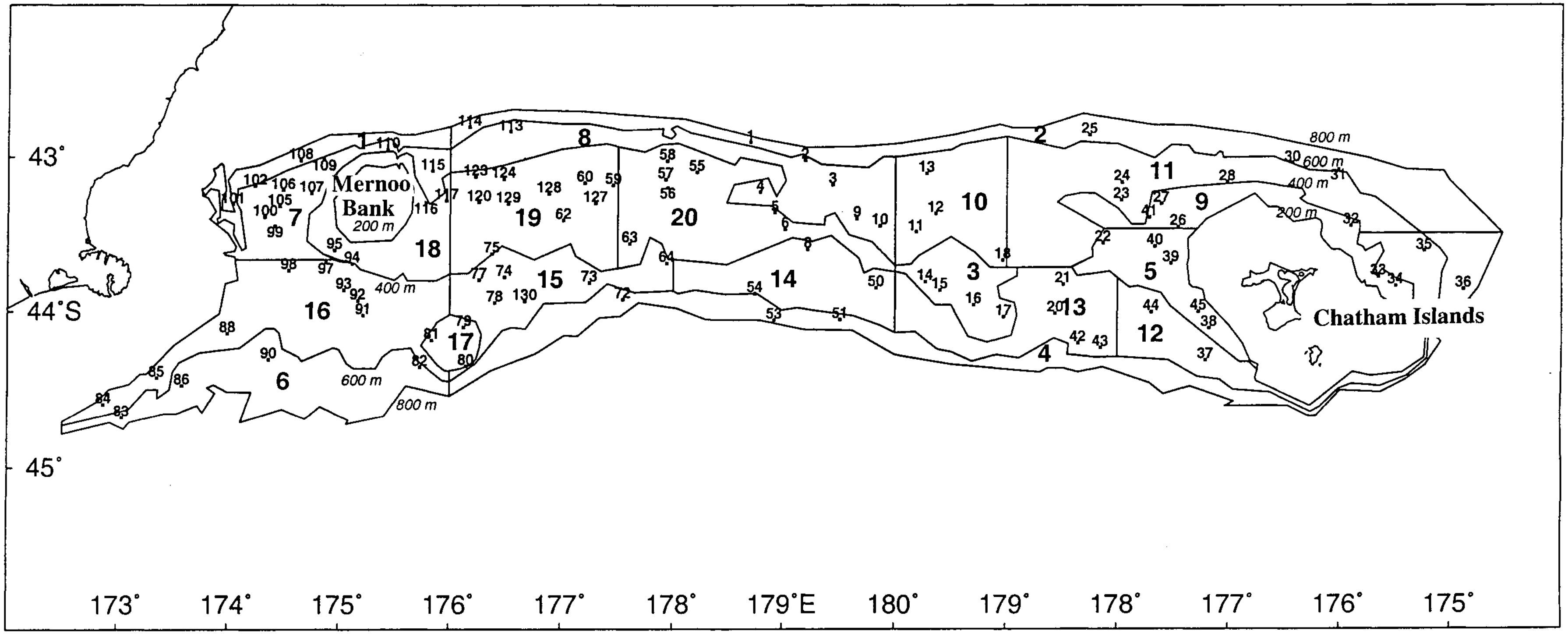


Figure 1: Chatham Rise showing survey area, strata and trawl survey station positions.

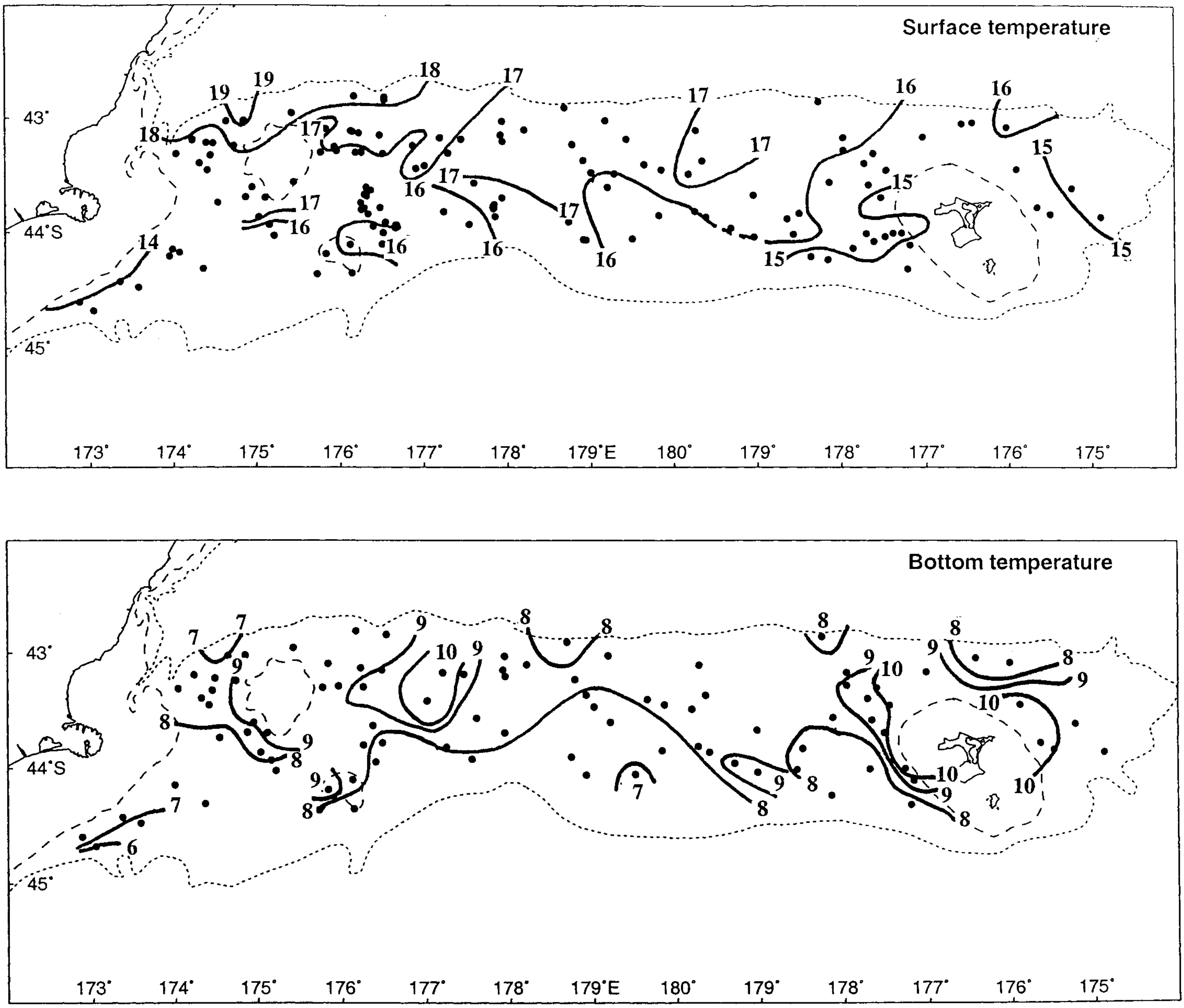


Figure 2: Positions of surface (top) and bottom temperature recordings and isotherms estimated from these data.

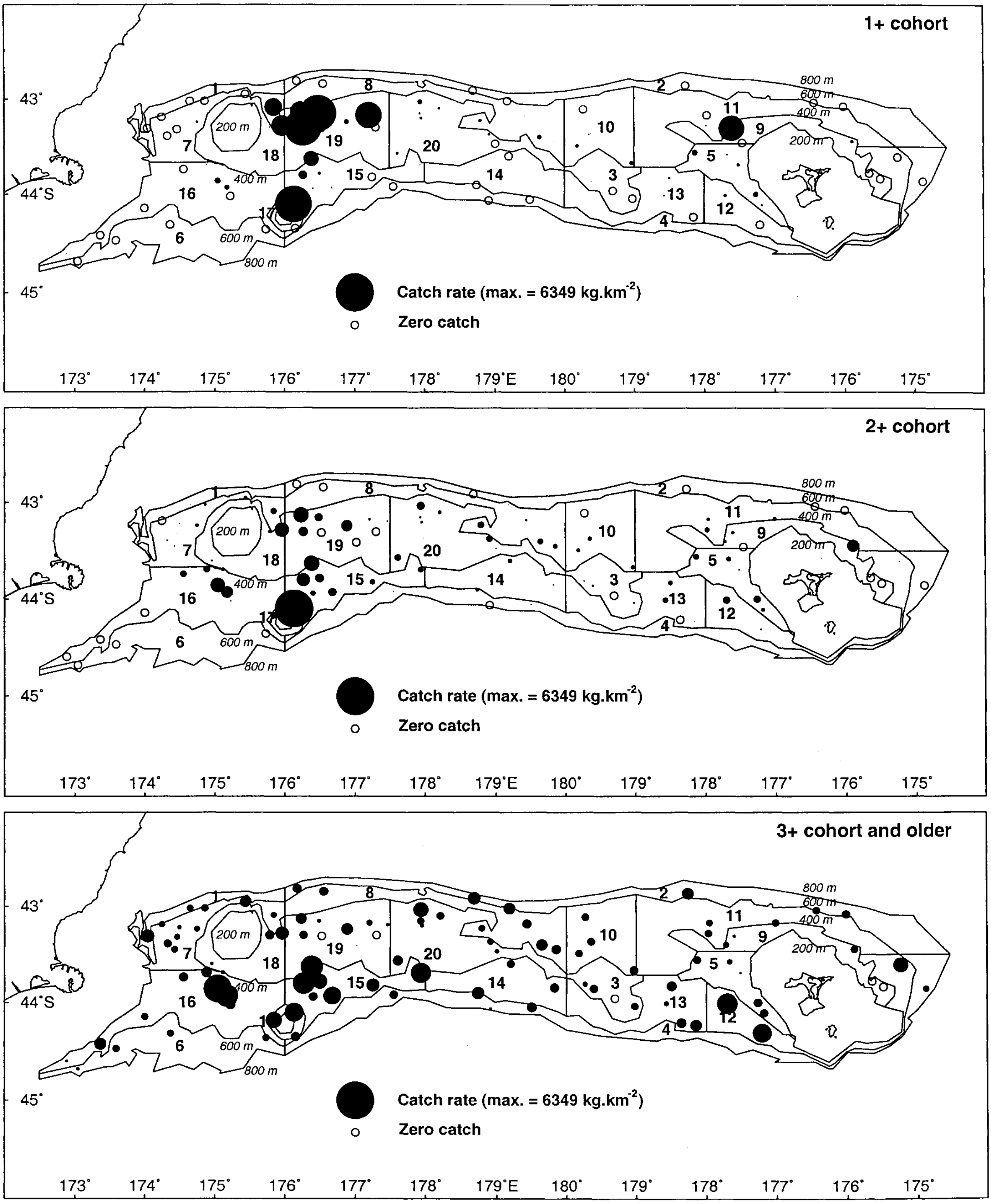


Figure 3: Catch rates (kg.km^{-2}) of cohort 1, cohort 2, and cohort 3 and older hoki. Circle area is proportional to catch rate. Max, maximum catch rate.

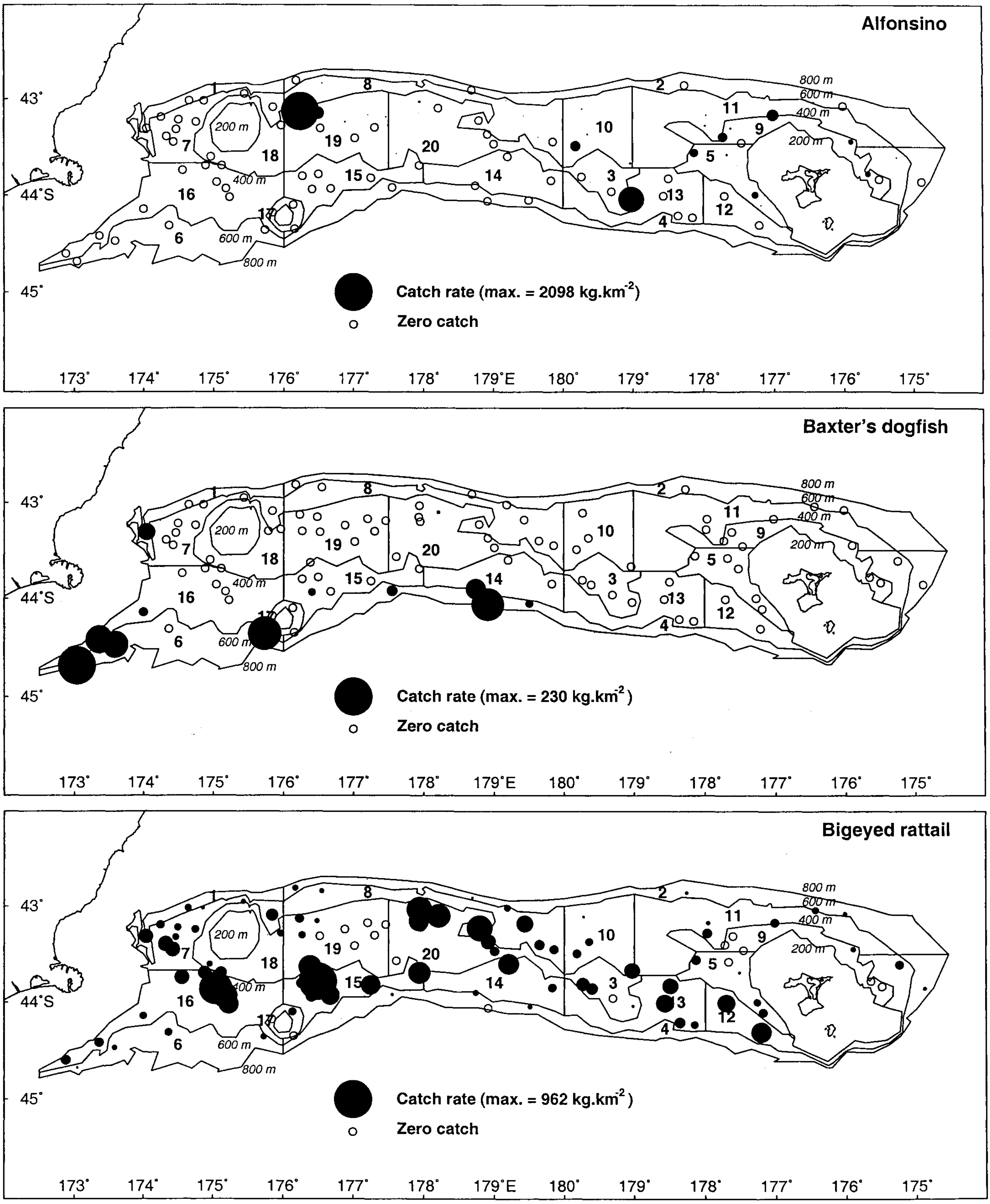


Figure 4: Catch rates ($kg.km^{-2}$) of the most abundant species. Circle area is proportional to catch rate. Max, maximum catch rate.

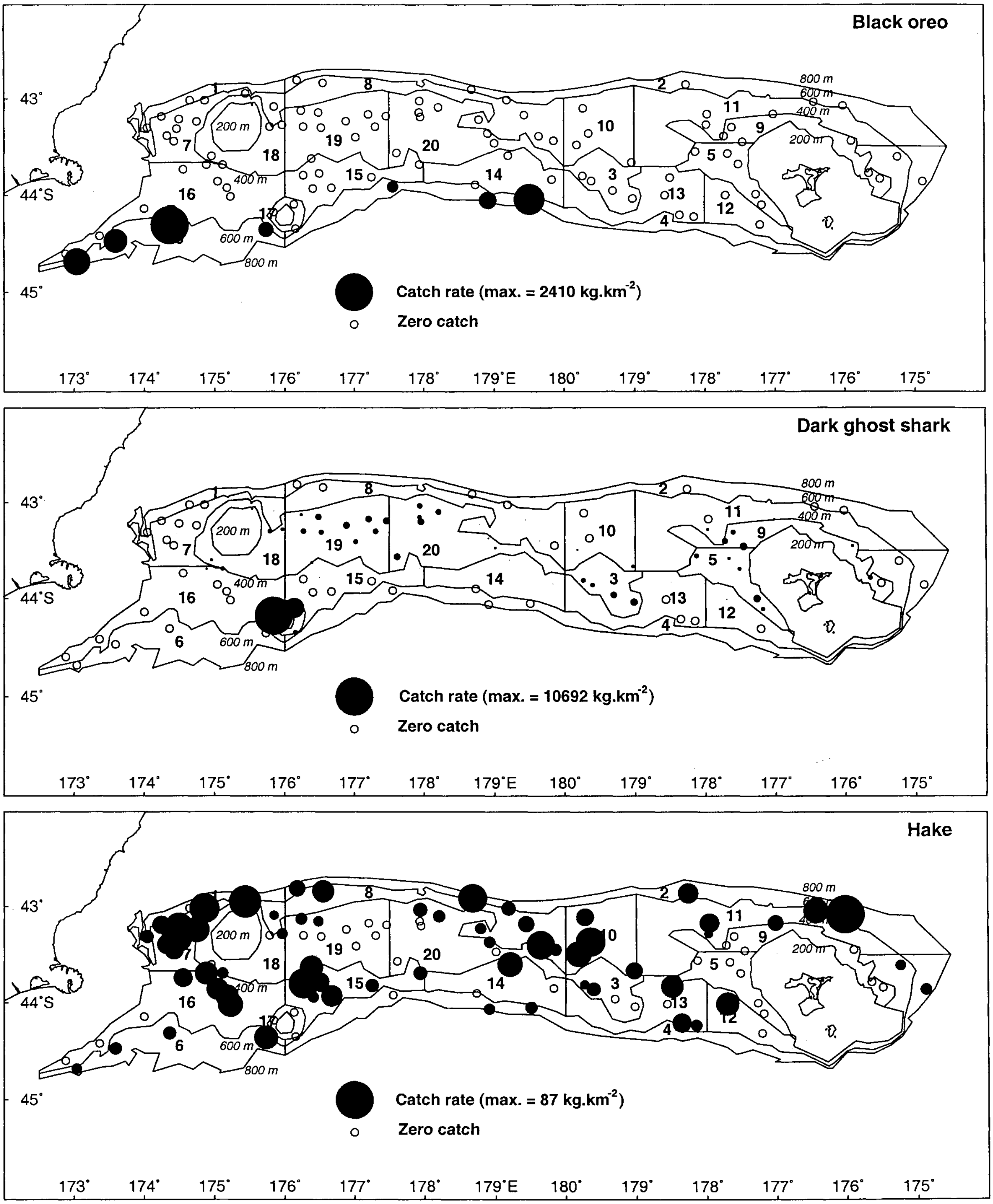


Figure 4 — *continued*

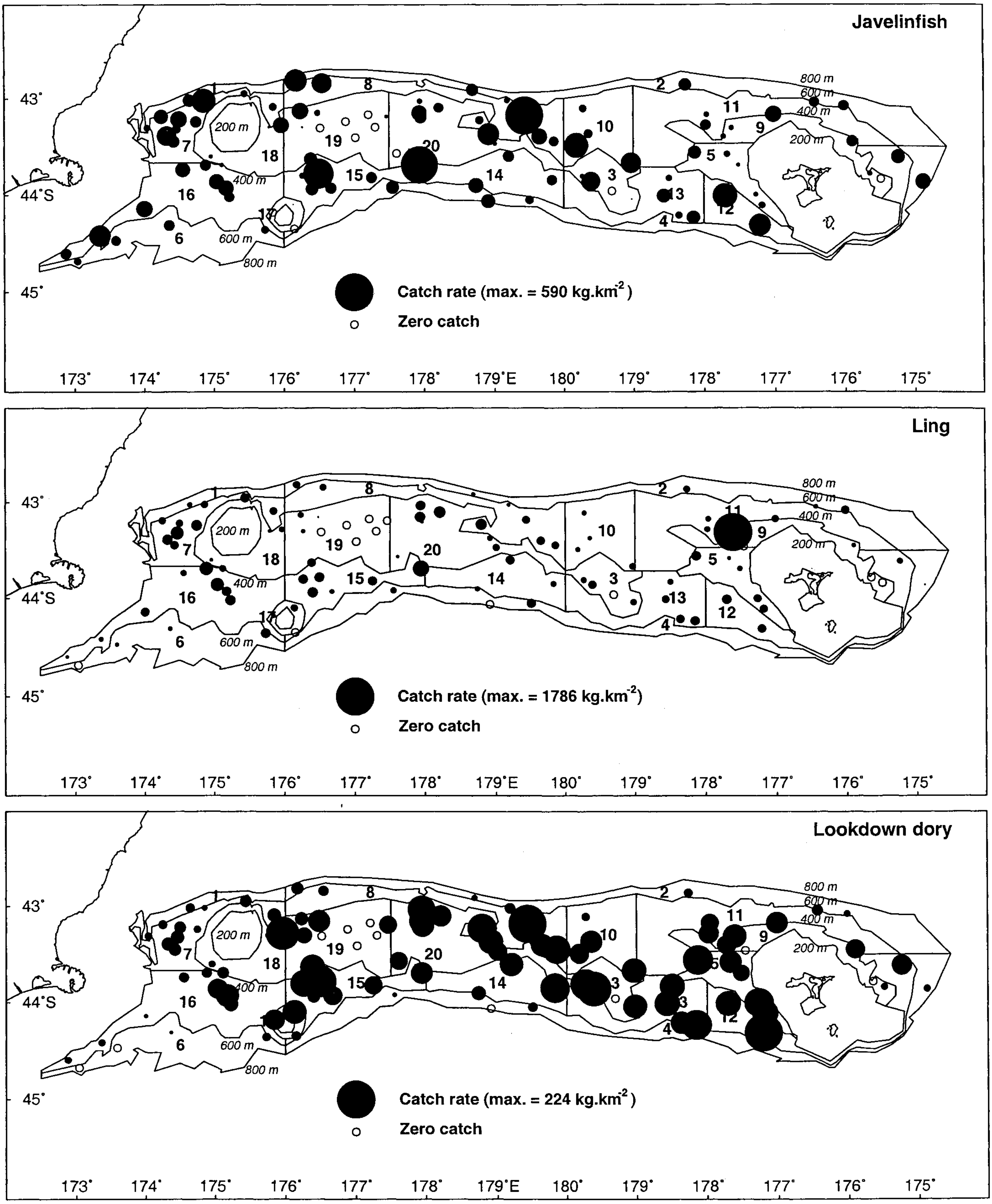


Figure 4 — *continued*

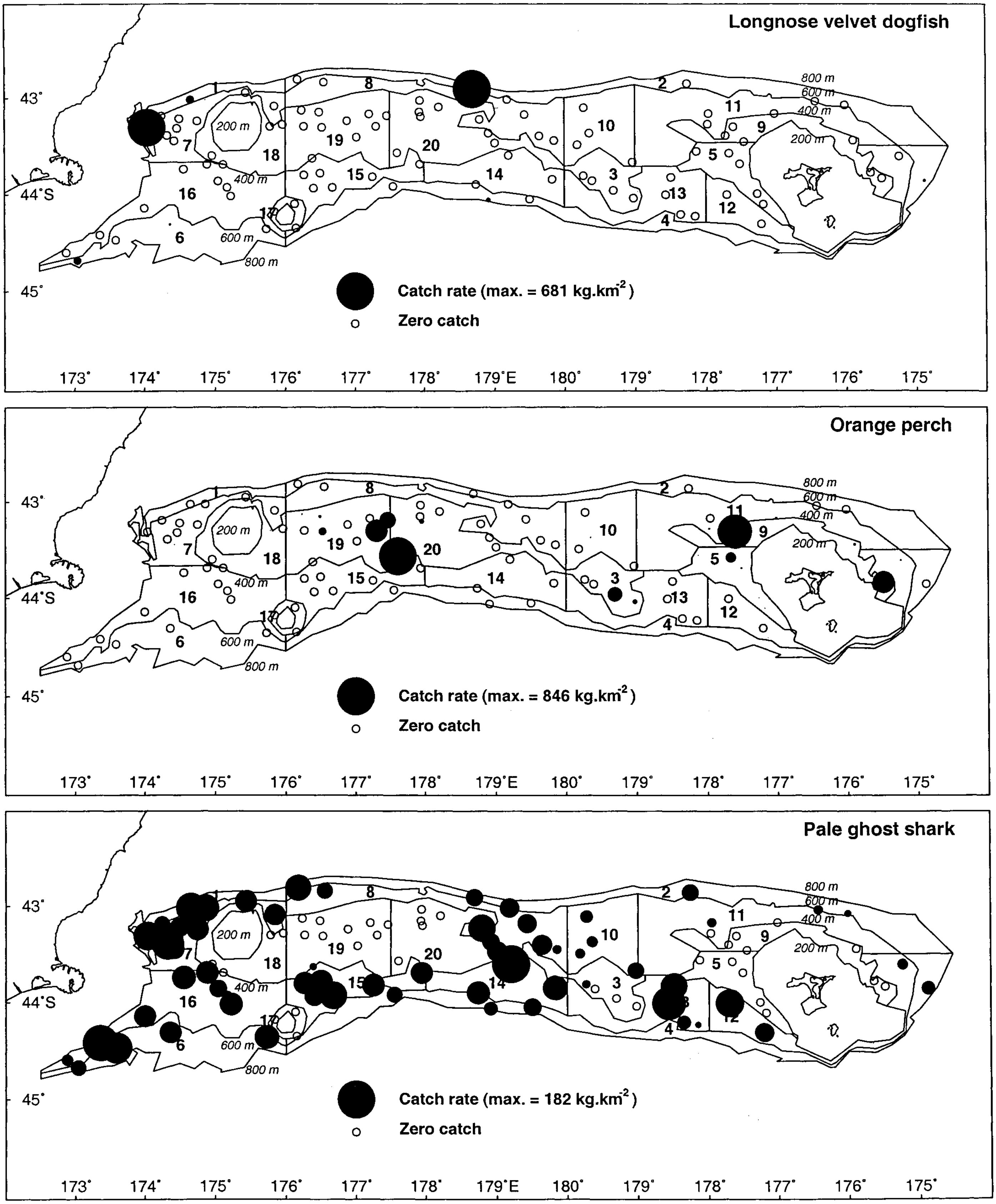


Figure 4 — *continued*

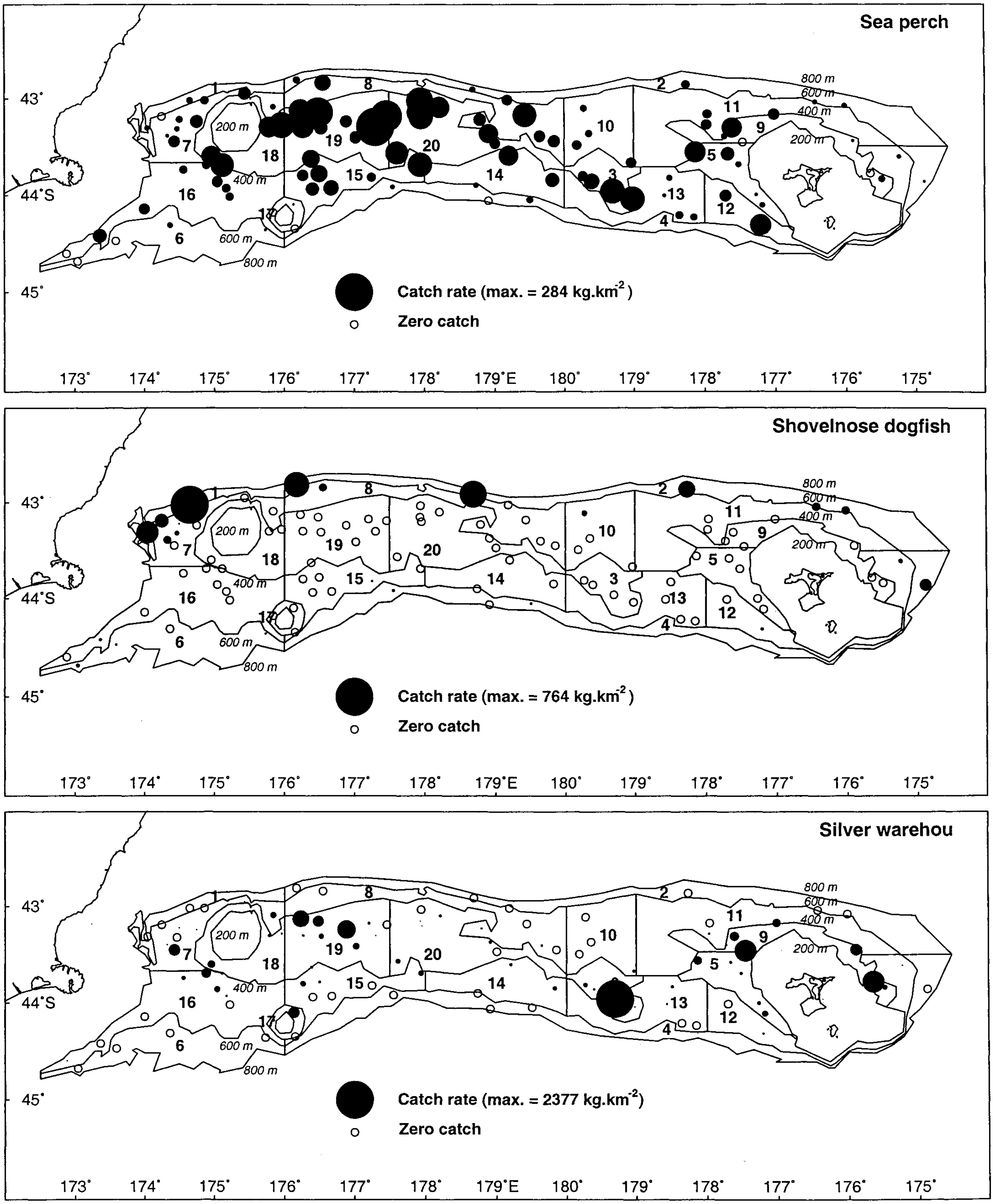


Figure 4 — *continued*

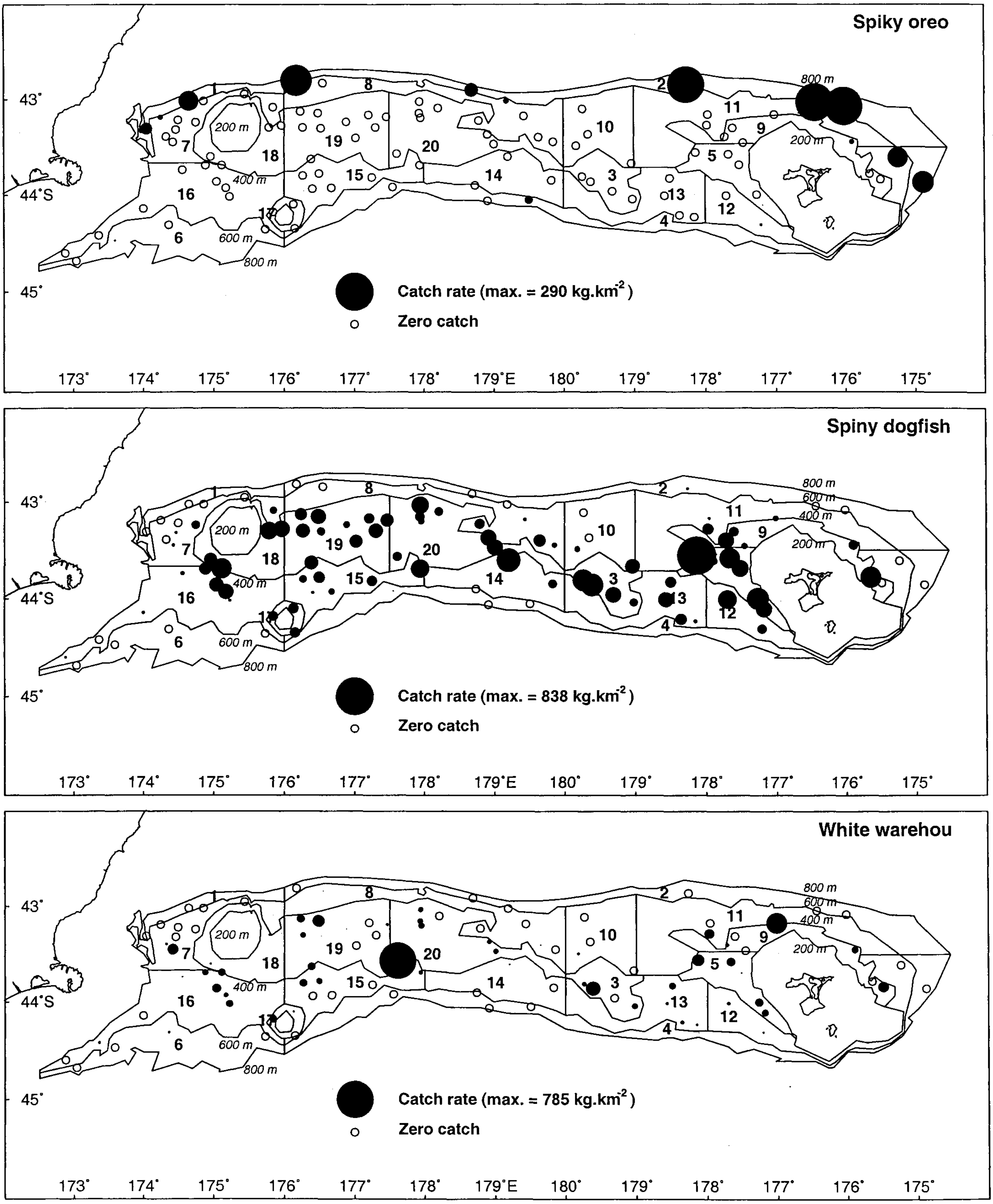


Figure 4 — *continued*

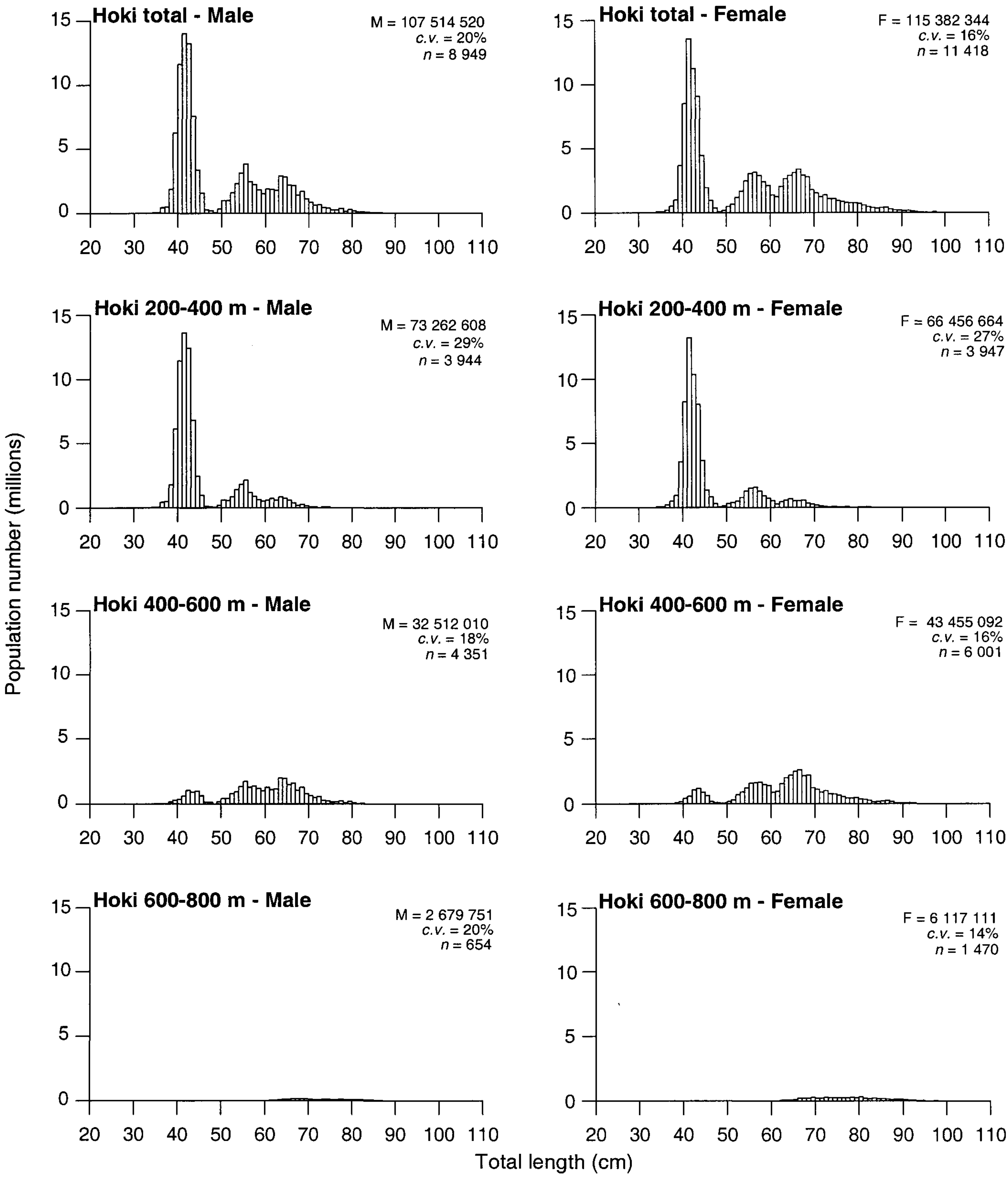


Figure 5a: Scaled length frequencies for hoki, by sex and depth zone (200--400, 400--600, 600--800 m). (M, estimated male population; F, estimated female population; *c.v.*, coefficent of variation of the estimated numbers of fish; n, number of fish measured).

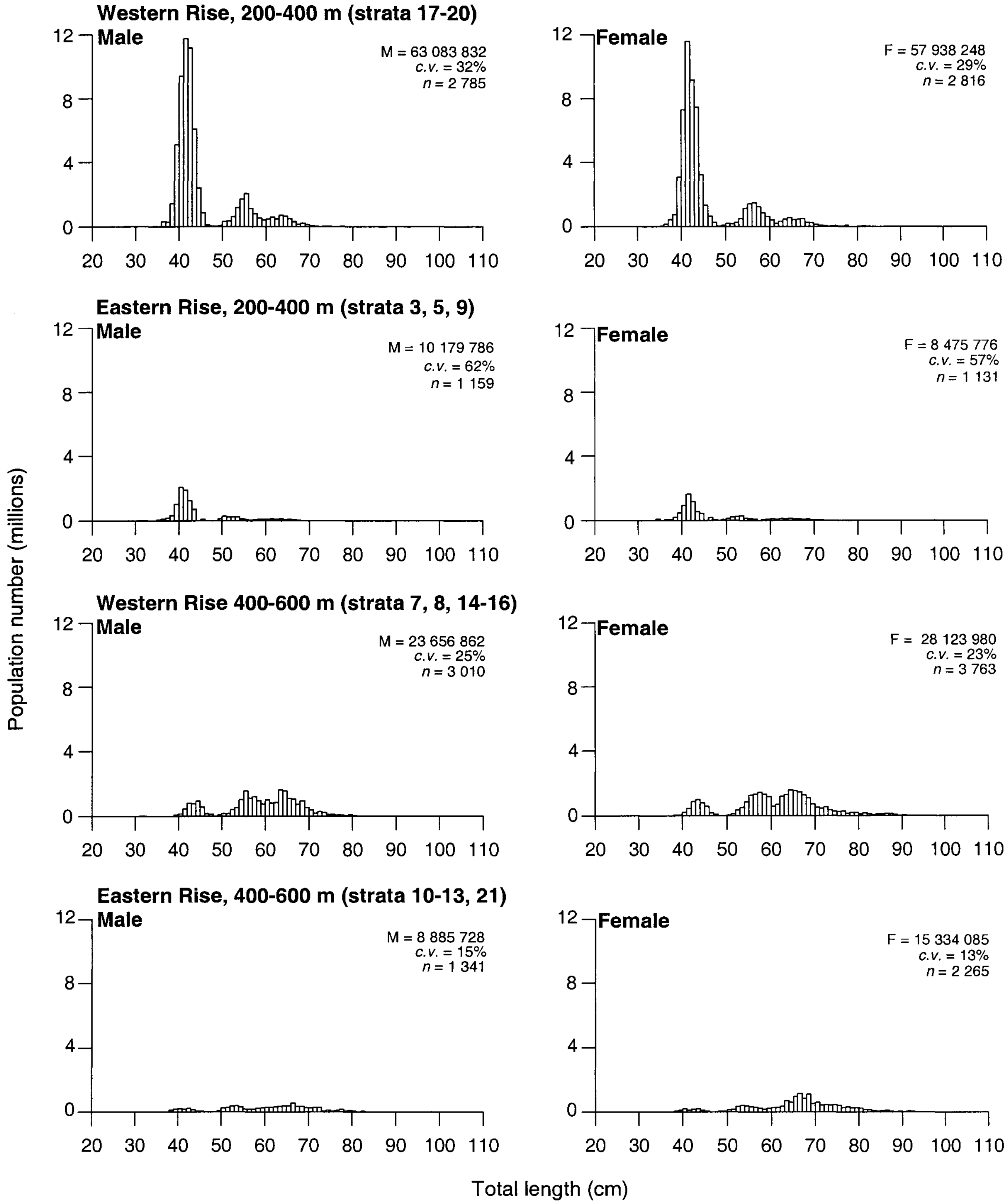


Figure 5b: Scaled length frequencies for hoki, by sex and depth zone (200--400, 400--600, 600--800 m) and area. (M, estimated male population; F, estimated female population; *c.v.*, coefficent of variation of the estimated numbers of fish; n, number of fish measured).

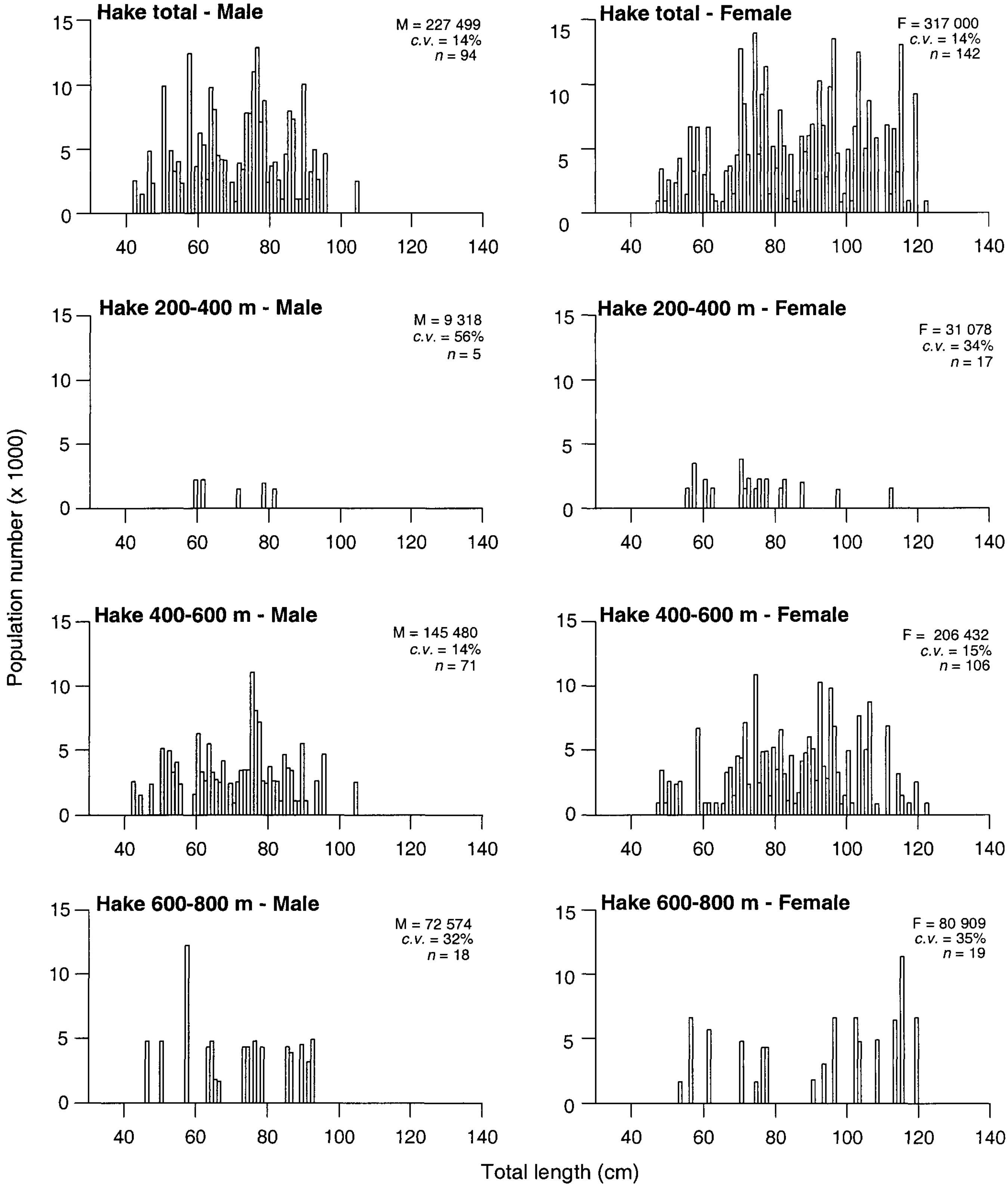


Figure 6: Scaled length frequencies for hake, by sex and depth zone (200--400, 400--600, 600--800 m). (M, estimated male population; F, estimated female population; *c.v.*, coefficent of variation of the estimated numbers of fish; n, number of fish measured).

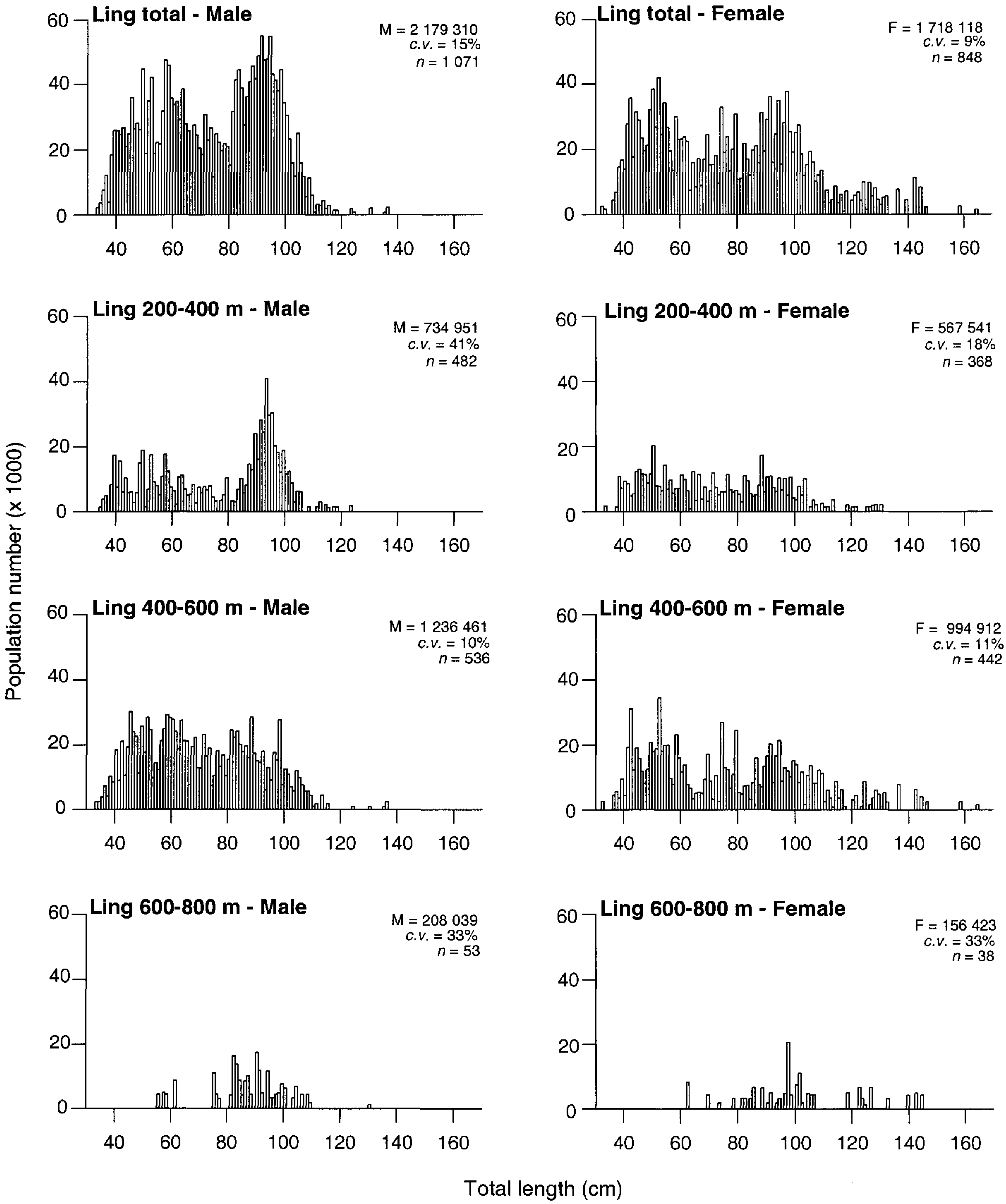


Figure 7: Scaled length frequencies for ling, by sex and depth zone (200--400, 400--600, 600--800 m). (M, estimated male population; F, estimated female population; *c.v.*, coefficent of variation of the estimated numbers of fish; n, number of fish measured).

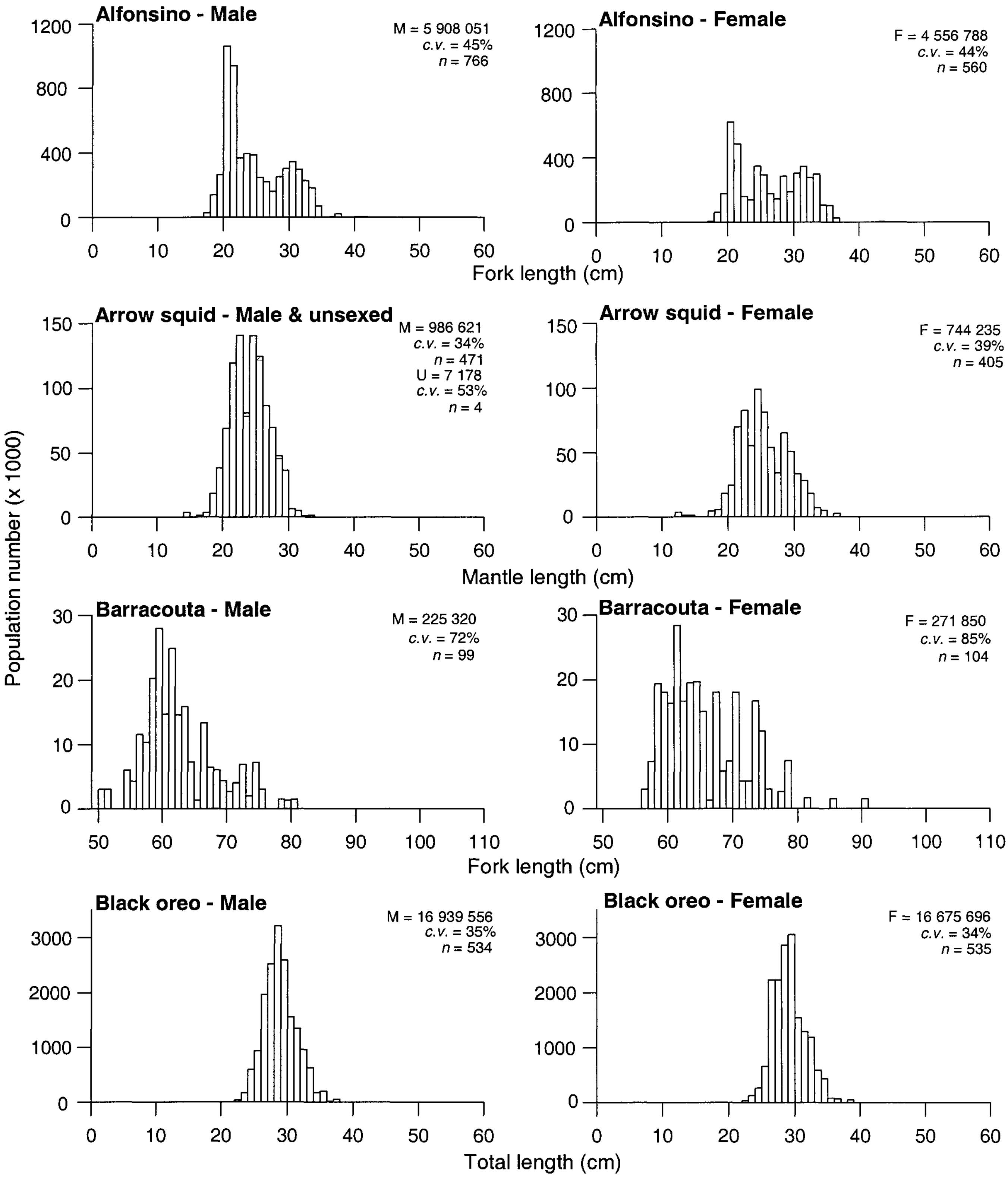


Figure 8: Scaled length frequencies for the major species, by sex. (M, estimated male population; F, estimated female population; U, estimated unsexed population (hatched bars); *c.v.* coefficient of variationof the estimated numbers of fish; n, number of fish measured).

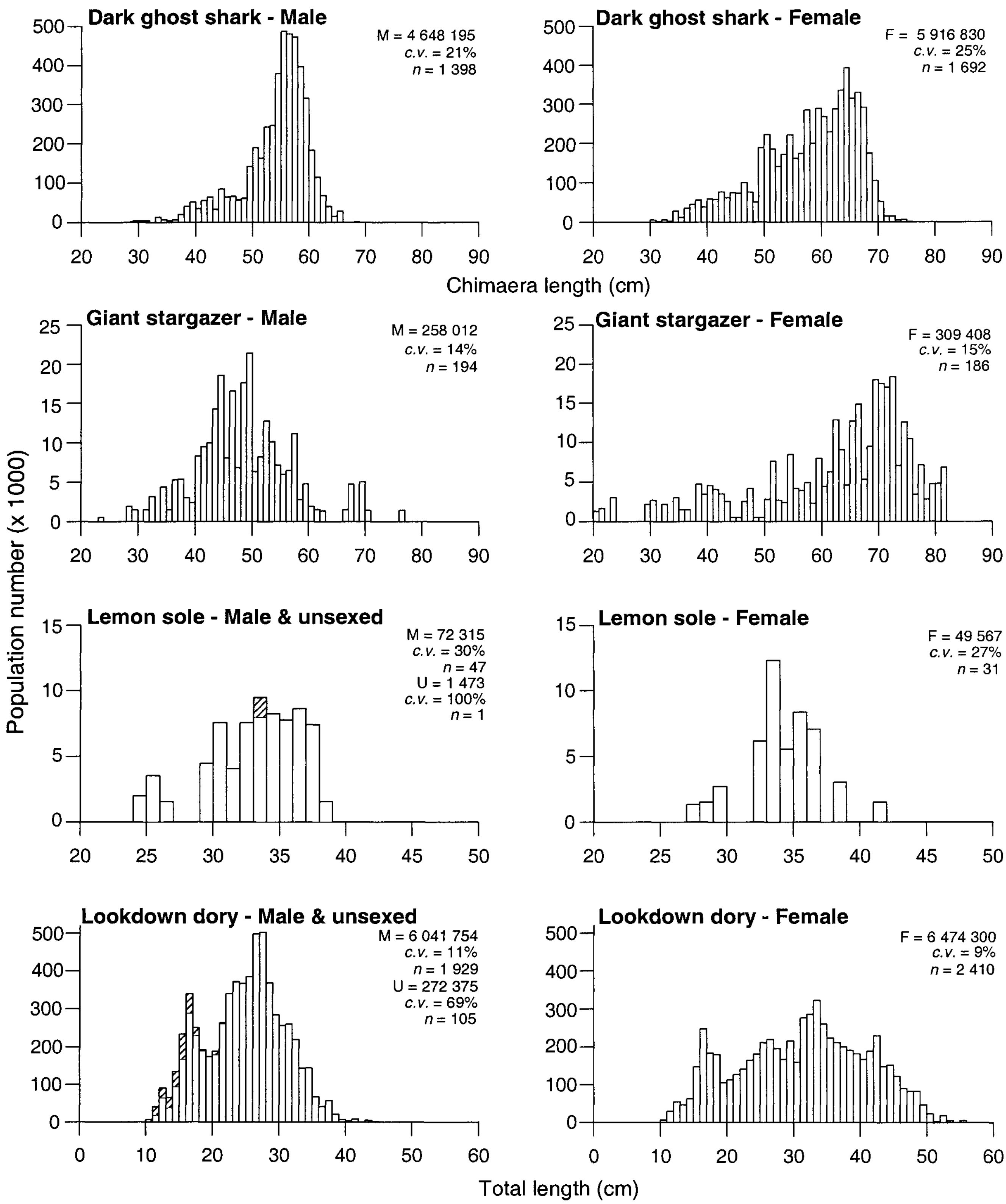


Figure 8 - ***continued***

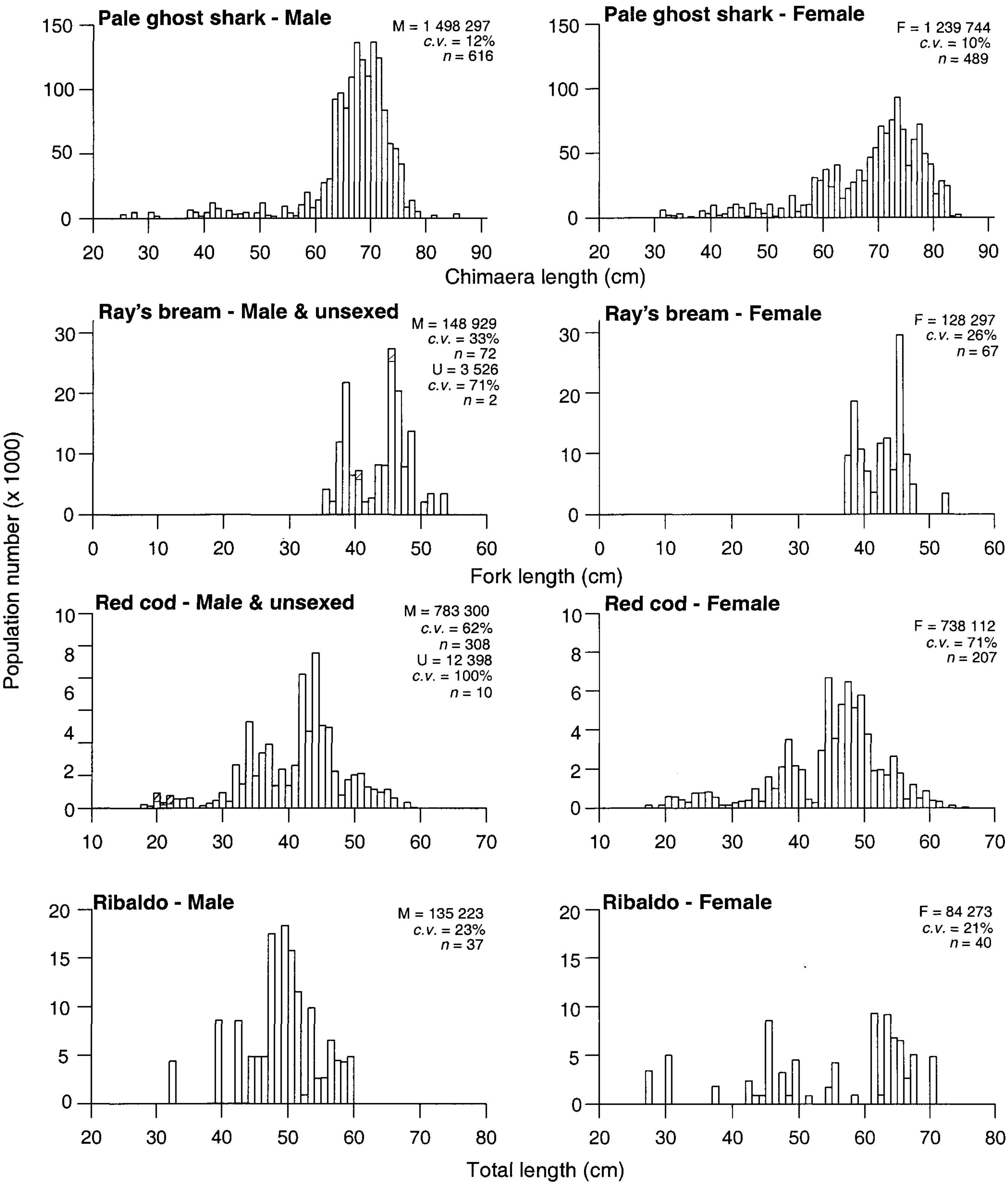


Figure 8 - ***continued***

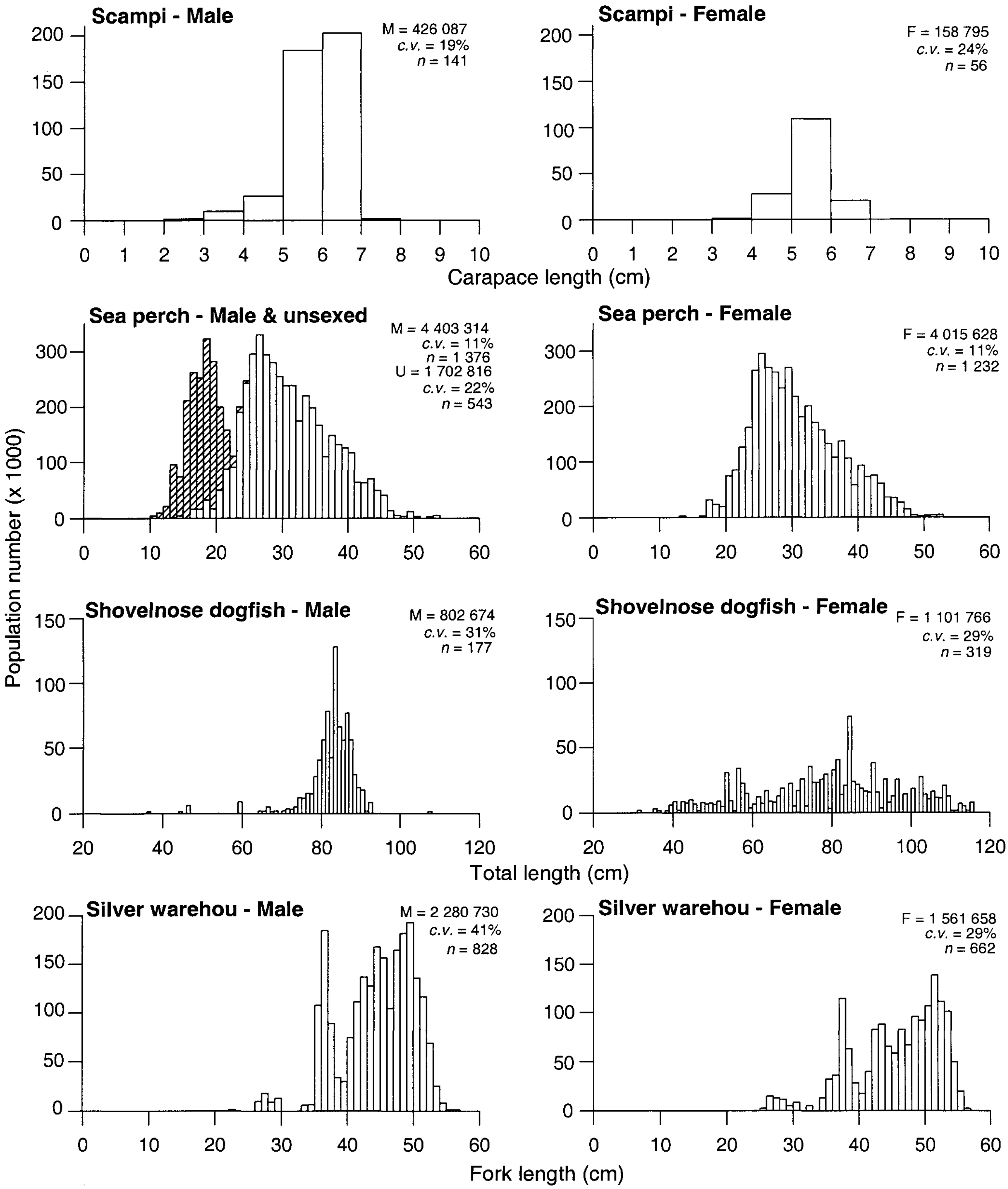


Figure 8 - ***continued***

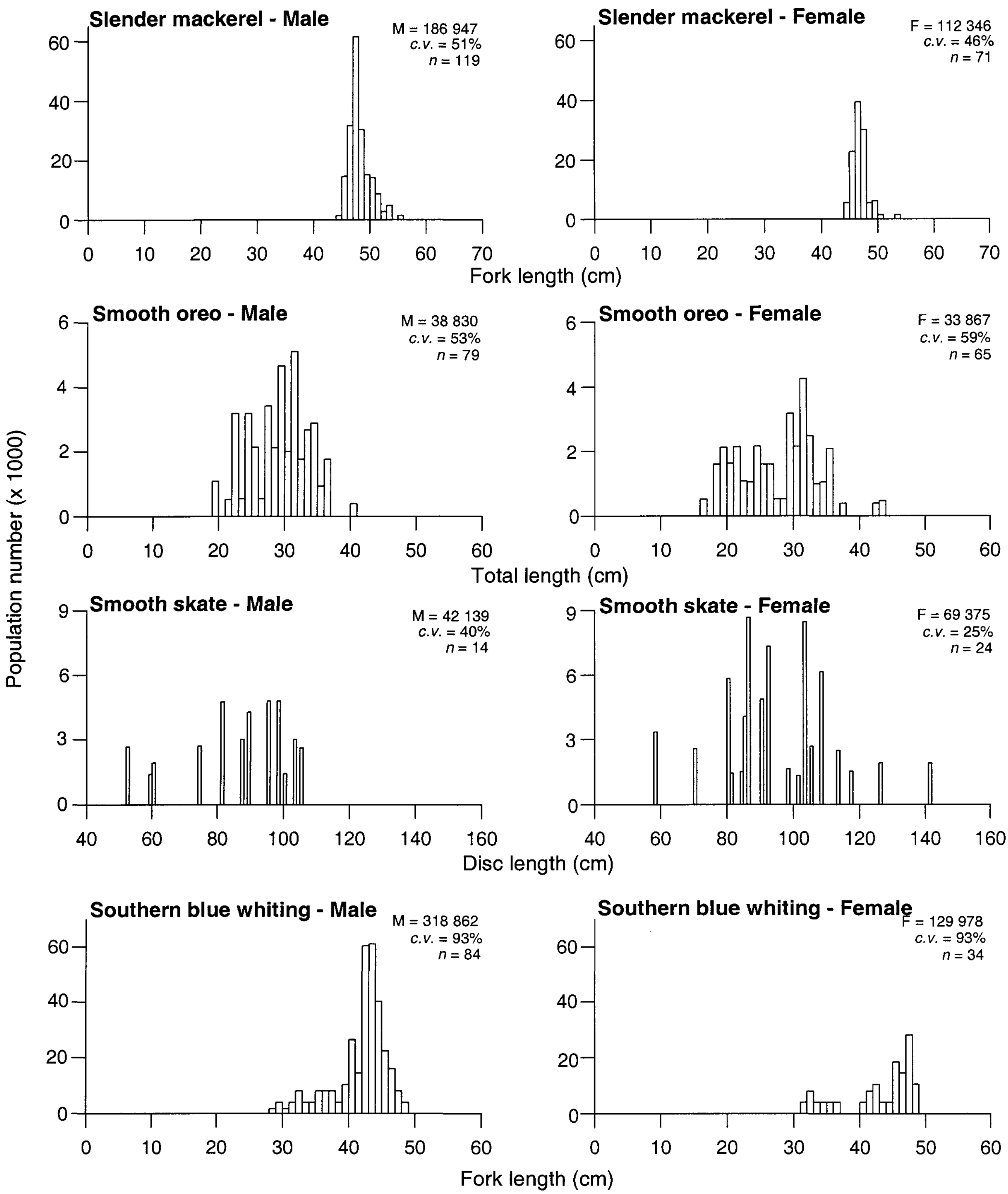


Figure 8 - ***continued***

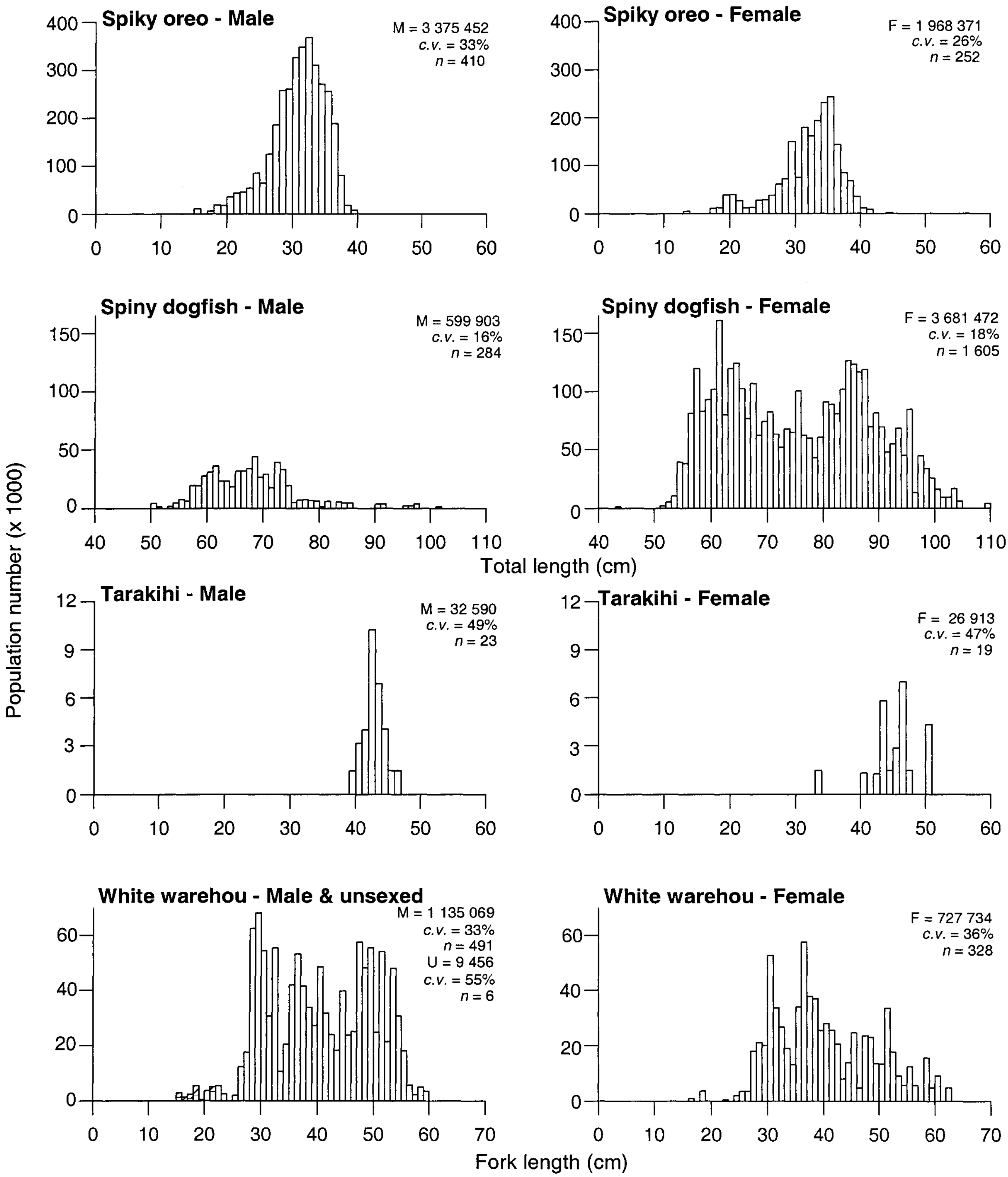


Figure 8 - ***continued***

Appendix 1: Individual station data for 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)		
			Date	Time	Latitude	Longitude				towed	hoki	ling	hake
Type	Stn.	Stratum	1999	NZDT	° ´S	° ´	E/W	min.	max.	(n.mile)			
BIO	1	2	04-Jan	450	42 54.30	178 41.58	E	715	758	2.9	438.3	14.3	30.3
BIO	2	8	04-Jan	823	43 01.39	179 11.31	E	508	513	3.0	412.5	13	8
BIO	3	8	04-Jan	1114	43 10.97	179 26.39	E	436	448	3.0	289.7	54.3	10.9
BIO	4	8	04-Jan	1446	43 13.91	178 47.14	E	414	414	3.0	296.1	99.2	4.8
BIO	5	20	04-Jan	1729	43 21.96	178 55.09	E	393	397	3.1	271.4	27.7	5.2
BIO	6	20	04-Jan	1927	43 28.28	179 00.78	E	367	377	2.0	42.3	27.3	0
AC	7		04-Jan	2344	43 28.90	179 17.48	E	150	170	1.6	2.1	0	0
BIO	8	14	05-Jan	432	43 36.00	179 12.80	E	422	436	3.0	251.4	64.7	24
BIO	9	8	05-Jan	813	43 24.22	179 39.29	E	414	457	3.0	531.3	57.5	30.6
BIO	10	8	05-Jan	1027	43 26.98	179 51.64	E	424	429	3.0	338.6	50.7	5.8
BIO	11	10	05-Jan	1307	43 29.36	179 48.74	W	400	426	2.9	262.1	21.4	25.8
BIO	12	10	05-Jan	1505	43 22.25	179 38.59	W	461	476	2.8	237.8	15.1	31.6
BIO	13	10	05-Jan	1811	43 06.42	179 43.43	W	526	531	3.0	197	25.8	13.1
BIO	14	3	06-Jan	444	43 48.67	179 43.88	W	375	379	3.0	94.8	30.9	3.5
BIO	15	3	06-Jan	704	43 51.84	179 35.94	W	349	357	3.0	235.1	58.5	7.7
BIO	16	3	06-Jan	929	43 57.52	179 17.91	W	208	227	3.0	0	0	0
BIO	17	3	06-Jan	1145	44 02.12	179 01.49	W	316	351	3.0	175.7	33	0
BIO	18	10	06-Jan	1517	43 40.31	179 02.02	W	404	425	3.0	334.2	36.3	11.1
BIO	*19	13	06-Jan	1901	43 52.54	178 37.95	W	456	468	2.0	0	0	0
BIO	20	13	07-Jan	439	44 00.72	178 33.63	W	446	457	3.0	171.4	48.7	0
BIO	21	13	07-Jan	705	43 49.77	178 29.23	W	438	449	3.0	373.8	29.6	20.6
BIO	22	5	07-Jan	1009	43 33.73	178 07.76	W	377	388	3.0	376.4	71.9	0
BIO	23	11	07-Jan	1306	43 16.82	177 57.96	W	416	451	3.0	256.3	29.6	3.2
BIO	24	11	07-Jan	1501	43 10.13	177 57.84	W	477	482	3.0	176.8	27	15.2
BIO	25	2	07-Jan	1845	42 51.40	178 15.45	W	611	631	2.5	372.2	37.9	15
BIO	26	9	08-Jan	441	43 27.40	177 27.48	W	269	272	3.0	2.5	0	0
BIO	27	9	08-Jan	721	43 18.39	177 36.60	W	338	348	3.0	1 768.1	1 078.0	0
BIO	28	11	08-Jan	1046	43 09.94	177 01.36	W	423	472	3.0	213.6	44	9.9
BIO	*29	11	08-Jan	1350	43 02.92	176 33.81	W	572	580	1.8	0	0	0
BIO	30	11	08-Jan	1536	43 02.40	176 26.28	W	570	582	3.0	183.6	19.8	26.2
BIO	31	2	08-Jan	1900	43 04.94	176 01.06	W	628	639	2.1	143.8	39.2	38.7
BIO	32	9	09-Jan	433	43 27.15	175 53.82	W	377	380	3.0	619.3	17.1	0
BIO	33	9	09-Jan	815	43 46.84	175 39.25	W	297	320	3.0	0	0	0
BIO	34	9	09-Jan	1000	43 50.42	175 29.63	W	260	314	2.4	0	0	0
BIO	35	12	09-Jan	1251	43 36.84	175 14.32	W	569	578	3.0	670	30.1	4.6
BIO	36	4	09-Jan	1618	43 51.70	174 52.86	W	709	723	3.0	143.8	3.8	6.2
BIO	37	12	10-Jan	851	44 18.83	177 12.41	W	466	475	3.0	1 083.5	64.3	0
BIO	38	5	10-Jan	1121	44 06.42	177 10.58	W	373	380	3.0	264.8	57.1	0
BIO	39	5	10-Jan	1456	43 41.54	177 31.27	W	350	366	3.0	55.5	23.8	0
BIO	40	5	10-Jan	1646	43 34.96	177 39.92	W	357	371	3.0	165.9	11.4	0
BIO	41	9	10-Jan	1856	43 23.81	177 42.99	W	353	373	2.2	136.4	26.1	0
BIO	42	13	11-Jan	438	44 12.38	178 21.11	W	504	512	3.0	284.3	57.9	14.6
BIO	43	13	11-Jan	643	44 14.05	178 08.90	W	524	536	3.0	396.4	69	5.8
BIO	44	12	11-Jan	952	44 00.42	177 41.79	W	427	445	3.0	1 346.7	70.3	20.9
BIO	45	5	11-Jan	1232	44 00.12	177 16.42	W	342	370	3.0	458.8	53.7	0
AC	46		12-Jan	1230	44 08.14	177 51.01	W	490	491	2.0	850.4	35.9	14.7
AC	47		12-Jan	1426	44 04.51	177 36.45	W	450	451	2.0	842.5	48.8	4.1
AC	48		12-Jan	1605	44 02.14	177 28.19	W	392	402	2.0	49	1	0
AC	49		12-Jan	1741	44 00.15	177 22.54	W	361	370	2.0	115.6	5.9	0

Appendix 1 — *continued*

Type	Stn.	Stratum	Date 1999	Time NZDT	Start of tow Latitude ° ´S	Longitude ° ´	E/W	Depth (m) min.	max.	Dist. towed (n.mile)	Catch (kg) hoki	ling	hake
BIO	50	14	13-Jan	454	43 50.94	179 49.75	E	439	445	2.6	223.6	26.2	0
BIO	51	4	13-Jan	746	44 03.25	179 30.45	E	633	643	3.0	298.4	70.5	6.2
BIO	*52	4	13-Jan	1416	44 03.78	178 57.11	E	757	765	1.3	0	0	0
BIO	53	4	13-Jan	1553	44 03.52	178 55.08	E	760	771	3.0	30.5	0	4.9
BIO	54	14	13-Jan	1854	43 54.15	178 44.50	E	522	567	3.0	476.9	23.2	0
BIO	55	20	14-Jan	452	43 06.01	178 12.44	E	351	364	3.0	251.8	108.8	6.3
BIO	56	20	14-Jan	711	43 12.18	177 56.80	E	317	339	3.0	106.2	12	0
BIO	57	20	14-Jan	905	43 08.97	177 55.56	E	365	395	3.0	198.5	91.5	0
BIO	58	20	14-Jan	1120	43 01.63	177 56.36	E	353	378	3.0	964.1	79.9	8.4
BIO	59	19	14-Jan	1503	43 11.14	177 27.38	E	282	297	3.0	45.5	0	0
BIO	60	19	14-Jan	1750	43 10.26	177 12.07	E	238	246	3.0	2 082.6	0	0
AC	61		14-Jan	2237	43 26.08	176 55.24	E	198	216	2.2	90.1	0	0
BIO	62	19	15-Jan	508	43 24.85	177 01.12	E	244	248	2.1	1.7	0	0
BIO	63	20	15-Jan	816	43 33.97	177 36.58	E	283	310	3.0	518.5	10.7	0
BIO	64	15	15-Jan	1103	43 41.49	177 56.38	E	463	464	3.0	1 258.6	211.5	8
AC	65		15-Jan	1414	43 51.47	177 51.60	E	559	563	2.0	237.6	53.9	17.9
AC	66		15-Jan	1608	43 45.28	177 50.92	E	473	484	2.0	727	51.3	12.8
AC	67		15-Jan	1849	43 47.31	177 50.44	E	359	457	2.0	24.7	0	0
AC	68		15-Jan	2015	43 45.89	177 49.94	E	215	225	1.4	0	0	0
AC	69		15-Jan	2121	43 46.79	177 50.60	E	277	284	1.1	2.4	0	0
AC	70		15-Jan	2333	43 46.44	177 50.04	E	406	417	1.0	2.9	0	0
AC	71		15-Jan	2354	43 47.07	177 50.74	E	489	495	0.6	32.2	1.6	0
BIO	72	4	16-Jan	518	43 55.41	177 32.86	E	687	740	3.0	240.4	35.1	0
BIO	73	15	16-Jan	801	43 49.10	177 14.80	E	498	514	3.0	606.7	72.6	7.6
BIO	74	15	16-Jan	1207	43 46.86	176 29.41	E	451	462	3.0	873.4	75.9	14.9
BIO	75	19	16-Jan	1440	43 37.81	176 22.62	E	378	382	3.0	2 685.5	58.3	21.6
BIO	*76	15	16-Jan	1646	43 44.42	176 15.48	E	404	406	1.5	0	0	0
BIO	77	15	16-Jan	1849	43 47.94	176 15.70	E	437	462	3.0	2 065.3	74.6	36.3
BIO	78	15	17-Jan	516	43 56.67	176 24.24	E	509	527	3.0	311.9	89.4	5.2
BIO	79	17	17-Jan	749	44 06.03	176 07.67	E	342	359	3.0	8 791.8	43.1	0
BIO	80	17	17-Jan	1253	44 21.02	176 08.83	E	303	382	3.0	228.8	0	0
BIO	81	17	17-Jan	1545	44 10.98	175 50.20	E	295	326	3.0	789.6	16.8	0
BIO	82	6	17-Jan	1753	44 21.59	175 44.03	E	605	694	3.0	151.8	76.4	22.3
BIO	83	6	18-Jan	541	44 40.67	173 02.61	E	725	740	2.1	29.1	0	3.4
BIO	84	16	18-Jan	809	44 35.85	172 52.50	E	401	449	2.8	24.9	9.4	0
BIO	85	16	18-Jan	1200	44 25.44	173 21.62	E	477	534	3.0	435.1	20.1	0
BIO	86	6	18-Jan	1418	44 28.35	173 35.13	E	680	709	3.0	181.4	16.7	7
BIO	*87	16	18-Jan	1730	44 12.05	173 57.41	E	584	589	2.0	0	0	0
BIO	88	16	18-Jan	1912	44 08.56	173 59.80	E	547	560	2.0	97.3	41.8	0
AC	89		19-Jan	232	44 10.35	174 04.60	E	573	574	0.8	14	6.7	0
BIO	90	6	19-Jan	533	44 18.53	174 21.90	E	643	646	3.0	150.6	18.1	7
BIO	91	16	19-Jan	1030	44 01.42	175 13.07	E	483	488	3.0	323.3	88	24.7
BIO	92	16	19-Jan	1236	43 55.72	175 09.92	E	448	453	3.0	1 741.9	69.8	19.3
BIO	93	16	19-Jan	1422	43 51.72	175 02.19	E	445	448	3.0	2 927.6	142.6	18.6
BIO	94	18	19-Jan	1633	43 41.55	175 06.87	E	383	393	3.0	108.4	39.1	5.2
BIO	95	18	19-Jan	1822	43 36.24	174 57.24	E	354	369	3.0	44.4	11.2	0
AC	96		19-Jan	2322	43 33.23	175 27.38	E	158	185	2.0	3	0	0
BIO	97	7	20-Jan	531	43 41.21	174 52.76	E	432	445	3.0	462.3	144.9	20.3
BIO	98	16	20-Jan	800	43 44.15	174 32.74	E	528	569	3.0	373.2	31.9	14.2
BIO	99	7	20-Jan	1136	43 27.05	174 25.08	E	520	537	3.0	156.9	64.9	15.5
BIO	100	7	20-Jan	1346	43 23.47	174 19.41	E	575	580	3.0	203.6	91.9	15.6

Appendix 1 — *continued*

			Start of tow					Depth (m)		Dist.	Catch (kg)		
			Date	Time	Latitude	Longitude				towed	hoki	ling	hake
Type	Stn.	Stratum	1999	NZDT	° ′S	° ′	E/W	min.	max.	(n.mile)			
BIO	101	1	20-Jan	1651	43 18.56	174 02.35	E	609	646	2.2	379.2	3.8	5.3
BIO	102	1	20-Jan	728	43 11.43	174 14.14	E	603	614	2.0	84.2	31.9	9.2
AC	103		20-Jan	2129	43 10.99	174 14.55	E	569	613	2.6	39.3	5.4	15.7
AC	104		21-Jan	241	43 12.80	174 24.44	E	550	560	1.1	34.6	11.3	9.7
BIO	105	7	21-Jan	532	43 19.38	174 27.44	E	525	532	3.0	118.4	149.9	39.8
BIO	106	7	21-Jan	730	43 13.03	174 29.25	E	548	558	3.0	63.1	49.3	37.2
BIO	107	7	21-Jan	1011	43 14.28	174 44.51	E	431	459	3.0	163.4	96.4	26.2
BIO	108	1	21-Jan	1307	43 01.33	174 38.57	E	634	657	3.0	145.1	23.5	0
BIO	109	7	21-Jan	1522	43 00.99	174 51.11	E	542	560	3.0	186.1	45.3	34.9
BIO	110	7	21-Jan	1902	42 57.10	175 25.59	E	494	521	2.5	359.3	68.2	37.6
AC	111		21-Jan	2341	43 06.82	176 09.15	E	417	420	1.0	121.3	30.2	2.9
AC	112		22-Jan	116	43 06.71	176 08.06	E	428	428	1.0	13.3	0	0
BIO	113	8	22-Jan	519	42 50.18	176 32.39	E	497	510	3.0	243.6	40.3	19.6
BIO	114	2	22-Jan	804	42 48.35	176 10.44	E	647	657	3.0	255	50.2	11.3
BIO	115	7	22-Jan	1129	43 05.50	175 50.22	E	454	475	3.0	1 216.4	50.3	3.6
BIO	116	18	22-Jan	1404	43 17.97	175 46.56	E	304	335	3.0	289.7	10.2	0
BIO	117	18	22-Jan	1610	43 17.07	175 57.72	E	371	382	3.0	2 377.8	30.5	5
AC	118		22-Jan	1838	43 16.56	175 57.83	E	371	374	3.0	1 320.9	19.6	12.3
AC	119		23-Jan	223	43 14.94	175 56.25	E	378	383	1.0	39.1	4.5	3.4
BIO	120	19	23-Jan	518	43 17.83	176 15.59	E	325	350	3.0	4 151.7	14.9	0
AC	121		23-Jan	738	43 17.58	176 15.62	E	325	351	3.0	2 293.6	5.9	0
AC	122		23-Jan	1501	43 17.96	176 11.56	E	310	331	2.5	425.8	0	0
BIO	123	19	23-Jan	1630	43 07.81	176 13.67	E	360	393	3.0	2 164.8	30	5.6
BIO	124	19	23-Jan	1841	43 08.81	176 28.80	E	316	320	3.0	4 040.5	3.2	4.6
AC	125		23-Jan	2142	43 54.32	176 33.20	E	456	456	0.4	0	0	0
AC	126		23-Jan	2358	42 48.82	176 32.30	E	532	534	0.7	72.5	9	3.8
BIO	127	19	24-Jan	515	43 18.21	177 18.00	E	210	226	3.0	0	0	0
BIO	128	19	24-Jan	750	43 14.43	176 52.98	E	266	273	3.0	829.3	0	0
BIO	*129	19	24-Jan	1010	43 18.40	176 31.14	E	266	273	3.0	0	0	0
BIO	130	15	24-Jan	1500	43 55.96	176 40.43	E	483	494	3.1	1 156.9	20.4	18.9
AC	131		25-Jan	108	43 55.89	176 40.96	E	492	503	1.5	66	9.8	0
AC	132		25-Jan	220	43 56.90	176 41.93	E	498	510	1.5	88.7	28.6	5.5
AC	133		25-Jan	341	43 57.36	176 40.30	E	500	508	1.5	31.5	14.6	0.5
AC	134		25-Jan	1148	43 35.98	176 19.09	E	375	378	2.0	1 405.3	59.1	6.9
AC	*135		25-Jan	1327	43 39.96	176 18.09	E	381	383	1.0	0	0	0
AC	136		25-Jan	1438	43 40.76	176 19.48	E	383	389	2.0	903.3	10.3	4.1
AC	137		25-Jan	1627	43 47.10	176 17.99	E	429	434	2.0	2 925.0	42.7	22.7
AC	138		25-Jan	1815	43 50.05	176 20.55	E	480	483	2.0	223.1	56.4	10.8
AC	139		25-Jan	2129	44 05.85	176 31.04	E	585	587	0.5	16.3	10	0
AC	140		25-Jan	2356	43 59.87	176 31.56	E	510	519	1.5	81.8	32.1	2
AC	141		26-Jan	741	44 03.07	176 49.12	E	586	591	2.0	234	43	3.4
AC	142		26-Jan	915	44 03.05	176 49.74	E	589	598	3.0	374.9	5.1	10.6

* 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 from successful biomass stations. The occurrence (Occ.) of each species in the 100 successful biomass tows is also shown.

Scientific name	Common name	Code	Occ.
Agnatha			
Myxinidae: hagfishes			
Eptatretus cirrhatus	hagfish	HAG	2
Chondrichthyes			
Chlamydoselachidae: frill shark			
Chlamydoselachus anguineus	frill shark	FRS	2
Hexanchidae: cow sharks			
Hexanchus griseus	sixgill shark	HEX	1
Squalidae: dogfishes			
Centrophorus squamosus	deepwater spiny dogfish	CSQ	4
Centroscymnus crepidater	longnose velvet dogfish	CYP	8
C. owstoni	Owston's dogfish	CYO	3
C. plunketi	Plunket's shark	PLS	8
Deania calcea	shovelnose dogfish	SND	24
Etmopterus baxteri	Baxter's dogfish	ETB	14
E. lucifer	Lucifer dogfish	ETL	60
Scymnorhinus licha	seal shark	BSH	22
Squalus acanthias	spiny dogfish	SPD	74
S. mitsukurii	northern spiny dogfish	NSD	7
Oxynotidae: rough sharks			
Oxynotus bruniensis	prickly dogfish	PDG	13
Scyliorhinidae: cat sharks			
Apristurus spp.	deepsea catsharks	APR	5
Halaelurus dawsoni	Dawson's catshark	DCS	1
Triakidae: smoothhounds			
Galeorhinus galeus	school shark	SCH	9
Torpedinidae: electric rays			
Torpedo fairchildi	electric ray	ERA	1
Rajidae: skates			
Notoraja asperula	smooth bluntnosed skate	BTA	18
N. spinifera	prickly bluntnosed skate	BTS	5
Dipturus innominatus	smooth skate	SSK	34
D. nasutus	rough skate	RSK	3
Chimaeridae: chimaeras, ghost sharks			
Hydrolagus novaezelandiae	dark ghost shark	GSH	55
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	38
Nemichthyidae: snipe eels			
Nemichthys curvirostris	snipe eel	NCU	1
Congridae: conger eels			
Bassanago bulbiceps	swollenheaded conger	SCO	36
B. hirsutus	hairy conger	HCO	26
Gonorynchidae: sandfish			
Gonorynchus spp.	sandfish	GON	1
Argentinidae: silversides			
Argentina elongata	silverside	SSI	60

Appendix 2 — *continued*

Scientific name	Common name	Code	Occ.
Alepocephalidae: slickheads			
Rouleina sp.	large headed slickhead	BAT	1
Xenodermichthys socialis	black slickhead	BSL	1
Sternoptychidae: hatchetfishes			
Maurolicus australis	pearlside	MMU	1
Photichthyidae: lighthouse fishes			
Photichthys argenteus	lighthouse fish	PHO	4
Malacosteidae	loosejaws	MAL	1
Scopelarchidae: pearleyes			
Scopelarchus sp.		SCP	1
Paralepididae: barracudinas			
Magnisudis prionosa	barracudina	BCA	2
Paralepididae	barracudinas	PAL	3
Myctophidae: lanternfishes			
Species not identified	lanternfish	LAN	2
Lampanyctus spp	lanternfish	LPA	1
Moridae: morid cods			
Austrophycis marginata	dwarf cod	DCO	4
Halargyreus johnsoni	slender cod	HJO	5
Lepidion microcephalus	small headed cod	SMC	1
Mora moro	ribaldo	RIB	28
Pseudophycis bachus	red cod	RCO	31
Gadidae: true cods			
Micromesistius australis	southern blue whiting	SBW	4
Merlucciidae: hakes			
Macruronus novaezelandiae	hoki	HOK	95
Merluccius australis	hake	HAK	62
Macrouridae: rattails, grenadiers			
Caelorinchus aspercephalus	oblique banded rattail	CAS	72
C. biclinozonalis	two saddle rattail	CBI	10
C. bollonsi	bigeyed rattail	CBO	83
C. fasciatus	banded rattail	CFA	29
C. innotabilis	notable rattail	CIN	4
C. matamua	Mahia rattail	CMA	4
C. oliverianus	Oliver's rattail	COL	54
C. parvifasciatus	small banded rattail	CCX	13
Coryphaenoides serrulatus	serrulate rattail	CSE	3
C. subserrulatus	four rayed rattail	CSU	4
Coryphaenoides sp. B	long barbel rattail	CBA	4
Lepidorhynchus denticulatus	javelinfish	JAV	90
Macrourus carinatus	ridge scaled rattail	MCA	1
Mesobius antipodum	black javelinfish	BJA	1
Trachyrincus aphyodes	unicorn rattail	WHX	5
Ventrifossa nigromaculata	blackspot rattail	VNI	10
Ophidiidae: cusk eels			
Genypterus blacodes	ling	LIN	87
Scomberesocidae: sauries			
Scomberesox saurus	saury	SAU	1
Trachichthyidae: roughies			
Hoplostethus atlanticus	orange roughy	ORH	2
Hoplostethus mediterraneus	silver roughy	SRH	18
Paratrachichthys trailli	common roughy	RHY	14
Berycidae: alfonsinos			
Beryx splendens	slender beryx	BYS	36
B. decadactylus	longfinned beryx	BYD	1

Appendix 2 — ***continued***

Scientific name	Common name	Code	Occ.
Zeidae: dories			
Capromimus abbreviatus	capro dory	CDO	14
Cyttus novaezelandiae	silver dory	SDO	20
C. traversi	lookdown dory	LDO	89
Zenopsis nebulosus	mirror dory	MDO	1
Oreosomatidae: oreos			
Allocyttus niger	black oreo	BOE	7
Neocyttus rhomboidalis	spiky oreo	SOR	16
Pseudocyttus maculatus	smooth oreo	SSO	8
Macrorhamphosidae: snipefishes			
Centriscops obliquus	banded bellowsfish	BBE	67
Notopogon lilliei	crested bellowsfish	CBE	2
Scorpaenidae: scorpionfishes			
Helicolenus spp.	sea perch	SPE	90
Congiopodidae: pigfishes			
Alertichthys blacki	alert pigfish	API	2
Congiopodus coriaceus	deepsea pigfish	DSP	2
Triglidea: gurnards			
Chelidonichthys kumu	red gurnard	GUR	1
Lepidotrigla brachyoptera	scaly gurnard	SCG	9
Hoplichthyidae: ghostflatheads			
Hoplichthys haswelli	deepsea flathead	FHD	36
Psychrolutidae: toadfishes			
Amblophthalmus angustus	pale toadfish	TOP	39
Percichthyidae: temperate basses			
Polyprion oxygeneios	hapuku	HAP	8
Serranidae: sea perches			
Lepidoperca aurantia	orange perch	OPE	26
Apogonidae: cardinalfishes			
Epigonus lenimen	bigeye cardinalfish	EPL	7
E. robustus	cardinalfish	EPR	8
E. telescopus	black cardinalfish	EPT	7
Rosenblattia robusta		ROS	1
Carangidae: jacks, trevallies, kingfishes			
Trachurus symmetricus	slender mackerel	JMM	14
T. declivis	jack mackerel	JMD	2
Bramidae: pomfrets			
Brama brama	Ray's bream	RBM	34
Taraticththys longipinnis	big scaled pomfret	BSP	1
Emmelichthyidae: bonnetmouths, rovers			
Emmelichthys nitidus	redbait	RBT	17
Plagiogeneion rubiginosus	rubyfish	RBY	1
Pentacerotidae: boarfishes, armourheads			
Pseudopentaceros richardsoni	southern boarfish	SBO	1
Cheilodactylidae: tarakihi, morwongs			
Nemadactylus macropterus	tarakihi	TAR	8
Uranoscopidae: armourhead stargazers			
Kathetostoma giganteum	giant stargazer	STA	56
Kathetostoma sp.	banded giant stargazer	BGZ	1
Percophidae: opalfishes			
Hemerocoetes spp.	opalfish	OPA	2
Pinguipedidae: weavers			
Parapercis gilliesi	yellow weaver	YCO	1
Gempylidae: snake mackerels			
Thyrsites atun	barracouta	BAR	14

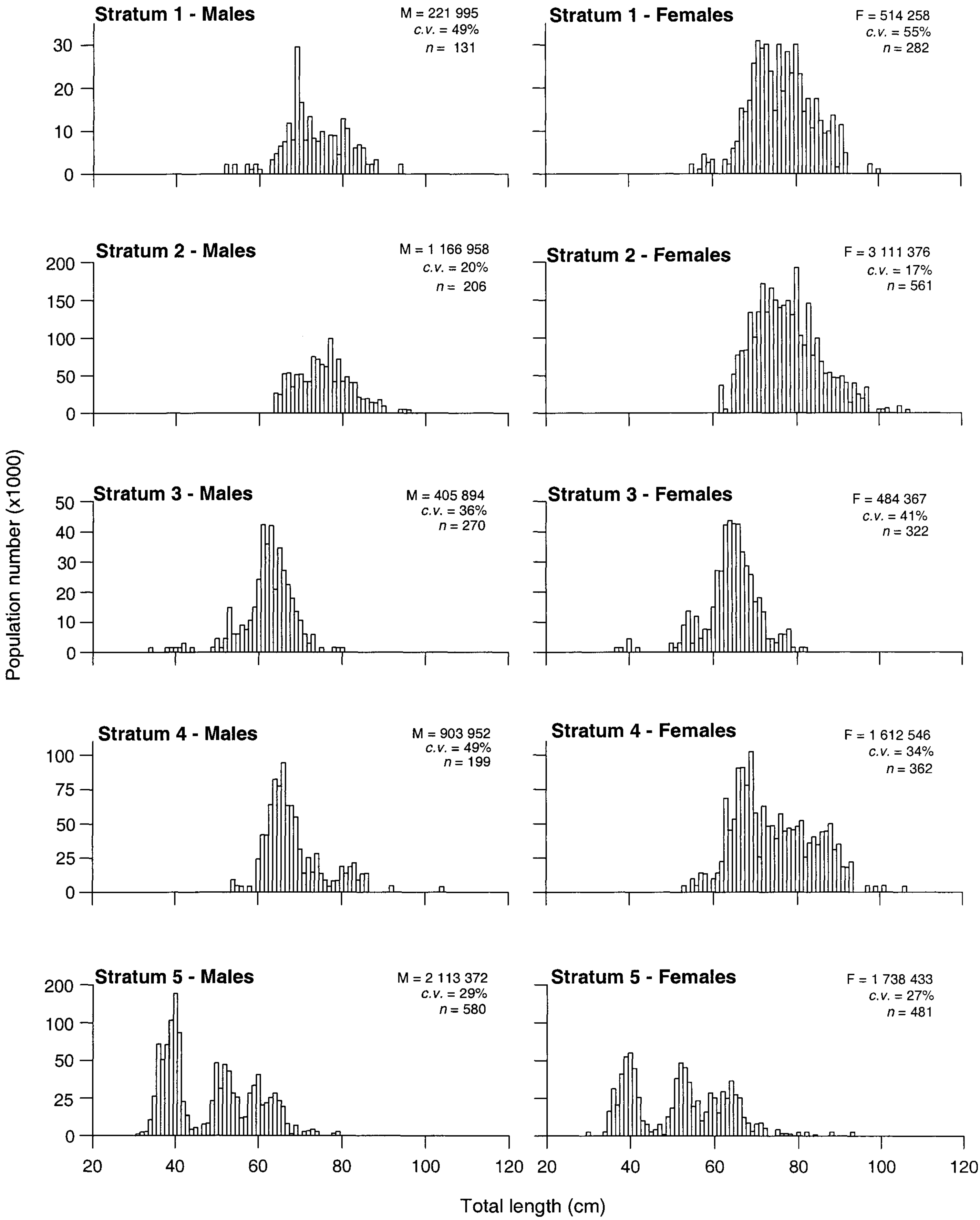
Appendix 2 — *continued*

Scientific name	Common name	Code	Occ.
Trichiuridae: cutlassfishes			
Lepidopus caudatus.	frostfish	FRO	1
Centrolophidae: raftfishes, medusafishes			
Centrolophus niger	rudderfish	RUD	21
Hyperoglyphe antarctica	bluenose	BNS	4
Icichthys australis	ragfish	RAG	4
Centrolophidae: raftfishes, medusafishes (*cont.*)			
Seriolella caerulea	white warehou	WWA	55
S. punctata	silver warehou	SWA	60
Bothidae: lefteyed flounders			
Arnoglossus scapha	witch	WIT	18
Neoachiropsetta milfordi	finless flounder	MAN	2
Pleuronectidae: righteyed flounders			
Azygopus pinnifasciatus	spotted flounder	SDF	1
Pelotretis flavilatus	lemon sole	LSO	16
Cephalopoda			
Cranchiidae	cranchiid squid	CHQ	1
Histioteuthidae			
Histioteuthis miranda	violet squid	VSQ	1
Ommastrephidae			
Nototodarus sloanii	arrow squid	NOS	64
Ommastrephes bartrami	red squid	RSQ	3
Todarodes filippovae	Antarctic flying squid	TSQ	11
Onychoteuthidae			
Moroteuthis ingens	warty squid	MIQ	29
Moroteuthis robsoni	warty squid	MRQ	2
Crustacea			
Homolidae			
Paromola petterdi	antlered crab	ATC	3
Lithodidae			
Neolithodes brodiei	southern stone crab	NEB	1
Paralomis zelandica	stone crab	PHS	2
Nephropsidae			
Metanephrops challengeri	scampi	SCI	45
Decapoda (Natantia)	species not identified	CRB	5
Lipkius holthuisi	omega prawn	LHO	3
Oplophorus novaezeelandiae	prawn	ONO	1
Other marine organisms			
Porifera	sponges	ONG	16
Coelenterata			
Anthozoa	sea anemones	ANT	25
Anthozoa	coral	COU	5
Scyphozoa	jellyfish	JFI	9
Mollusca			
Octopoda	octopus	OCT	5
Graneledone spp	deepwater octopus	DWO	2
Echinodermata			
Asteroidea	starfish	SFI	49
Holothurian	sea cucumber	SCC	7

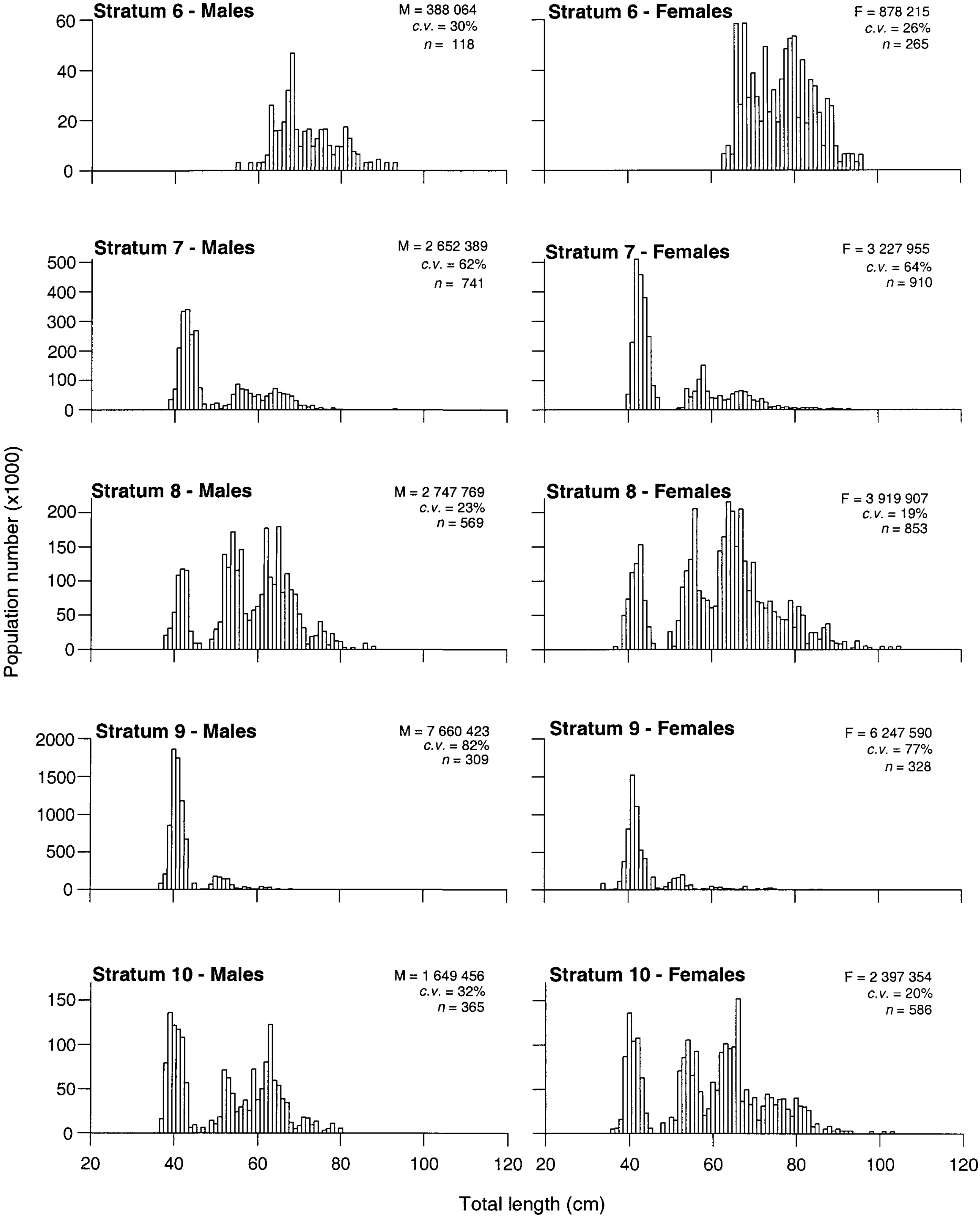
Appendix 2 — *continued*

Scientific name	Common name	Code	Occ.
Echinidae			
Gracilechinus multidentatus	sea urchin	GRM	4
Echinothuriidae			
Araeosoma coriaceum	Tam-o-shanter	ACO	2
Thaliacea			
Salpidae	Salps	SAL	16

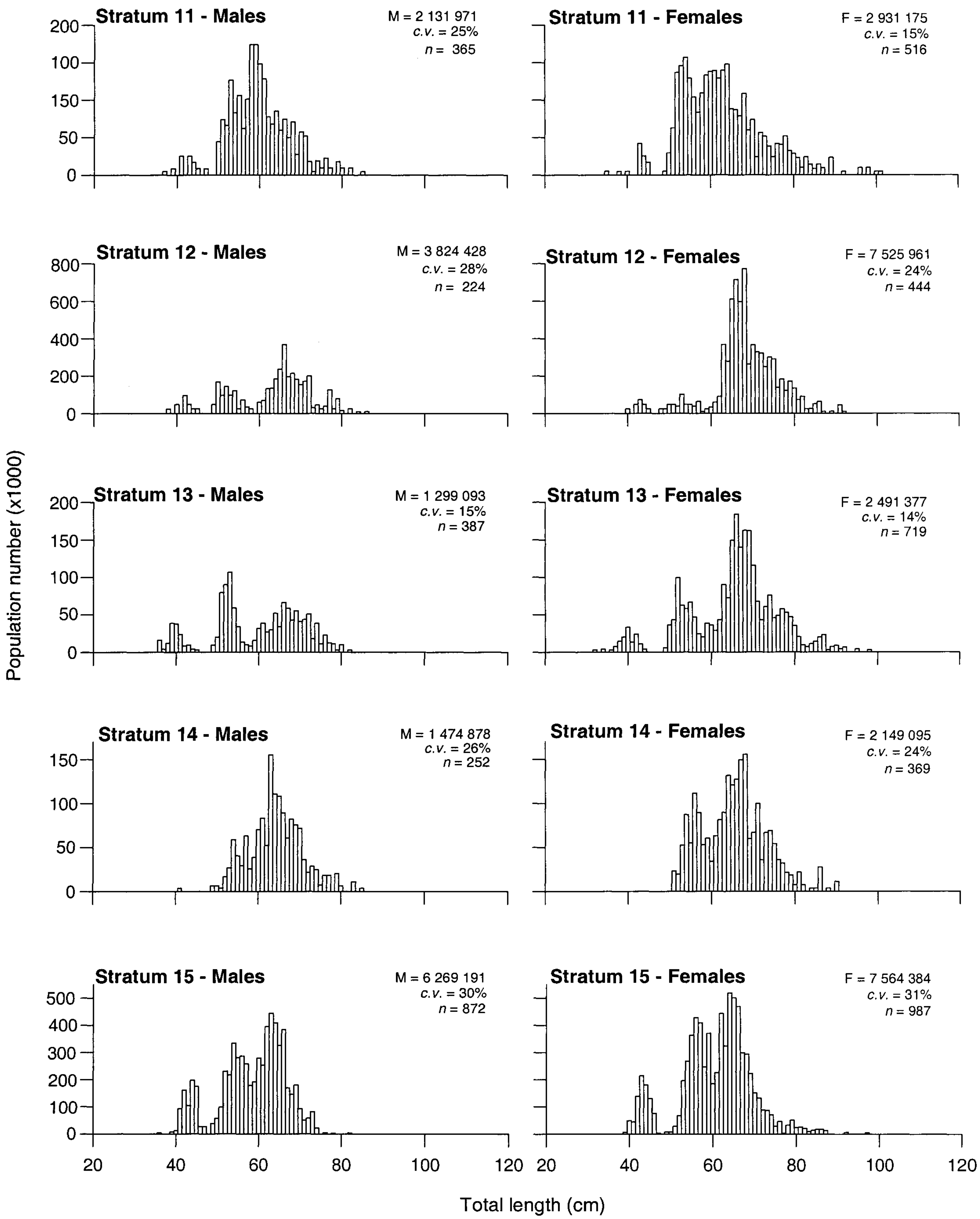
Appendix 3: Scaled length frequencies of hoki, by stratum and sex. (M, estimated male population; F, estimated female population; *c.v.*, coefficient of variation of the estimated numbers of fish; n, number of fish meaured).



Appendix 3 - *continued*



Appendix 3 - *continued*



Appendix 3 - *continued*