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Inshore trawl survey of the west coast South Island and Tasman and Golden Bays, March-April 1995 (KAH9504)

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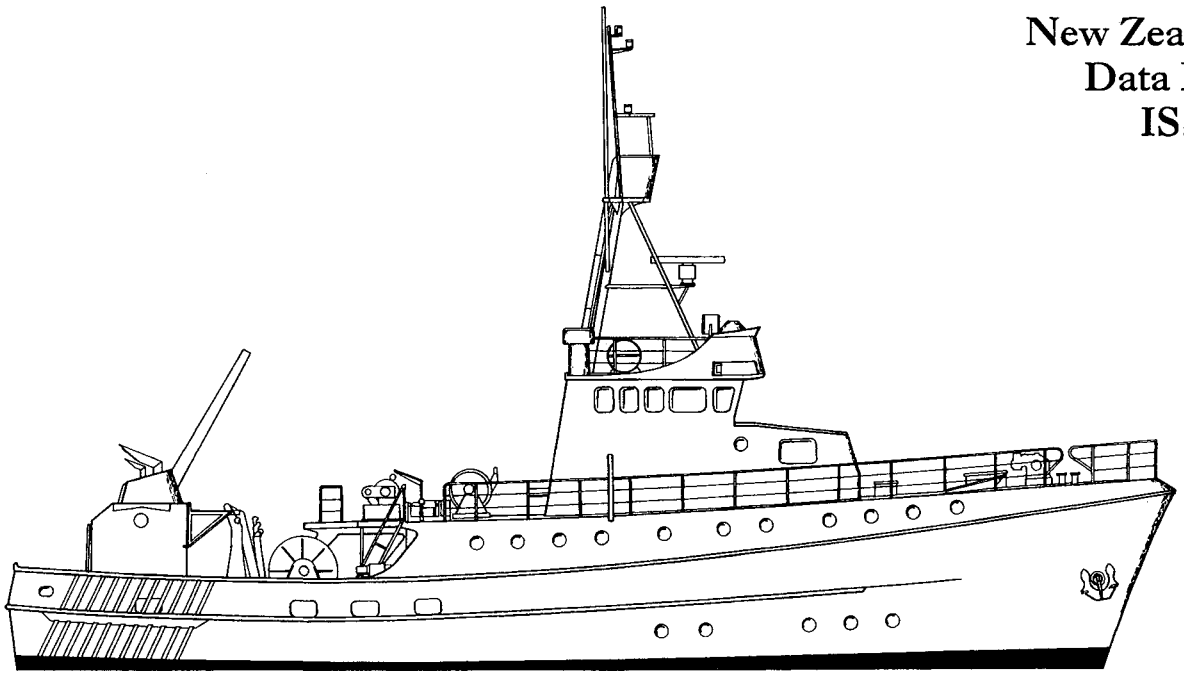

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Introduction

This report presents results from the third in a time series of stratified random trawl surveys with RV *Kaharoa* in waters between 20 and 400 m deep off the west coast of the South Island, and within Tasman and Golden Bays. The pilot *Kaharoa* trawl survey of this area (March–April 1990) was described by Drummond & Ryan (1992) and the first two of the standardised time series of surveys (March–April 1992 and 1994) were described by Drummond & Stevenson (1995a, 1995b).

The principal aim of the time series is to estimate the relative abundance of the species that are both important to the inshore fishery and vulnerable to bottom trawl within the survey area over the survey period. The four main species that meet these criteria are giant stargazer (*Kathetostoma giganteum*), red cod (*Pseudophycis bachus*), red gurnard (*Chelidonichthys kumu*), and tarakihi (*Nemadactylus macropterus*). A standardised index of relative abundance estimates for key inshore species will assist with stock assessment and management strategies.

This report details the survey design and methods, and provides relevant stock assessment data for commercially important Individual Transferable Quota (ITQ) and non-ITQ species. The survey was carried out using RV *Kaharoa* between 21 March and 26 April 1995.

Project objectives

The major objectives of this research programme are:

1. to determine the distribution and develop a time series of relative abundance indices for giant stargazer, red cod, red gurnard, and tarakihi in the inshore waters of the west coast of the South Island and Tasman and Golden Bays; and
2. to provide parameter inputs for the stock assessment of the target species caught by collecting and analysing biological data, i.e., length and age frequency, weight, reproductive condition, and fecundity.

Survey objectives

The specific objectives of the trawl survey were:

1. to obtain relative biomass data for giant stargazer, red cod, red gurnard, tarakihi, and other commercially important species sampled by bottom trawl in the inshore waters of the west coast of the South Island and Tasman and Golden Bays;
2. to collect data on the length, sex, and reproductive condition of giant stargazer, red cod, red gurnard, and tarakihi;
3. to collect otoliths from giant stargazer, red cod, red gurnard, and tarakihi as part of the NIWA Ageing Unit's otolith collection programme;
4. to collect data on the length and sex of all other ITQ and selected non-ITQ species.
5. to tag lively school shark, as part of a national study on the growth and movement of this species; and
6. to collect rig and school shark vertebrae and elephantfish spines in support of an ageing study on these species.

Project and voyage personnel

The project leader was K. Drummond. The survey was divided into three sections (21–30 March, 30 March–13 April, 13–25 April). K. Drummond was the voyage leader and A. Muir the skipper during the first leg. M. Stevenson was the voyage leader for the latter sections and R. Brown was the skipper.

Methods

Survey area

The survey area covered depths of 20–400 m off the west coast of the South Island from Farewell Spit to Haast River mouth (25–400 m south of Karamea), and within Tasman and Golden Bays, inside a line drawn between Farewell Spit and Stephens Island (Figure 1). The survey area totalled 25 594 km^2, about 41% of the 62 500 km^2 inside the 400 m depth contour within the Challenger Fishery Management Area (QMA 7).

The depth range trawled reflected the distribution of the main species of interest. The area covered was the same as that surveyed in 1992 and 1994. Adjustments were made to the charted 200 m depth contour between strata 12 and 13 and between strata 15 and 16 using updated information from the 1994 survey. Other stratum boundaries were retained. The trawlable ground within the survey area represented 85% of the total survey area.

Survey design

The survey used a two-phase stratified random design (*after* Francis 1984). The two-phase methodology was applied separately to the west coast and the Tasman and Golden Bay zones because of the geographic separation of the two areas and the variable weather patterns anticipated on the west coast. All strata used during the 1992 and 1994 surveys were retained.

Before the survey began sufficient trawl stations to cover both first and second phase stations within each stratum were randomly generated by the computer programme 'rand_stn v2.1' (*see* Vignaux 1994). The stations were required to be a minimum of 5.6 km (3 n. miles) apart. Non-trawlable ground was identified before the voyage from data collected during previous trawl surveys in the area by GRVs *W. J. Scott* (1981–83), *James Cook* (1983–84), and *Kaharoa* (1990, 1992, 1994). The distribution of the non-trawlable ground is given in Table 1.

For the two-phase methodology, giant stargazer, red cod, red gurnard, and tarakihi were designated as the target species. In total 80 stations were assigned to the first phase, with a minimum of 3 stations per stratum. The balance of phase 1 stations was allocated to minimise the variance of the expected catch rates of the four target species, where the expected catch rates were assumed to be the combined catch rates obtained during the 1994 survey. Consequently, in 1995 more phase 1 effort was directed towards the Greymouth to Okarito area than in 1994. Phase 2 stations were aimed at improving the precision of biomass estimates for the four target species and were allocated after phase 1 had been completed.

Vessel and gear

RV *Kaharoa*, a 28 m stern trawler with a beam of 8.2 m, a displacement of 302 t, and engine power of 522 kW, is capable of trawling to depths of 500 m. The two-panel trawl net used during the survey was designed and constructed in 1991 specifically for South Island inshore trawl surveys. The net is based on an 'Alfredo' design, and is similar to one used during the 1980s for *W. J. Scott* South Island surveys. The net was fitted with a 74 mm (inside measurement) knotless codend. Details of the net design were given by Drummond & Stevenson (1995a).

Before the 1995 survey *Kaharoa* was equipped with new trawl doors based on the design of the old doors but heavier. Comparative details are given in Appendix 1. Doorspread and headline height measurements were read off Scanmar monitoring equipment with an average of five readings at 10–15 min intervals during each tow. Doorspread varied from 60 to 106.5 m. Headline height varied between 4.1 and 5 m (Appendix 2).

Trawling procedure

All tows were undertaken in daylight, and three to five tows a day were planned. For each tow the vessel steamed to the station position and, if necessary, the bottom was checked with the depth sounder. Once the tow was considered safe, the gear was set away so that the midpoint of the tow would coincide as nearly as possible with the station position. The direction of the tow was influenced firstly by the combination of weather conditions and bottom contours, and secondly by the location of the next tow.

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

A minimum of 200 m of warp was used during towing. At depths below 70 m a warp to depth ratio of 3 : 1 was used.

Water temperatures

The surface temperature at each station was recorded from a hull-mounted sensor. The calibration of the sensor was uncertain, so surface temperatures are only relative. Bottom temperatures were recorded by the Scanmar net monitor, with an average of five readings recorded at 10–15 min intervals during each tow, and are also of unknown accuracy.

Catch and biological sampling

The catch was sorted into species on deck and weighed on 100 kg electronic motion-compensating Seaway scales to the nearest 0.1 kg. The weight of tagged school shark was estimated from the length weight coefficients given in Appendix 3.

Length, to the nearest whole centimetre below the actual length, and sex were recorded for all ITQ species, either for the whole catch or a randomly selected subsample of up to 200 fish per tow. Biological data were collected from a sample of up to 20 fish per tow for giant stargazer, red cod, red gurnard, and tarakihi, as well as kahawai, snapper, and turbot when they were caught, and consisted of individual fish length and weight, and gonad stages. These samples were selected non-randomly to ensure that a full size range of each species was sampled.

Up to four pairs of otoliths per 1 cm size class, per sex, were collected for ageing from the target species, kahawai, snapper, and turbot.

Length-weight coefficients were determined for giant stargazer, red cod, red gurnard, and tarakihi using the geometric mean functional relationship.

Lively school shark were measured, sexed, and tagged using a single dart tag, and released within minutes of being removed from the codend. For each tagged school shark a release factor was assigned on a scale of 1–3, with 1 corresponding to the fish swimming away slowly, 2 freely, and 3 vigorously. A handling factor, on the same 1–3 scale, was also recorded to assess the liveliness of individual sharks before release.

Sections of vertebrae from just below the dorsal fin were taken from rig and school shark and dorsal spines collected from elephantfish for ageing studies at Greta Point. These samples were also selected non-randomly to ensure a full size range of the species was represented.

Data analysis

Relative biomass was estimated using the area-swept method described by Francis (1981, 1989) and the Trawlsurvey Analysis Program described by Vignaux (1994).

The following assumptions were made.

1. The area swept during each tow equalled the distance between doors multiplied by the distance towed.
2. Vulnerability was 1.0. This assumed that all fish in the volume swept were caught and there was no escapement.
3. Vertical availability was 1.0. This assumed that all fish in the water column were below the headline height and available to the net.
4. Areal availability was 1.0. This assumed that the fishstock being sampled was entirely within the area being sampled at the time of the survey.
5. Within the survey area, fish were distributed evenly over both trawlable and non-trawlable ground.

Although these assumptions are unlikely to be correct, their adoption provides the basis for a time series of relative biomass estimates. All assumptions listed are consistent with those of Drummond & Stevenson (1995a, 1995b).

A combined biomass and length frequency analysis was used for species for which biomass above and below a specific size was required, and for deriving weighted length frequency distributions. The length-weight coefficients used are given in Appendix 3. All length frequencies were scaled by the percentage of catch sampled, area swept, and stratum area using the Trawlsurvey Analysis Program.

The coefficient of variation (*c.v.*) associated with estimates of biomass was calculated using the method of Vignaux (1994).

All stations where the gear performance code was 1 or 2 were used for biomass estimation. This excluded 1 of the 103 stations completed.

Results

Trawl stations

Eighty phase 1 stations and 22 phase 2 stations were successfully completed (Figure 1, Table 1, Appendix 3). All but one of the 80 planned phase 1 stations were successfully completed, and an additional station was substituted for the unsuccessful one. A number of part days were lost to bad weather, but no full days. At least three stations were completed in all 16 strata. An overall station density of one per 251 km^2 was achieved.

Catch composition

A total of 106.8 t of fish was caught during the 103 tows, at an average of 1047 kg per tow (range 122–4841 kg). Amongst the wetfish catch, 16 elasmobranchs and 68 teleosts were recorded, together with 3 cephalopods. Other bivalves and crustaceans were caught, but not always identified. Southern spiny dogfish made up 17% of the catch by weight (Table 2, Appendix 4).

Giant stargazer, red cod, red gurnard, and tarakihi made up 3.9, 9.4, 1.6, and 3.3% of the catch, respectively. Southern spiny dogfish, red cod, barracouta, arrow squid, and witch flounder were all caught in over 90% of the tows.

Catch rates and species distribution

Distribution and catch rates for all species combined are shown in Figure 2. (N.B., catch rates are given in terms of $kg.km^{-2}$, hence a catch rate of 1000 $kg.km^{-2}$ equates to a catch of 440 kg in a standard tow as it covers 0.44 km^{-2} on average.) All total catch rates over 5000 $kg.km^{-2}$ were made south of Greymouth, as were most of the total catch rates over 2000 $kg.km^{-2}$.

Catch rates for the 11 most abundant ITQ species in the catch and the most abundant species overall (southern spiny dogfish) are shown in Figure 2. The catch rates for the 20 most abundant species are given in Table 3.

Biomass estimation

Relative biomass estimates for the top 20 species in the catch are given by subarea in Table 4. For species subject to a regulatory or processing size limit, estimates above a given size are provided. For red cod the processing size has varied between years (38 cm in 1992, 45 cm in 1994, and 40 cm in 1995). The 40 cm size limit is used as the minimum size of recruited red cod in this report. The relative biomass estimates for the four target species by stratum are given in Table 5.

Water temperatures

Sea surface and bottom water temperatures are included in Appendix 2. Isotherms estimated from the station data are shown in Figure 3.

School shark tagging

Two hundred and six school shark (115 male and 91 female) were tagged and released. The total length of tagged school shark ranged from 59 to 154 cm.

Length frequency and biological data

The numbers of length frequency and biological samples taken during the survey are given in Table 6. The scaled length frequency distributions for the 11 most abundant ITQ species, blue cod, blue warehou, and the other two jack mackerel species are given in Figure 4.

Length weight relationships for the four target species are given in Appendix 3.

Vertebrae were collected from about 75% of rig and school shark caught. Spines were collected from all elephantfish caught.

Target species

Giant stargazer. Most (85%) of the relative biomass estimate of 1551 t (*c.v.* = 16%) was south of Cape Foulwind, and 67% was within the 100–200 m depth range (*see* Table 5). The sex ratios (male : female) were 0.67 : 1 at depths less than 100 m, 1.67 : 1, at 100–200 m, and 1.45 : 1 at 200–400 m (*see* Figure 4). Virtually all females less than 50 cm total length were immature or had resting gonads. Above this size, most had maturing gonads (Table 7).

Red cod. Of the estimated total relative biomass of 3123 t (*c.v.* = 15%), 2181 t (*c.v.* = 18%) was recruited biomass (≥ 40 cm) (*see* Table 4). Most (55%) of the biomass was in depths less than 200 m on the west coast (*see* Table 5). The length frequency data show one dominant cohort present at the time of the survey, aged 1+ years. A second modal group (> 40 cm) probably consists of a number of cohorts aged 2+ years and older. A small mode (15–20 cm) represents 0+ fish. This cohort is more strongly represented than in 1992 or 1994 (Drummond & Stevenson 1995a, 1995b). Information from a 1995 winter trawl survey in Tasman and Golden Bays (Stevenson 1996) shows this cohort to be very strong. The sex ratio in Tasman and Golden Bays favoured females (0.47 : 1), while on the west coast it favoured males at all depths (1.23 : 1 inside 100 m, 2.12 : 1 at 100–200 m, and 8.61 : 1 at 200–400 m) (*see* Figure 4). Most female red cod examined had immature or resting gonads: some large fish on the west coast were at later stages of reproductive development (*see* Table 7).

Red gurnard. The relative biomass estimate of 584 t (*c.v.* = 19%) was divided between Tasman and Golden Bays (185 t) and the west coast (399 t) (*see* Table 4). The recruited biomass estimate (≥ 30 cm) was 502 t (*c.v.* = 22%). Virtually all red gurnard biomass was at depths less than 100 m (*see* Table 5). The sex ratio was 1.25 : 1 in Tasman and Golden Bays and 2.45 : 1 on the west coast (*see* Figure 4). On the west coast, females generally had well

developed gonads. In Tasman and Golden Bays, females were typically spent or developing (*see* Table 7).

Tarakihi. The relative biomass estimate for all tarakihi was 1389 t (*c.v.* = 10%), with 1291 t (*c.v.* = 11%) recruited (≥ 25 cm) (*see* Table 4). The length frequency data for Tasman and Golden Bays consisted of three successive cohorts of ages 1+ to 3+ years, confirming that these areas are important nursery grounds for tarakihi. These year classes were present only in small numbers on the west coast (*see* Figure 4). Of the total tarakihi biomass, 93% was on the west coast, and most (705 t) of this was at 100–200 m depth (*see* Table 5). The sex ratios on the west coast were 0.49 : 1 inside 100 m, 0.39 : 1 at 100–200 m, and 4.22 : 1 at 200–400 m (*see* Figure 4). There was little reproductive development in tarakihi below 30 cm FL, but a full range of gonad stages was recorded for bigger fish(*see* Table 7). A high proportion of tarakihi gonads sampled in southern waters (south of Greymouth) were at late stages of maturity or running ripe.

Discussion

For the third successive survey the *c.v.*s for the four target species were below 20%. This suggests that the survey design provides satisfactory indices of abundance for these species. For giant stargazer, the length frequency data suggest that pre-recruits are not well sampled so the relative abundance estimate mainly applies to recruited fish.

The best precision (*c.v.* = 10%) was associated with the relative biomass estimates for southern spiny dogfish, tarakihi, and rig. Southern spiny dogfish was once again the species caught in the greatest quantity (17.0 t or 16.8% of the total catch). The total catch of 107 t was substantially higher than in previous years (68 t in 1992 and 86 t in 1994), with the most notable increase being in the catch of hoki (mostly 0+ cohort) and hake (virtually all 1+), which were up on 1994 catches by 295% to 10.7 t and 3630% to 15.9 t respectively.

The changing of *Kaharoa*'s trawl doors between the 1994 and 1995 surveys means that the 1995 survey is not directly comparable to the previous two in the time series. Although the trawl doors used were of essentially the same design, the difference in weight may have altered performance in 1995 by better maintaining bottom contact throughout a tow.

For the 1995 survey, trawl performance monitoring was improved through the use of Scanmar equipment. On previous surveys doorspread has been estimated using the method of Koyama (1974), and relative biomass estimates assumed a mean doorspread of 79 m. To improve estimates of doorspread for the 1992 and 1994 surveys, Scanmar equipment was fitted to the previous trawl gear (including doors), and trials were completed off the west coast of the South Island in June 1995 (voyage KAH9506). The results (summarised in Appendix 5) showed that the doorspread in 1992 and 1994 increased from 72.5 m inside 25 m, to 104.4 m in 300–400 m: the 1995 doorspread ranged from 73.8 to 99.7 m.

Revised biomass estimates incorporating the updated doorspread information for the top 20 species from each of the two previous surveys are given in Appendix 6. Only these new estimates should be used when making comparisons with 1995 equivalents, as the area swept is standardised between surveys.

Improved doorspread information from the 1995 survey also enabled sweep angles to be calculated and compared to optimal angles (Prado 1990). To achieve the desired sweep angles of 15–19°, it was calculated that a doorspread of 73–90 m was required (*see* Appendix 5). At the start of the survey the observed doorspreads were generally above this range and

some modifications to trawl gear configurations were made, including altering the point of attachment of the warp to the doors and adjusting warp to depth ratios.

The completion of a third survey in 1995 establishes a time series of relative abundance estimates. The estimates adjusted for different trawl gear configurations should allow meaningful conclusions to be drawn on recent trends in size distribution and abundance for a number of important inshore species. However, in making comparisons between surveys it should be noted that although the 1992 and 1994 catches were obtained with a greater doorspread, the overall vulnerability of fish to the trawl may have been lower because of overspreading of the gear. In view of this, the revised 1992 and 1994 estimates are probably low.

Acknowledgments

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

Stratum	Depth (m)	Area (km^2)	Non-trawlable area (km^2)	Number of stations		Station density (no. per km^2)
				Phase 1	Phase 2	
1	20–100	1 343	102	3	0	1 : 448
2	100–200	4 302	300	4	0	1 : 1 075
5	25–100	1 224	0	3	0	1 : 408
6	100–200	3 233	238	5	0	1 : 647
7	25–100	927	0	5	0	1 : 185
8	100–200	2 354	214	7	6	1 : 181
9	200–400	1 877	1 456	3	0	1 : 626
11	25–100	1 438	63	8	4	1 : 120
12	100–200	2 054	500	11	0	1 :187
13	200–400	1 101	466	5	0	1 : 220
14	25–100	851	36	4	7	1 : 77
15	100–200	881	373	8	0	1 : 110
16	200–400	319	35	3	0	1 : 106
17	20–33	307	27	3	0	1 : 102
18	20–42	947	30	5	2	1 : 135
19	20–70	2 436	193	3	3	1 : 406
Total (average)		25 594	3 840	80	22	(1 : 251)

Table 2: Species caught, total weight, and number of stations out of 103 at which each species occurred (Occ)

Common name	Scientific name	Code	Catch (kg)	% of total catch	Occ
Southern spiny dogfish	*Squalus acanthias*	SPD	17 938.4	17	99
Hake	*Merluccius australis*	HAK	15 860.4	15	83
Hoki	*Macruronus novaezelandiae*	HOK	10 742.3	10	74
Red cod	*Pseudophycis bachus*	RCO	10 040.1	9	96
Barracouta	*Thyrsites atun*	BAR	9 933.8	9	99
Rattails	Macrouridae	RAT	7 404.9	7	75
Arrow squid	*Nototodarus sloanii, N. gouldi*	SQU	6 452.6	6	103
Giant stargazer	*Kathetostoma giganteum*	STA	4 154.8	4	69
Tarakihi	*Nemadactylus macropterus*	TAR	3 517.0	3	89
School shark	*Galeorhinus galeus*	SCH	2 125.0	2	89
Witch	*Arnoglossus scapha*	WIT	1 765.0	2	99
Red gurnard	*Chelidonichthys kumu*	GUR	1 710.5	2	58
Rig	*Mustelus lenticulatus*	SPO	1 523.3	1	71
Carpet shark	*Cephaloscyllium isabella*	CAR	1 481.0	1	89
Sea perch	*Helicolenus* spp.	SPE	1 459.2	1	67
Murphy's mackerel	*Trachurus murphyi*	JMM	1 359.8	1	53
Ling	*Genypterus blacodes*	LIN	1 241.3	1	65
Scaly gurnard	*Lepidotrigla brachyoptera*	SCG	1 155.8	1	85
Dark ghost shark	*Hydrolagus novaezelandiae*	GSH	993.5	1	29
Smooth skate	*Raja innominata*	SSK	654.8	1	47
Rough skate	*R. nasuta*	RSK	502.3	< 1	58
Common roughy	*Paratrachichthys trailli*	RHY	442.8	< 1	7
Blue warehou	*Seriolella brama*	WAR	384.9	< 1	37
Lemon sole	*Pelotretis flavilatus*	LSO	360.4	< 1	61
Leatherjacket	*Parika scaber*	LEA	347.8	< 1	15
Blue cod	*Parapercis colias*	BCO	328.2	< 1	14
Sand flounder	*Rhombosolea plebeia*	SFL	325.7	< 1	21
Jack mackerel	*Trachurus declivis*	JMD	238.7	< 1	52
Frostfish	*Lepidopus caudatus*	FRO	226.7	< 1	32
Elephantfish	*Callorhinchus milii*	ELE	215.3	< 1	16
Electric ray	*Torpedo fairchildi*	ERA	207.8	< 1	13
Spotty	*Notolabrus celidotus*	STY	188.8	< 1	10
N.Z. sole, common sole	*Peltorhamphus novaezelandiae*	ESO	134.0	< 1	21
Northern spiny dogfish	*Squalus mitsukuri*	NSD	128.0	< 1	15
Horse mackerel	*Trachurus novaezelandiae*	JMN	98.8	< 1	19
Snapper	*Pagrus auratus*	SNA	96.9	< 1	3
Silver warehou	*Seriolella punctata*	SWA	96.8	< 1	74
Capro dory	*Capromimus abbreviatus*	CDO	92.7	< 1	35
Javelinfish	*Lepidorhynchus denticulatus*	JAV	92.6	< 1	10
Cucumberfish	*Chlorophthalmus nigripinnis*	CUC	91.0	< 1	28
Conger eel	*Conger* spp.	CON	60.9	< 1	11
Hapuku	*Polyprion oxygeneios*	HAP	58.7	< 1	4
Slender smoothhound	*Gollum attenuatus*	SSH	54.8	< 1	6
Gemfish	*Rexea solandri*	SKI	50.9	< 1	5
Silverside	*Argentina elongata*	SSI	46.1	< 1	40
Orange perch	*Lepidoperca aurantia*	OPE	41.3	< 1	3
John dory	*Zeus faber*	JDO	39.2	< 1	12
Octopus	*Octopus* sp.	OCT	26.8	< 1	17
Silver dory	*Cyttus novaezelandiae*	SDO	26.8	< 1	14
Red mullet	*Upeneichthys lineatus*	RMU	23.2	< 1	7

Table 2—*continued*

Common name	Scientific name	Code	Catch (kg)	% of total catch	Occ
White warehou	*Seriolella caerulea*	WWA	22.9	< 1	10
Lookdown dory	*Cyttus traversi*	LDO	19.9	< 1	4
Alfonsino	*Beryx splendens*	BYS	19.7	< 1	1
Blue mackerel	*Scomber australasicus*	EMA	19.7	< 1	5
Sprat	*Sprattus antipodum*, *S. muelleri*	SPR	18.8	< 1	30
Pigfish	*Congiopodus leucopaecilus*	PIG	14.7	< 1	18
Trevally	*Pseudocaranx dentex*	TRE	14.7	< 1	3
Brill	*Colistium guntheri*	BRI	13.1	< 1	6
Thresher shark	*Alopias vulpinus*	THR	12.9	< 1	1
Longtailed skate	*Arhynchobatis asperrimus*	LSK	12.3	< 1	7
Deepsea flathead	*Hoplichthys haswelli*	FHD	11.7	< 1	5
Turbot	*Colistium nudipinnis*	TUR	11.4	< 1	4
Ray's bream	*Brama brama*	RBM	10.4	< 1	6
Pufferfish	*Sphoeroides* spp.	PUF	8.6	< 1	4
Kahawai	*Arripis trutta*	KAH	8.4	< 1	4
Bass	*Polyprion americanus*	BAS	6.6	< 1	1
Prickly dogfish	*Oxynotus bruniensis*	PDG	5.0	< 1	1
Redbait	*Emmelichthys nitidus*	RBT	3.2	< 1	10
Slender sole	*Peltorhamphus tenuis*	SLS	3.1	< 1	7
Yelloweyed mullet	*Aldrichetta forsteri*	YEM	2.9	< 1	3
Scallop	*Pecten novaezelandiae*	SCA	2.8	< 1	4
Horse mussel	*Atrina zelandica*	HOR	2.7	< 1	1
Crested bellowsfish	*Notopogon lilliei*	CBE	2.5	< 1	1
Dredge oyster	*Tiostrea chilensis*	OYS	2.4	< 1	5
Opalfish	*Hemerocoetes* spp.	OPA	2.2	< 1	12
Ahuru	*Auchenoceros punctatus*	PCO	2.1	< 1	13
Eagle ray	*Myliobatis tenuicaudatus*	EGR	1.5	< 1	1
Green-shelled mussel	*Perna canaliculus*	MSG	1.5	< 1	2
Broad squid	*Sepioteuthis australis*	BSQ	1.4	< 1	2
Yellowbelly flounder	*Rhombosolea leporina*	YBF	1.0	< 1	2
Spotted stargazer	*Genyagnus monopterygius*	SPZ	0.8	< 1	1
Mirror dory	*Zenopsis nebulosus*	MDO	0.7	< 1	2
Dark toadfish	*Neophrynichthys latus*	TOD	0.6	< 1	4
Yellow boarfish	*Pentaceros decacanthus*	YBO	0.6	< 1	1
Whelks	Gastropoda	WHE	0.5	< 1	1
Anchovy	*Engraulis australis*	ANC	0.4	< 1	4
Speckled sole	*Peltorhamphus latus*	SPS	0.4	< 1	4
Prawn killer	*Ibacus alticrenatus*	PRK	0.3	< 1	3
Spiny sea dragon	*Solegnathus spinosissimus*	SDR	0.3	< 1	2
Skate	Rajidae, Arhynchobatidae	SKA	0.2	< 1	1
Unidentified crustacean	Crustacea	CRU	0.1	< 1	1
Unidentifies echinoderm	Echinodermata	ECH	0.1	< 1	1
Eucla cod	*Euclichthys polynemus*	EUC	0.1	< 1	1
Unidentified fish	Unidentified telost	UNI	0.1	< 1	1
Porcupine fish	*Allomycterus jaculiferus*	POP	*	< 1	2
			106 808		

* counted but not weighed

Table 3: Mean catch rates (kg.km^{-2}) for the 20 most abundant species by stratum*

ITQ species												
		Species code										
		HAK	HOK	RCO	BAR	SQU	STA	TAR	SCH	GUR	SPO	JMM	LIN
West coast													
Stratum	Depth (m)												
1	20–100	66	0	91	85	37	10	0	18	44	22	2	0
5	25–100	713	1	128	2	13	0	0	4	18	19	0	25
7	25–100	523	16	166	104	19	45	45	21	70	42	3	16
11	25–100	1 537	118	504	209	52	60	41	67	103	64	5	51
14	25–100	674	79	655	107	109	38	14	77	104	80	5	9
2	100–200	0	0	2	136	73	0	13	105	0	0	16	0
6	100–200	9	82	34	217	104	65	54	18	3	0	20	2
8	100–200	188	162	159	331	106	117	123	54	1	26	76	4
12	100–200	198	390	90	455	291	184	126	27	1	22	66	20
15	100–200	118	1 442	295	475	98	197	137	26	0	23	77	10
9	200–400	0	217	0	5	327	0	56	0	0	0	1	18
13	200–400	17	143	154	80	498	264	132	8	0	3	18	15
16	200–400	26	210	119	16	78	119	77	32	0	6	0	382
Tasman and Golden Bays													
17	20–33	3	8	23	17	27	0	30	14	93	36	0	11
18	20–42	3	4	149	100	58	2	94	81	119	61	0	0
19	20–70	1	2	48	105	150	3	1	73	18	15	0	1

Non-ITQ species									
		Species code							
		SPD	RAT	WIT	CAR	SPE	SCG	GSH	SSK
West coast									
Stratum	Depth (m)								
1	20–100	423	180	56	17	0	21	0	23
5	25–100	115	418	15	25	0	1	0	9
7	25–100	211	96	47	34	2	10	2	2
11	25–100	317	350	70	42	0	32	0	26
14	25–100	537	87	88	42	0	58	0	5
2	100–200	228	0	0	54	2	17	80	8
6	100–200	384	54	1	30	15	61	50	13
8	100–200	489	198	7	62	23	27	44	16
12	100–200	572	290	43	16	85	25	1	19
15	100–200	659	259	69	17	16	12	0	25
9	200–400	0	1	2	17	8	0	33	19
13	200–400	627	29	8	10	228	2	30	2
16	200–400	81	129	33	9	31	0	185	49
Tasman and Golden Bays									
17	20–33	91	0	61	0	20	0	0	0
18	20–42	114	0	29	16	14	11	0	0
19	20–70	235	0	7	35	28	29	0	0

* Species codes are given in Table 2.

Table 4: Relative doorspread biomass estimates of the 20 most abundant species by sub–area

	Tasman and Golden Bays		West coast		Total survey area	
Common name	Biomass (t)	*c.v.* (%)	Biomass (t)	*c.v.* (%)	Biomass (t)	*c.v.* (%)
Southern spiny dogfish	707	30.8	7 662	11.0	8 370	10.4
Hake	5	32.3	5 240	27.1	5 244	27.1
Hoki (all)	13	44.2	3 604	21.1	3 616	21.0
Hoki (65 + cm)	0		210	37.8	210	37.8
Red cod (all)	265	35.9	2 858	15.9	3 123	14.8
Red cod (40 + cm)	199	40.7	1 973	19.6	2 181	18.1
Barracouta (all)	355	32.3	4 125	13.4	4 480	12.6
Barracouta (60 + cm)	295	36.4	3 572	14.5	3 867	13.7
Rattails	1	55.2	2 958	13.0	2 959	13.0
Arrow squid	429	58.4	3 021	14.3	3 450	14.5
Giant stargazer	10	63.4	1 541	16.2	1 551	16.1
Tarakihi (all)	101	33.8	1 288	11.0	1 389	10.5
Tarakihi (25 + cm)	6	59.5	1 285	11.0	1 291	10.9
School shark	259	51.8	945	42.0	1 204	34.8
Witch	64	29.5	506	14.3	570	13.1
Red gurnard (all)	185	13.7	399	27.6	584	19.4
Red gurnard (30 + cm)	111	14.2	390	27.6	502	21.7
Rig	105	15.7	384	12.6	490	10.5
Carpet shark	101	24.2	752	12.4	852	11.3
Sea perch	88	88.1	579	24.3	667	22.8
Murphy's mackerel	0		551	24.2	551	24.2
Ling	6	30.3	361	16.5	367	16.2
Scaly gurnard	82	16.2	532	20.0	614	17.4
Dark ghost shark	0		767	23.7	767	23.7
Smooth skate	0		315	20.2	315	20.2

Table 5: Estimates of relative biomass (to the nearest whole tonne) for the four target species by stratum

		Red cod		Giant stargazer		Red gurnard		Tarakihi	
Stratum	Depth (m)	Biomass (t)	% of total	Biomass (t)	% of total	Biomass (t)	% of total	Biomass (t)	% of total
West coast									
1	20–100	122	4	14	1	59	10	1	0
5	25–100	156	5	0	0	22	4	0	0
7	25–100	154	5	42	3	65	11	42	3
11	25–100	725	23	86	6	148	25	59	4
14	25–100	557	18	32	2	88	15	12	1
2	100–200	8	0	1	0	1	0	56	4
6	100–200	109	3	210	14	9	2	174	13
8	100–200	375	12	277	18	3	1	290	21
12	100–200	185	6	378	24	2	0	259	19
15	100–200	260	8	173	11	0	0	121	9
9	200–400	1	0	0	0	0	0	105	8
13	200–400	170	5	290	19	0	0	145	10
16	200–400	38	1	38	2	0	0	25	2
									0
	Subtotal	2 858	92	1541	99	399	68	1 288	93
Tasman and Golden Bays									
17	20–33	7	0	0	0	29	5	9	1
18	20–42	141	5	2	0	112	19	89	6
19	20–70	117	4	9	1	44	8	2	0
	Subtotal	265	8	10	1	185	32	101	7
	Total	3 123		1 551		584		1 389	

Table 6: Number of length frequency and biological samples collected

	Length frequency		Biological data	
	No. of samples	No. of fish	No. of samples	No. of fish
Alfonsino	2	81		
Barracouta	99	4 908		
Bass	1	1	1	1
Blue cod	15	558		
Blue mackerel	6	12		
Blue warehou	38	665		
Brill	7	18		
Conger eel	1	1		
Dark ghost shark	30	808		
Elephantfish	17	65		
N.Z. sole	22	344		
Gemfish	6	13		
Giant stargazer	70	1 265	69	782
Hake	83	6 383		
Hapuku	5	8	1	1
Hoki	72	10 655		
Horse mackerel	20	847		
Jack mackerel	52	282		
John dory	13	31		
Kahawai	3	3	1	1
Lemon sole	61	1 310		
Ling	66	968		
Lookdown dory	4	19		
Murphy's mackerel	53	984		
Ray's bream	6	17		
Red cod	97	7 736	93	1 770
Red gurnard	56	3 058	57	766
Rig	71	704	37	310
Sand flounder	22	1 171		
School shark	84	863	39	330
Silver warehou	72	918		
Slender sole	6	25		
Snapper	4	21	1	8
Spotted stargazer	1	1		
Tarakihi	89	4 622	84	1 396
Trevally	4	6		
Turbot	5	6		
White warehou	11	58		
Yellowbelly flounder	1	1		

Table 7: Numbers of the four target species sampled at each reproductive stage

	Males Gonad stage					Females Gonad stage					
Total length (cm)	1	2	3	4	5	1	2	3	4	5	
Giant stargazer											
West coast											
11–20	2	0	0	0	0	4	0	0	0	0	
21–30	26	0	0	0	0	18	0	0	0	0	
31–40	36	17	3	1	1	20	0	0	0	0	
41–50	29	83	27	8	4	26	3	0	0	0	
51–60	8	70	41	7	3	35	40	0	0	2	
61–70	0	10	9	1	1	19	166	13	0	2	
71–80	0	1	0	0	0	1	23	1	0	1	
81–90	0	0	0	0	0	0	1	0	0	0	
Total	101	181	80	17	9	123	233	14	0	5	763
Tasman and Golden Bays											
11–20	0	0	0	0	0	1	0	0	0	0	
21–30	3	0	0	0	0	4	0	0	0	0	
31–40	3	0	0	0	0	5	0	0	0	0	
41–50	1	0	0	0	0	0	0	0	0	0	
51–60	0	0	0	0	0	1	0	0	0	0	
Total	7	0	0	0	0	11	0	0	0	0	18
Red cod											
West coast											
11–20	17	0	0	0	0	18	0	0	0	0	
21–30	107	0	0	1	0	38	0	0	0	0	
31–40	303	22	10	2	0	266	0	0	0	0	
41–50	164	80	32	9	3	119	6	3	0	1	
51–60	15	28	27	4	0	104	19	8	0	0	
61–70	1	2	2	0	0	58	21	4	0	2	
71–80	0	0	0	0	0	2	0	0	0	0	
Total	607	132	71	16	3	605	46	15	0	3	1 498
Tasman and Golden Bays											
11–20	10	0	0	0	0	20	0	0	0	0	
21–30	13	0	0	0	0	35	0	0	0	0	
31–40	36	1	0	0	0	60	0	0	0	0	
41–50	2	0	0	0	0	46	0	0	0	0	
51–60	8	2	0	0	0	23	0	0	0	0	
61–70	0	0	0	0	0	14	0	0	0	0	
Total	69	3	0	0	0	198	0	0	0	0	270

Table 7—*continued*

Fork length (cm)	Males Gonad stage 1	2	3	4	5	Females Gonad stage 1	2	3	4	5	
Red gurnard											
West coast											
11–20	0	0	0	0	0	0	0	0	0	0	
21–30	2	13	1	0	0	0	0	0	0	0	
31–40	37	209	11	1	13	6	34	17	2	5	
41–50	0	21	2	0	0	2	61	26	5	4	
51–60	0	0	0	0	0	0	1	0	0	0	
Total	39	243	14	1	13	8	96	43	7	9	473
Tasman and Golden Bays											
11–20	2	0	0	0	0	0	0	0	0	0	
21–30	53	46	1	0	11	34	5	0	0	21	
31–40	4	19	1	0	7	8	12	4	1	40	
41–50	0	0	0	0	0	0	7	1	5	11	
Total	59	65	2	0	18	42	24	5	6	72	293
Tarakihi											
West coast											
11–20	1	0	0	0	0	3	0	0	0	0	
21–30	77	3	0	2	9	98	3	0	0	1	
31–40	58	27	47	58	20	178	191	12	4	12	
41–50	1	12	21	25	2	11	278	15	4	19	
Total	136	42	68	85	31	290	472	27	8	32	1 191
Tasman and Golden Bays											
	1	2	3	4	5	1	2	3	4	5	
11–20	88	0	0	0	0	77	0	0	0	0	
21–30	23	0	0	0	0	15	0	0	0	0	
Total	111	0	0	0	0	92	0	0	0	0	203

Gonad stages used were: 1, immature or resting; 2, maturing (oocytes visible in females); 3, mature (hyaline oocytes in females, milt expressible in males); 4, running ripe (eggs and milt free flowing); 5, spent.

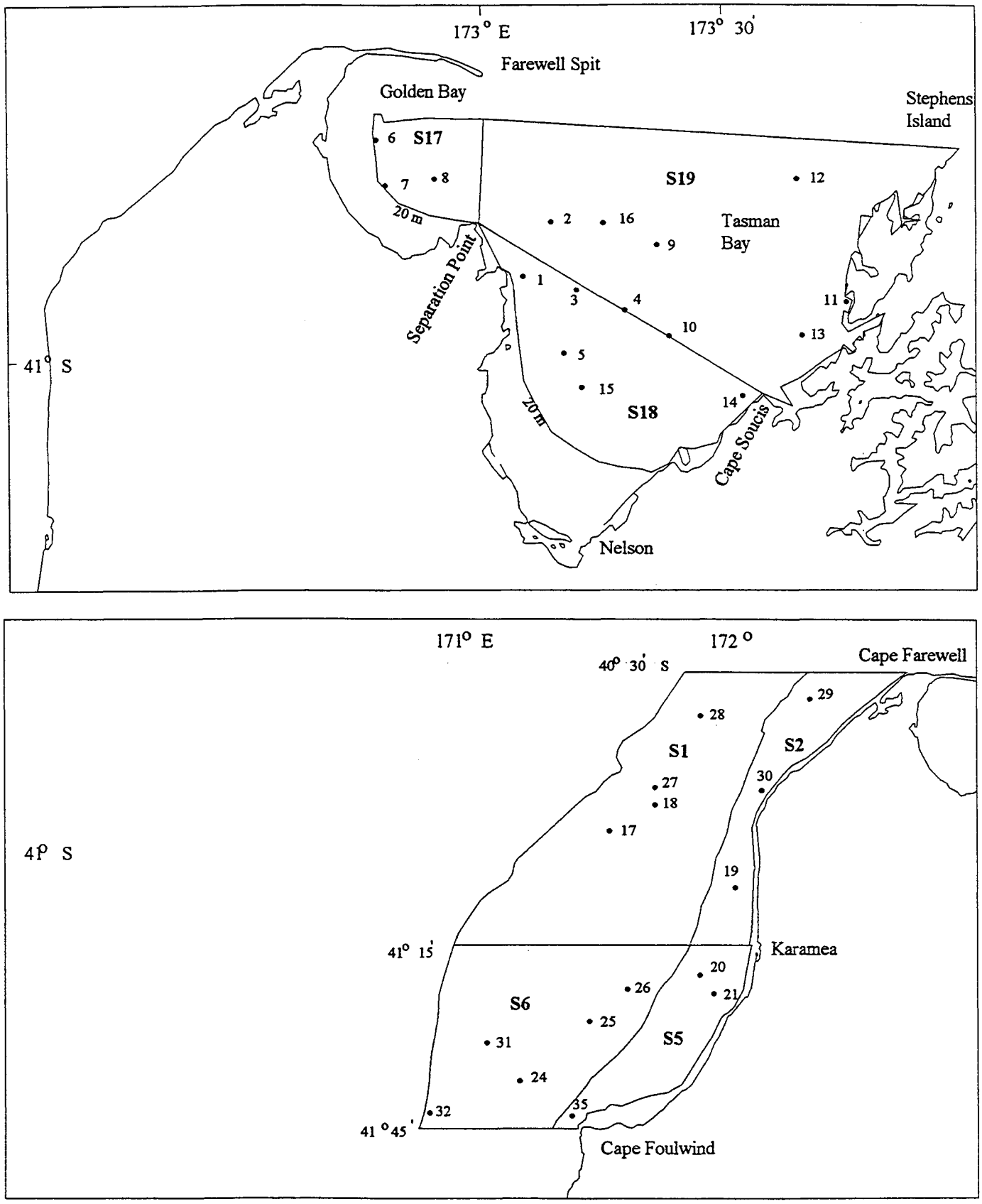


Figure 1a: Stratum boundaries (west coast north of Cape Foulwind and Tasman and Golden Bays) with station positions and numbers.

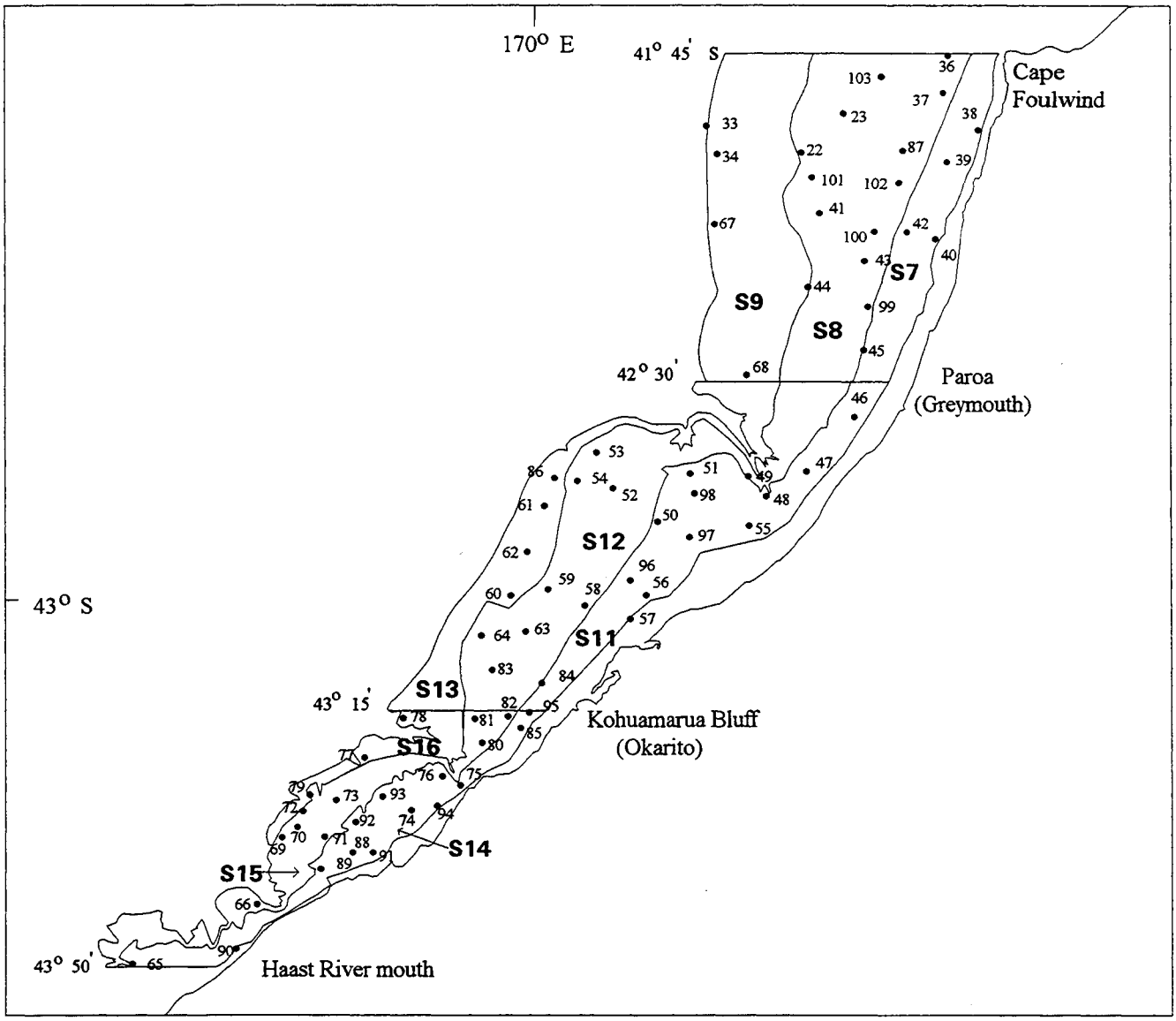


Figure 1b: Stratum boundaries (west coast south of Cape Foulwind) with station positions and numbers.

All species combined

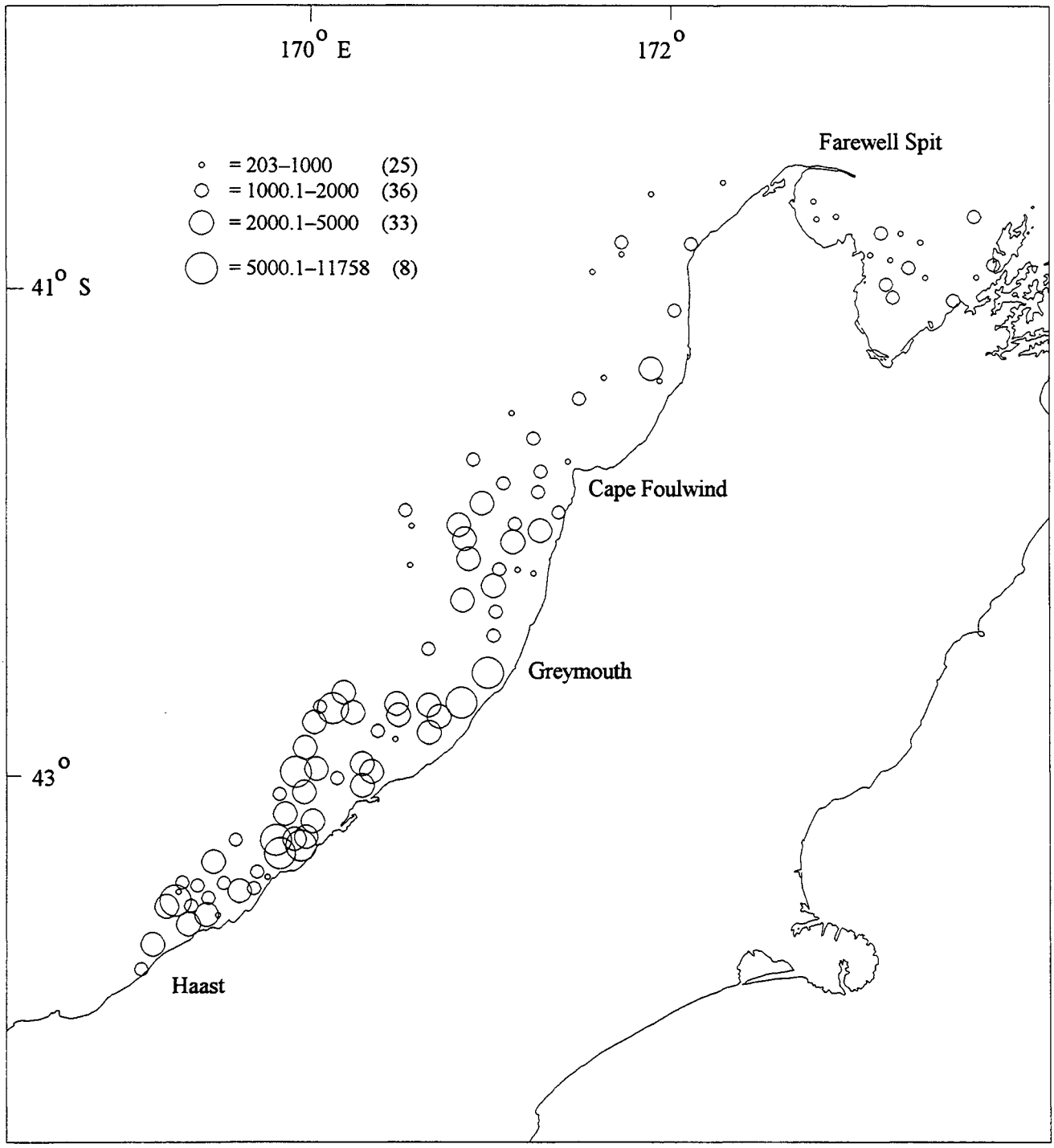


Figure 2: Catch rates (kg.km^{-2}) for all species combined and of the major finfish species for stations used for biomass estimates (numbers in parentheses are the number of stations at the given catch rate).

Barracouta

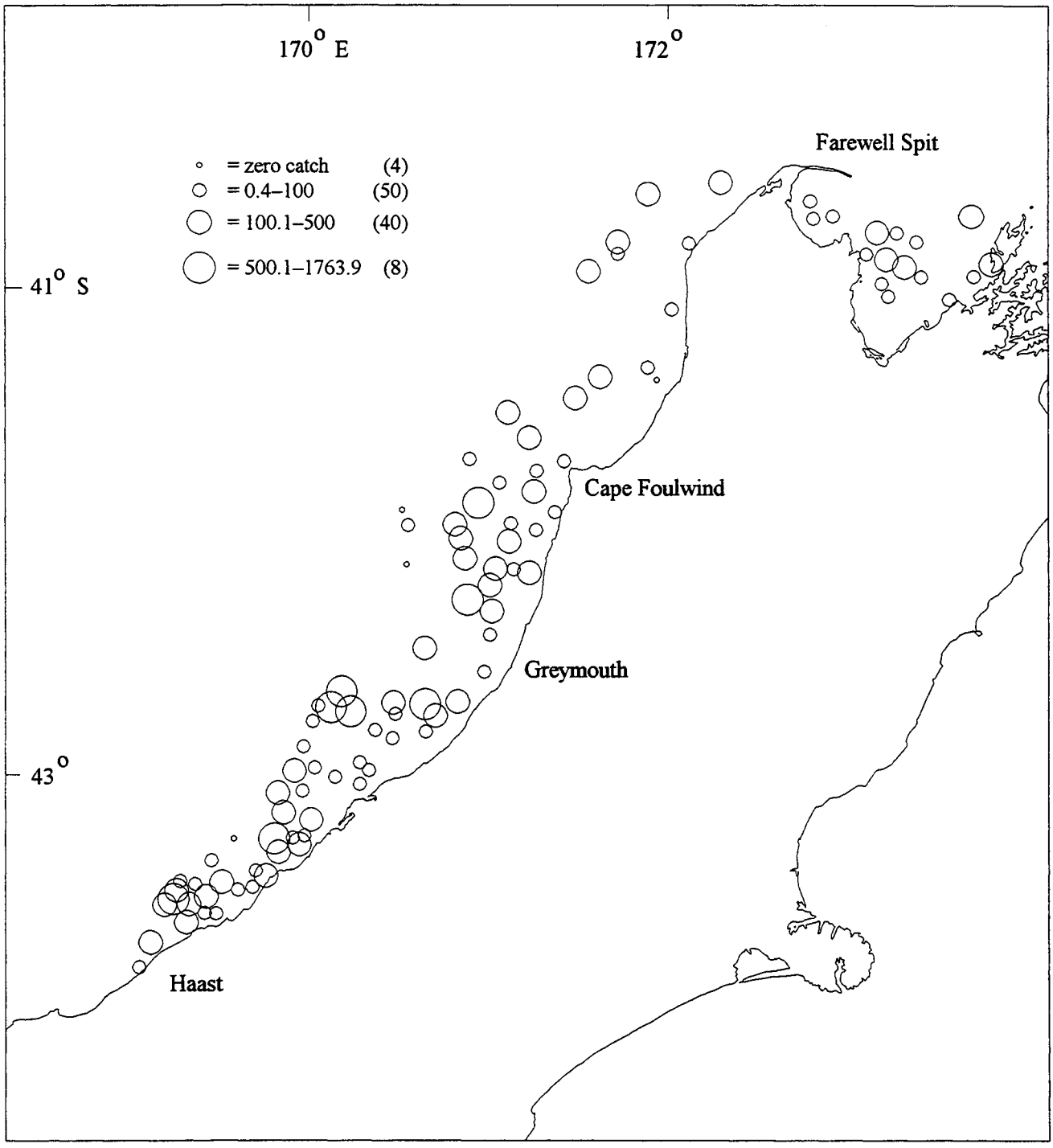


Figure 2— *continued*

Dark ghost shark

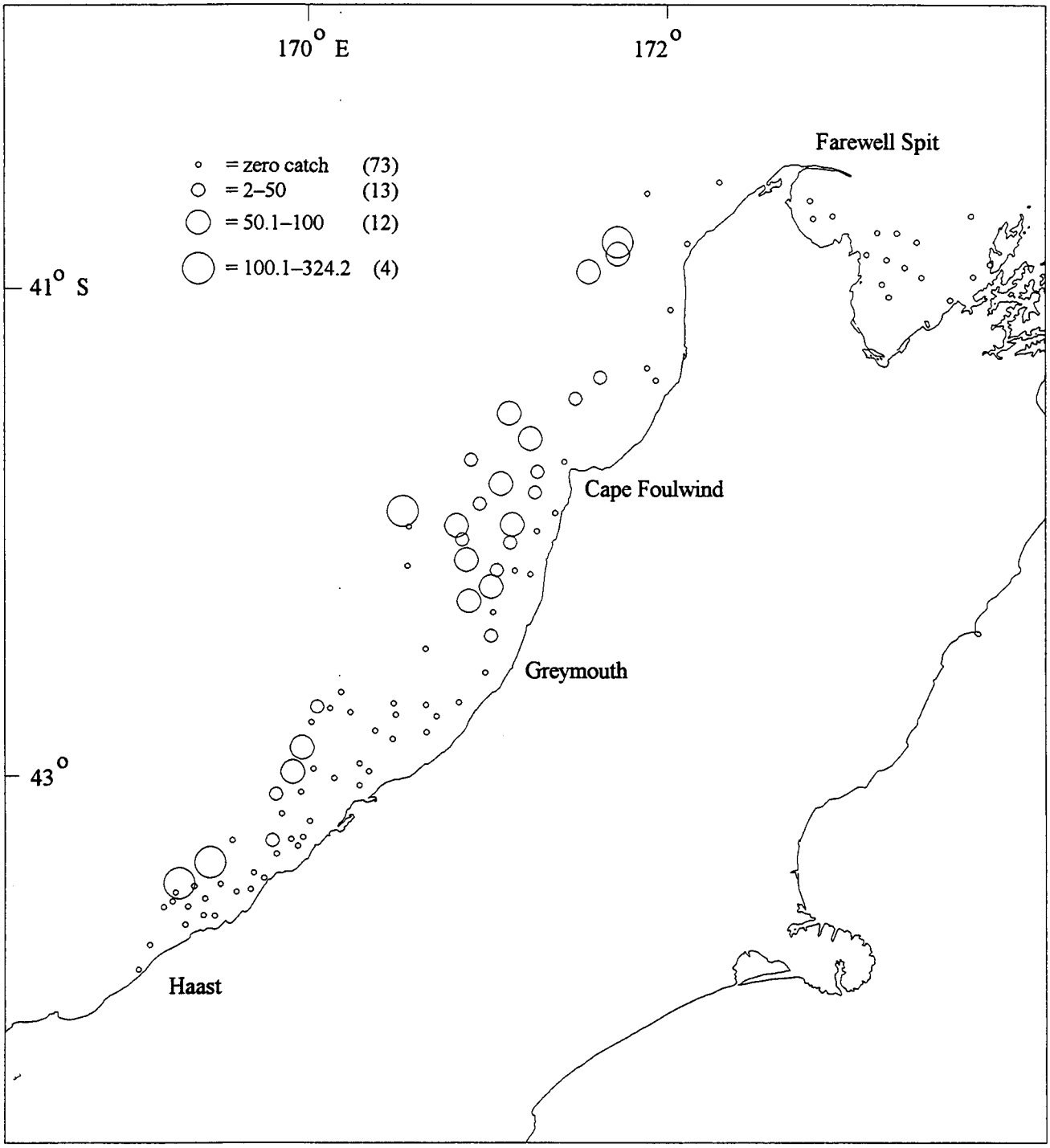


Figure 2— ***continued***

Giant stargazer

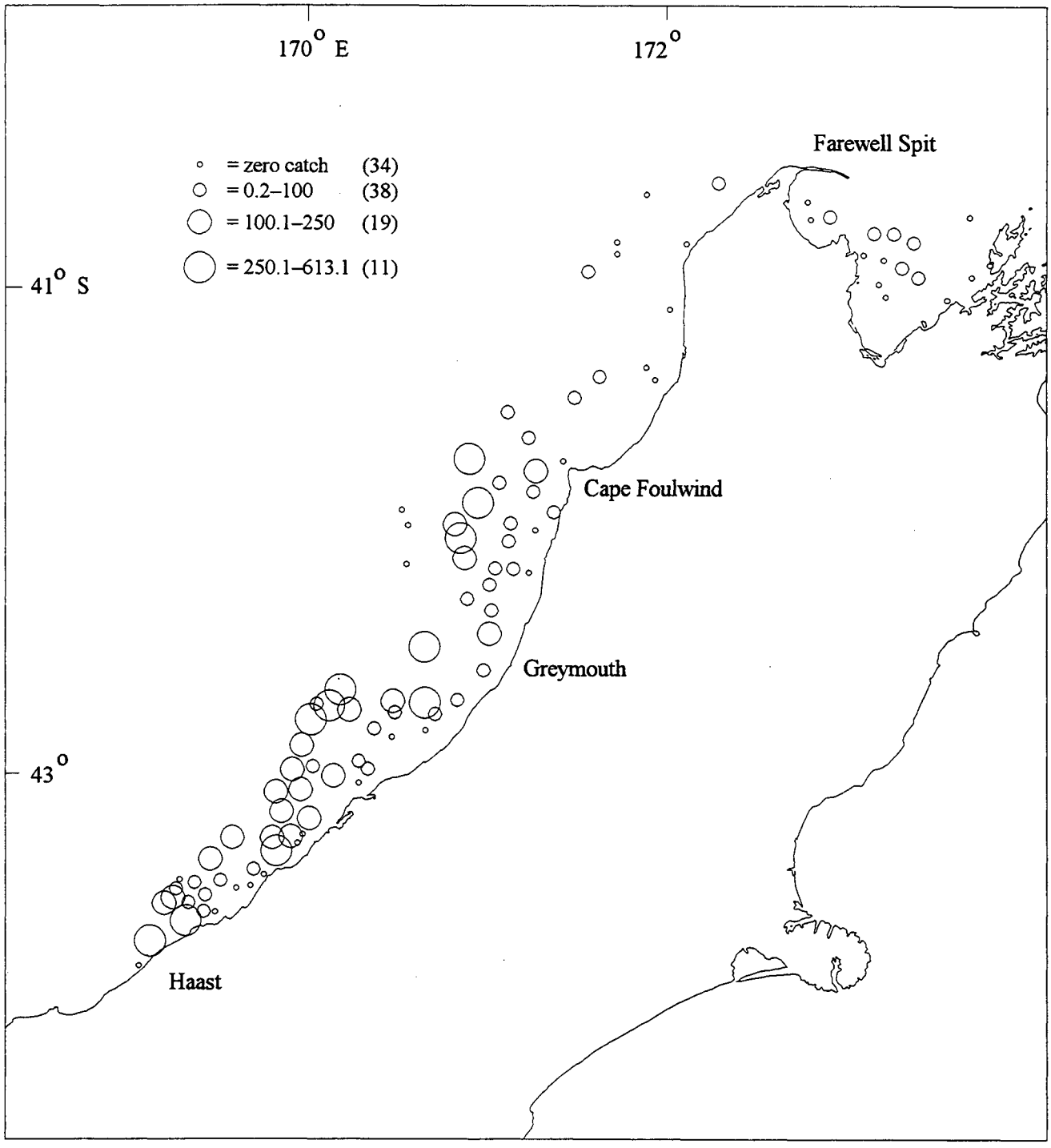


Figure 2— ***continued***

Hake

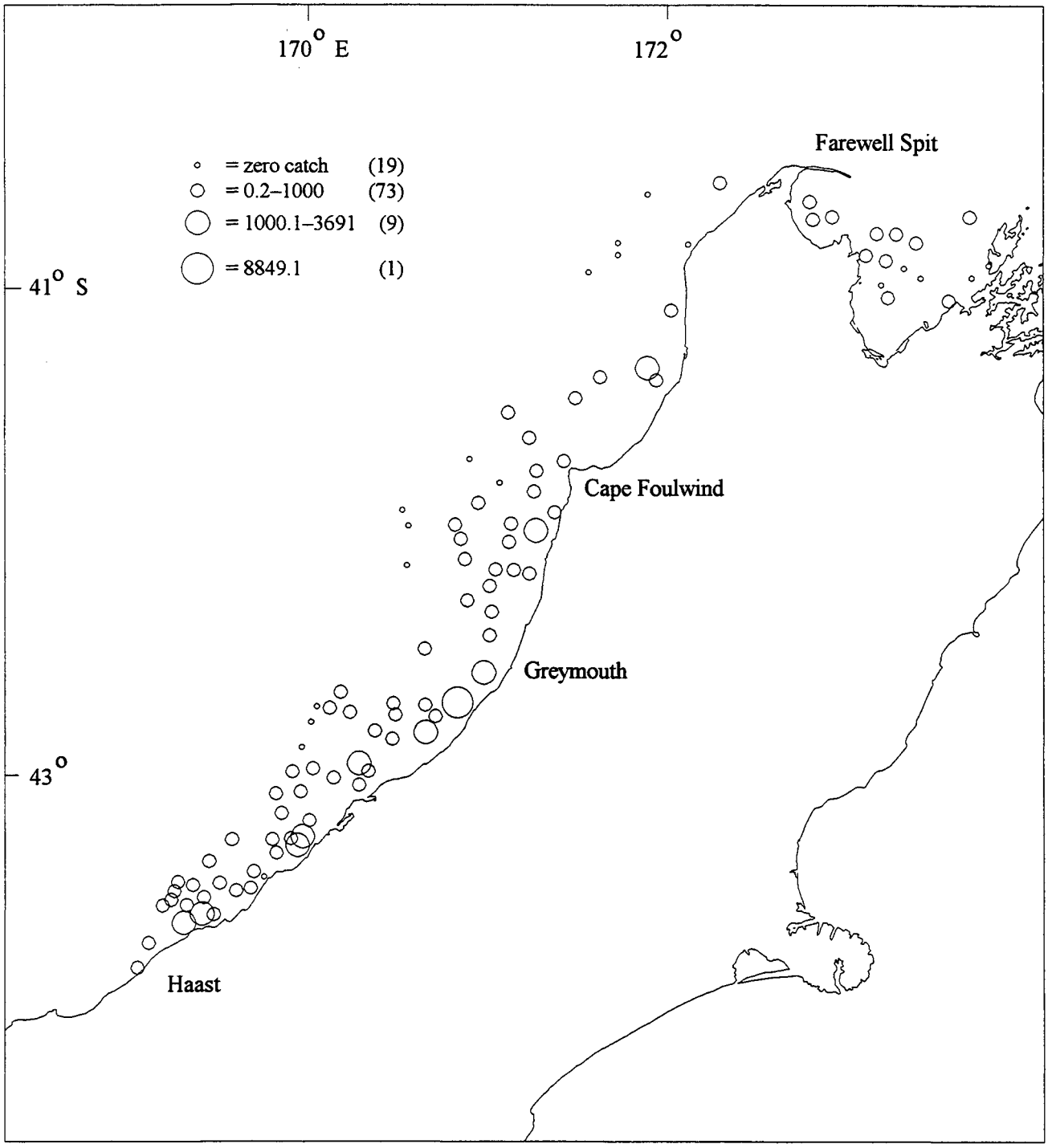


Figure 2— ***continued***

Hoki

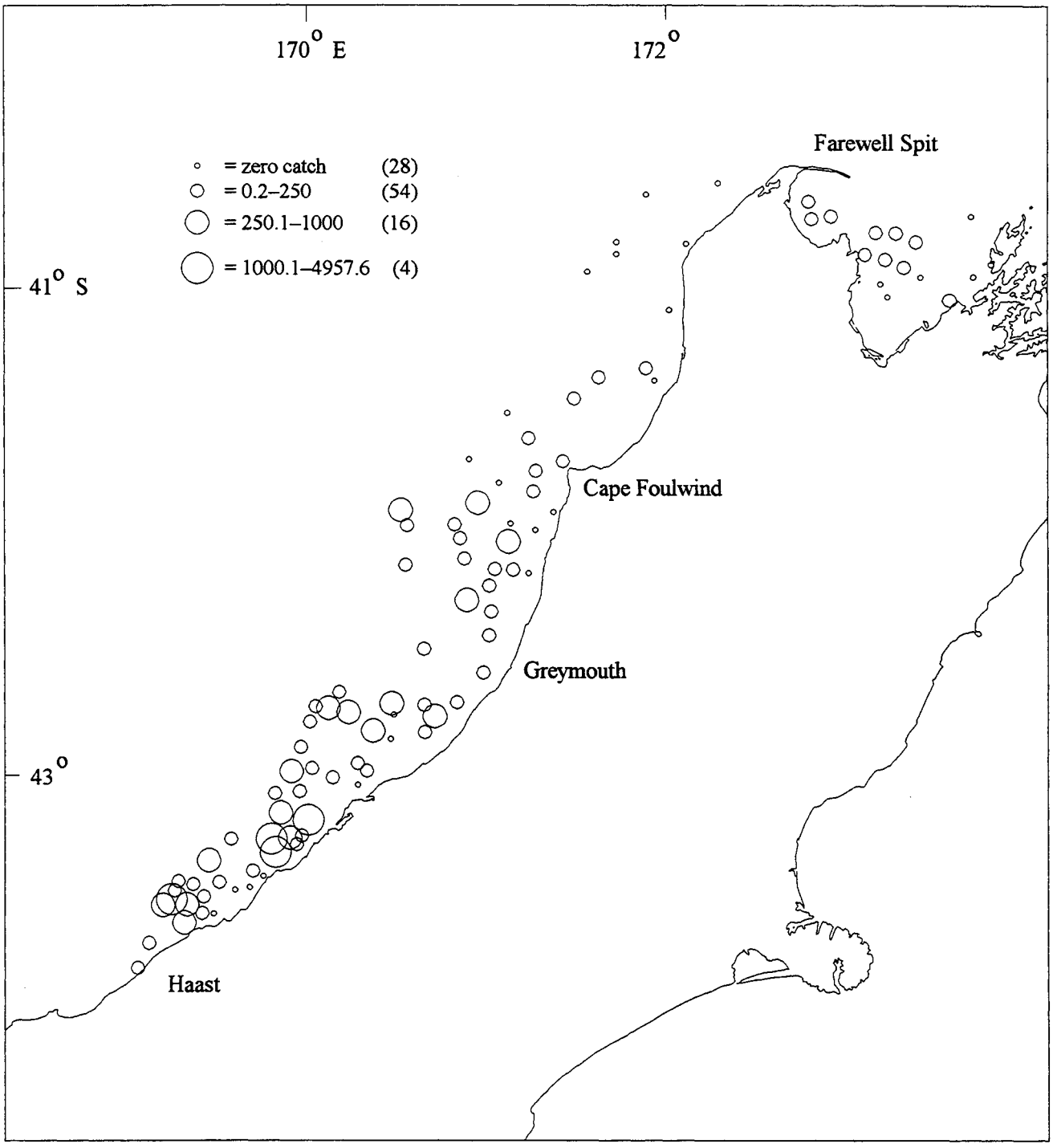


Figure 2— ***continued***

Jack mackerel

Trachurus murphyi

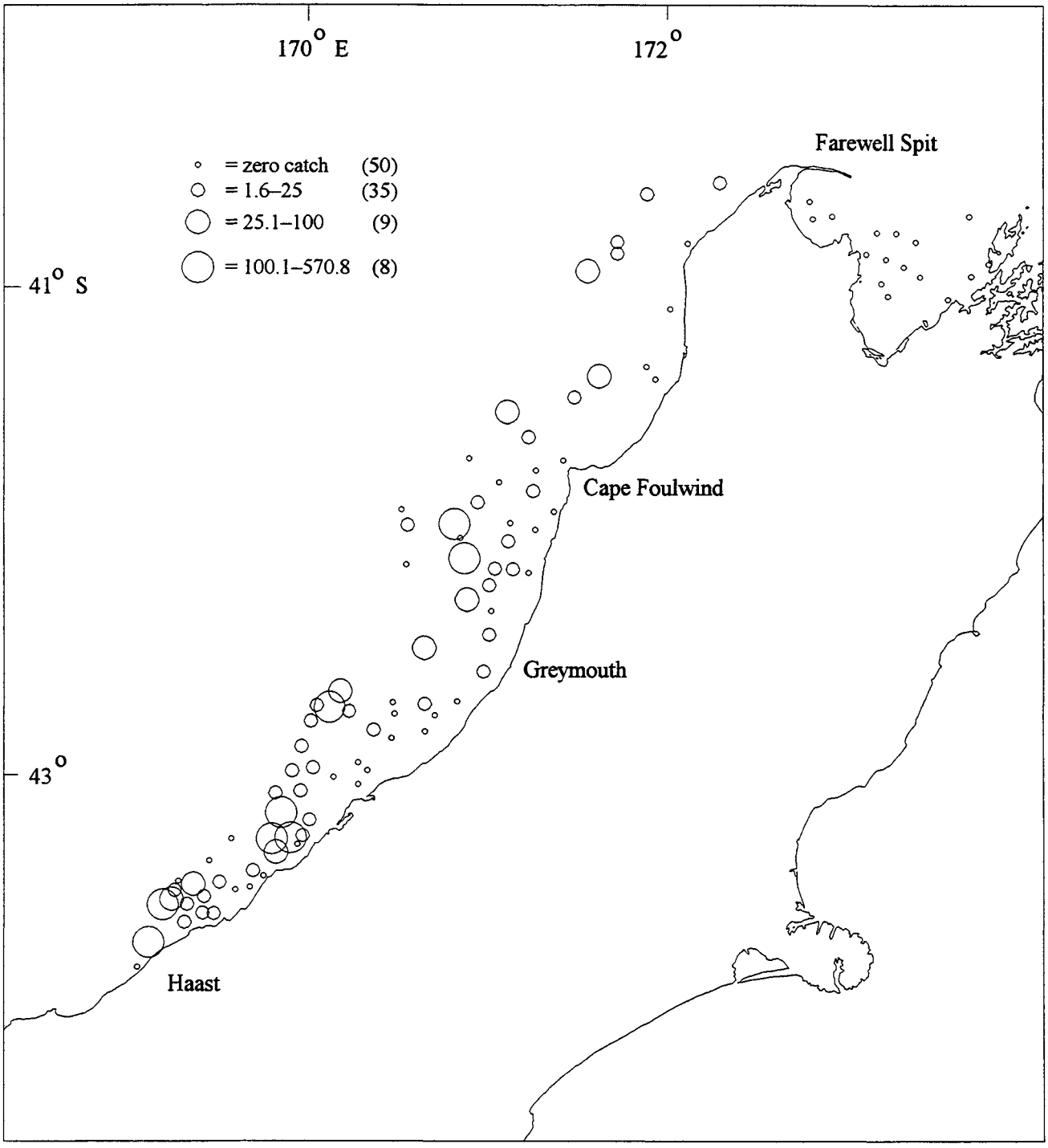


Figure 2— ***continued***

Ling

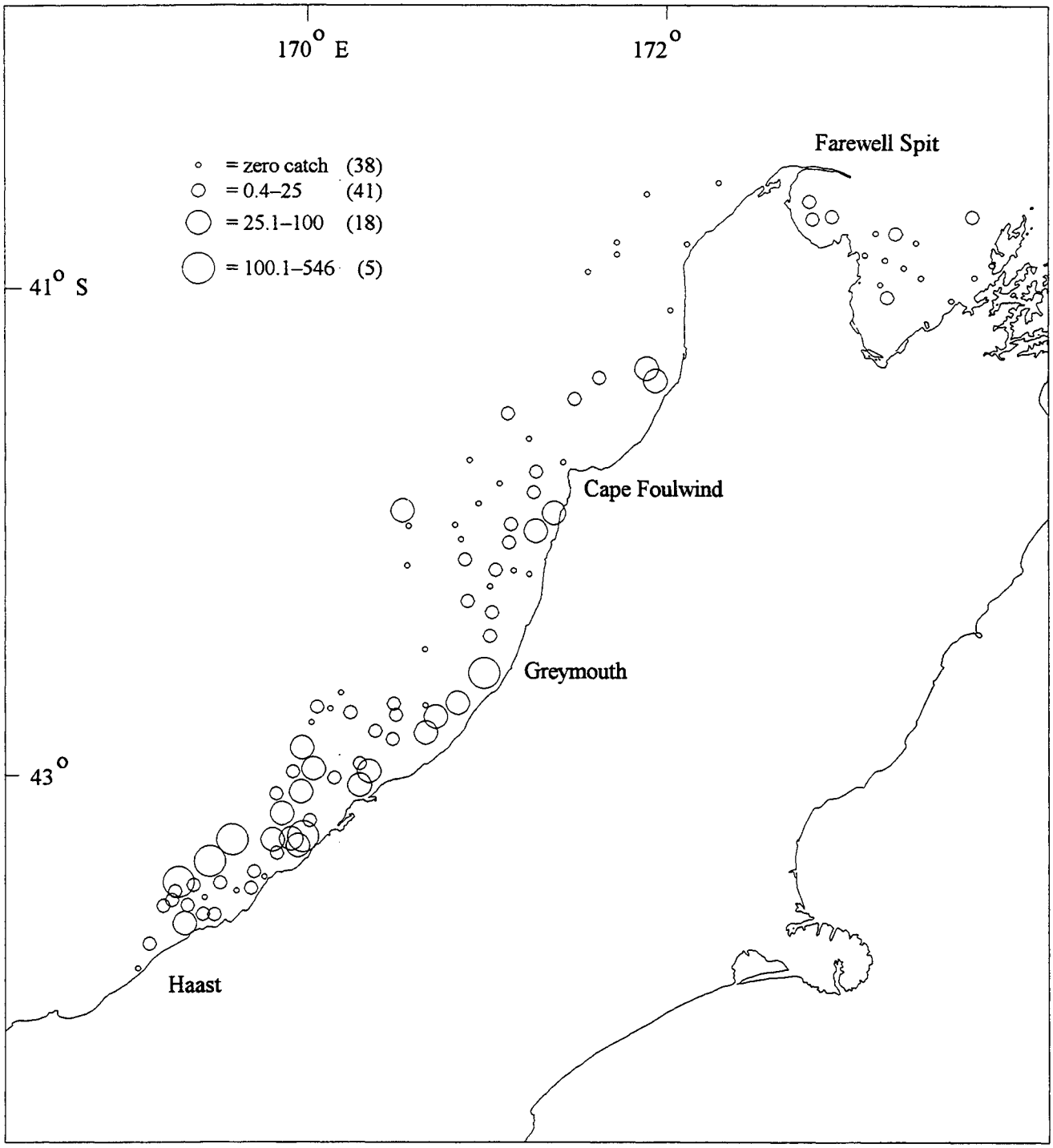


Figure 2— ***continued***

Red cod

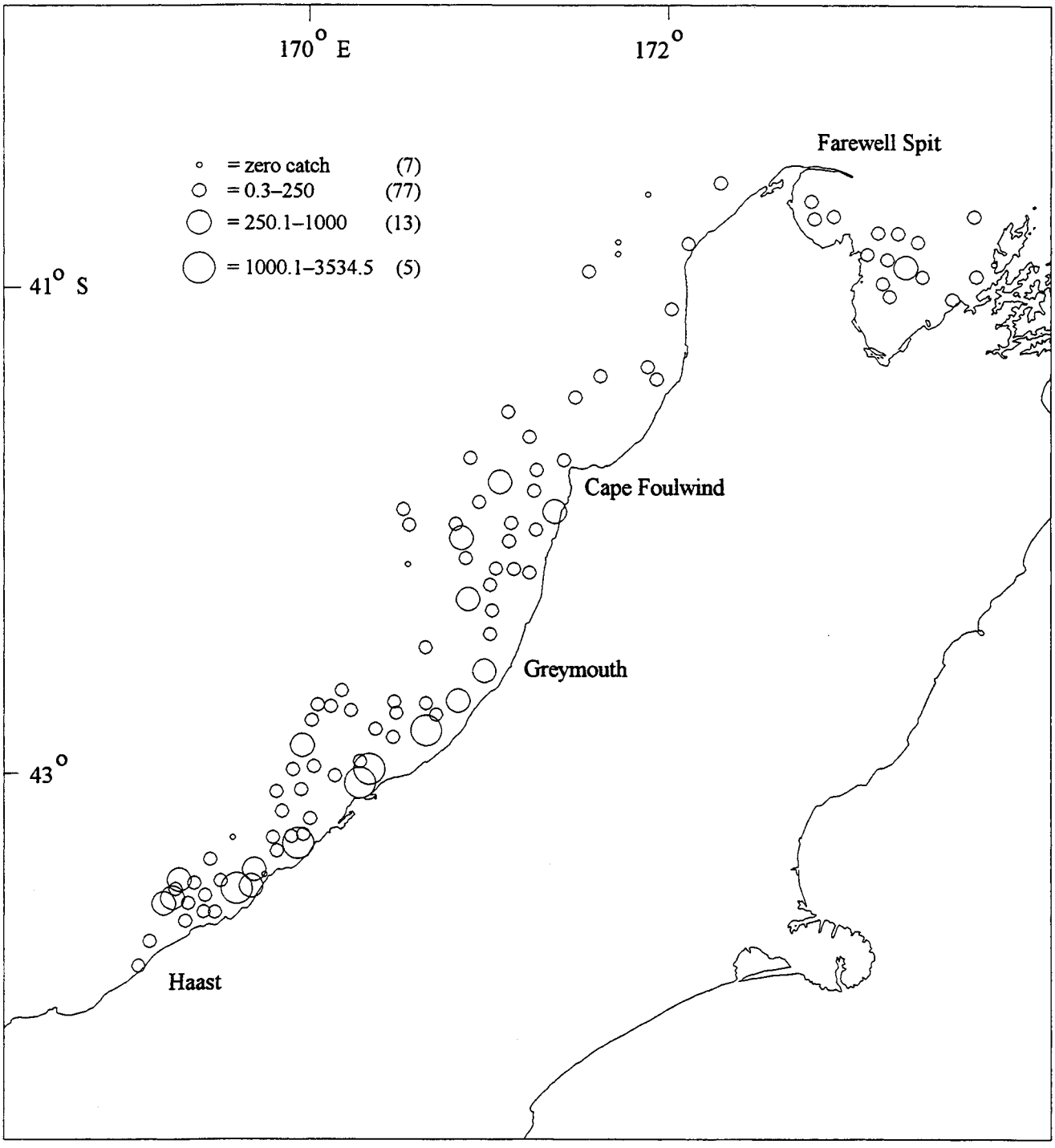


Figure 2— ***continued***

Red gurnard

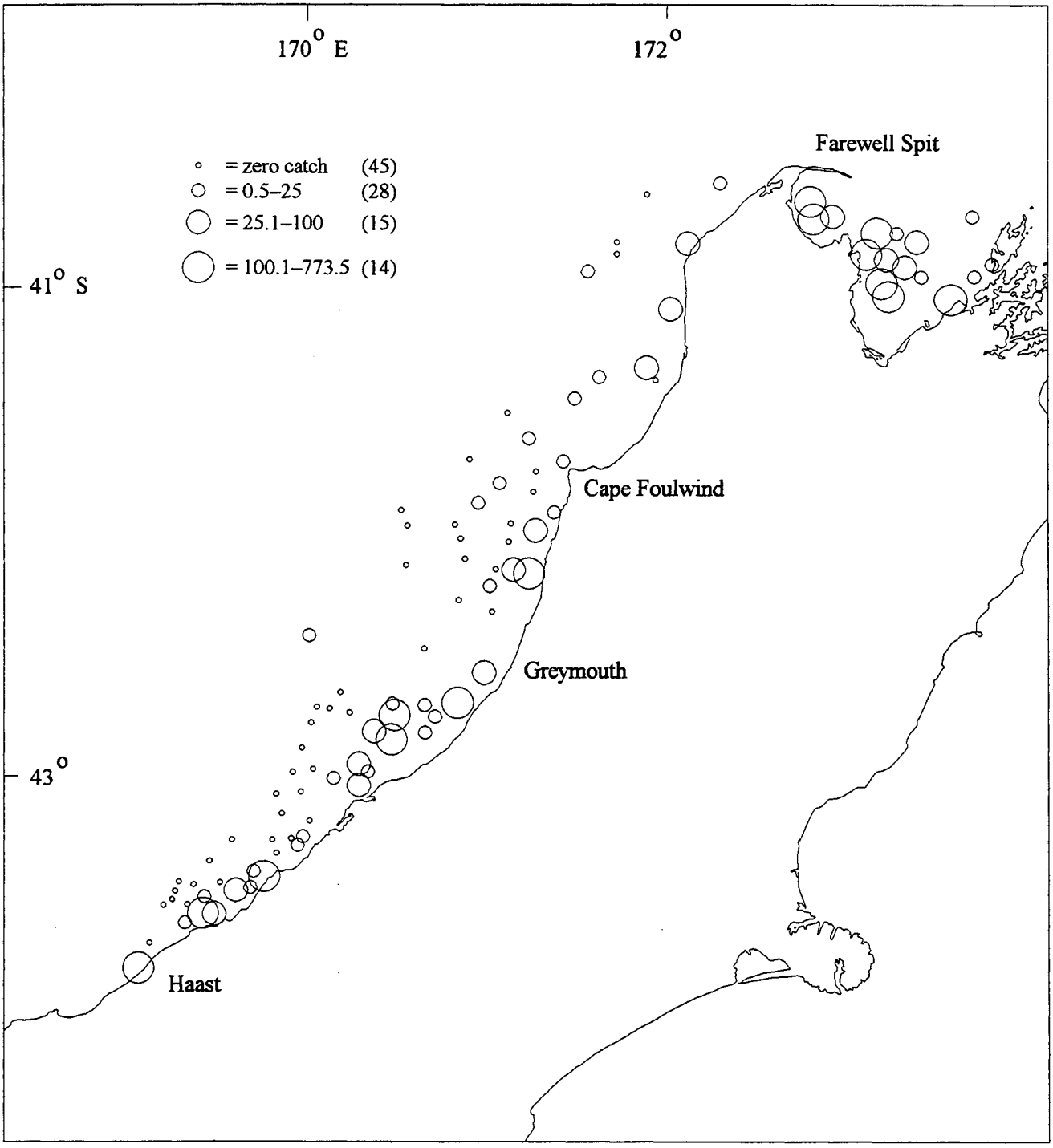


Figure 2— ***continued***

Rig

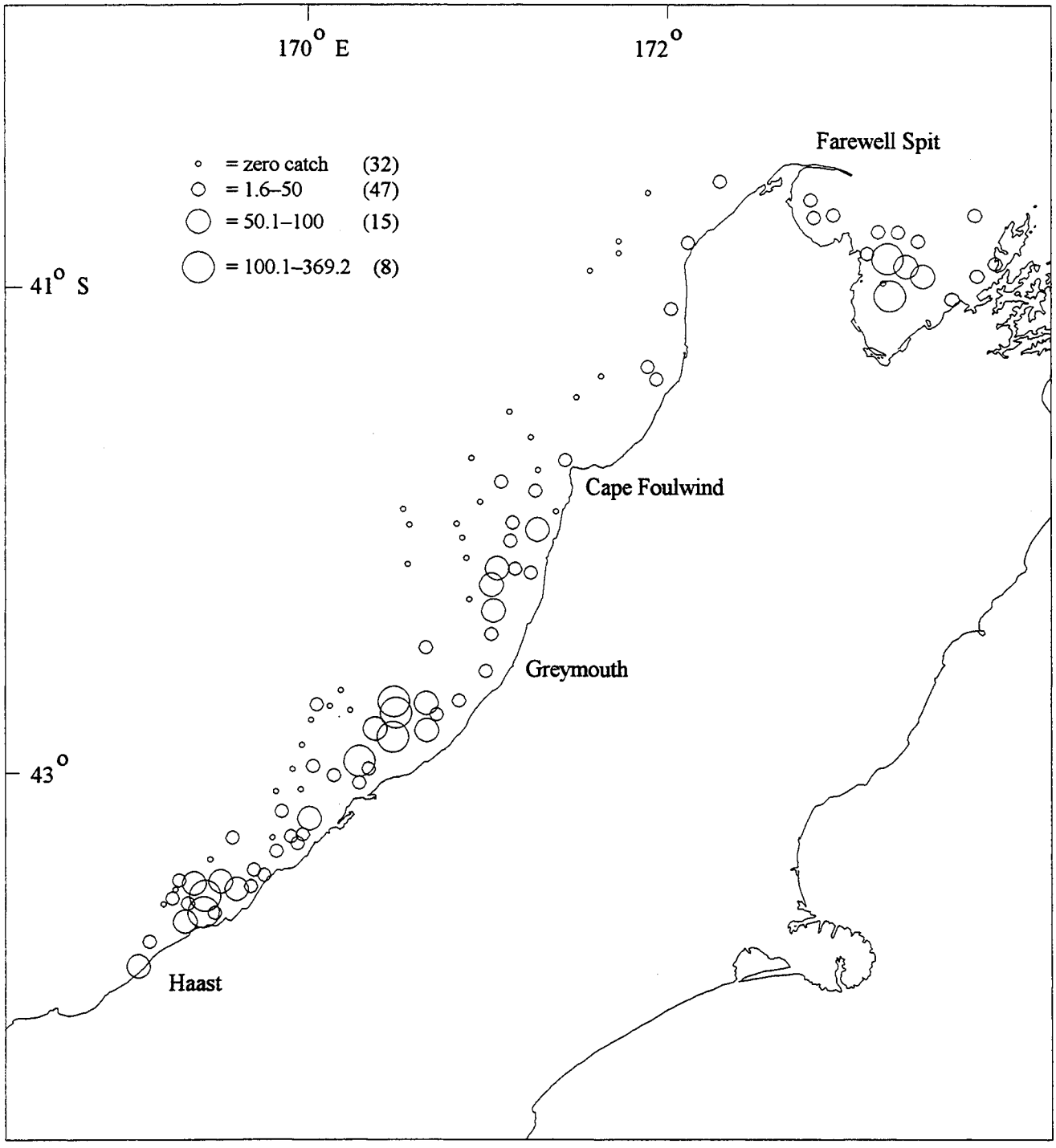


Figure 2— ***continued***

School shark

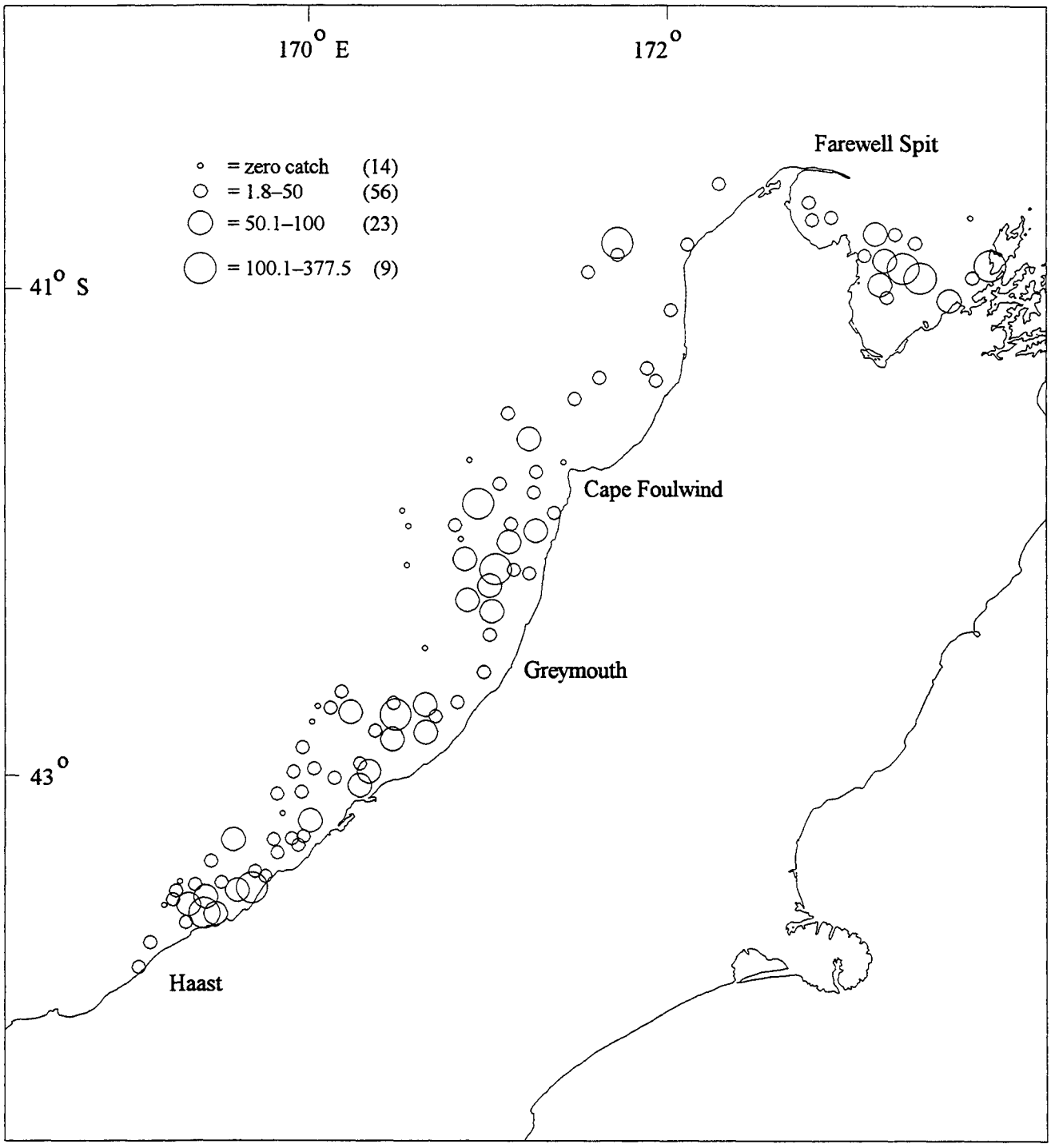


Figure 2— ***continued***

Sea perch

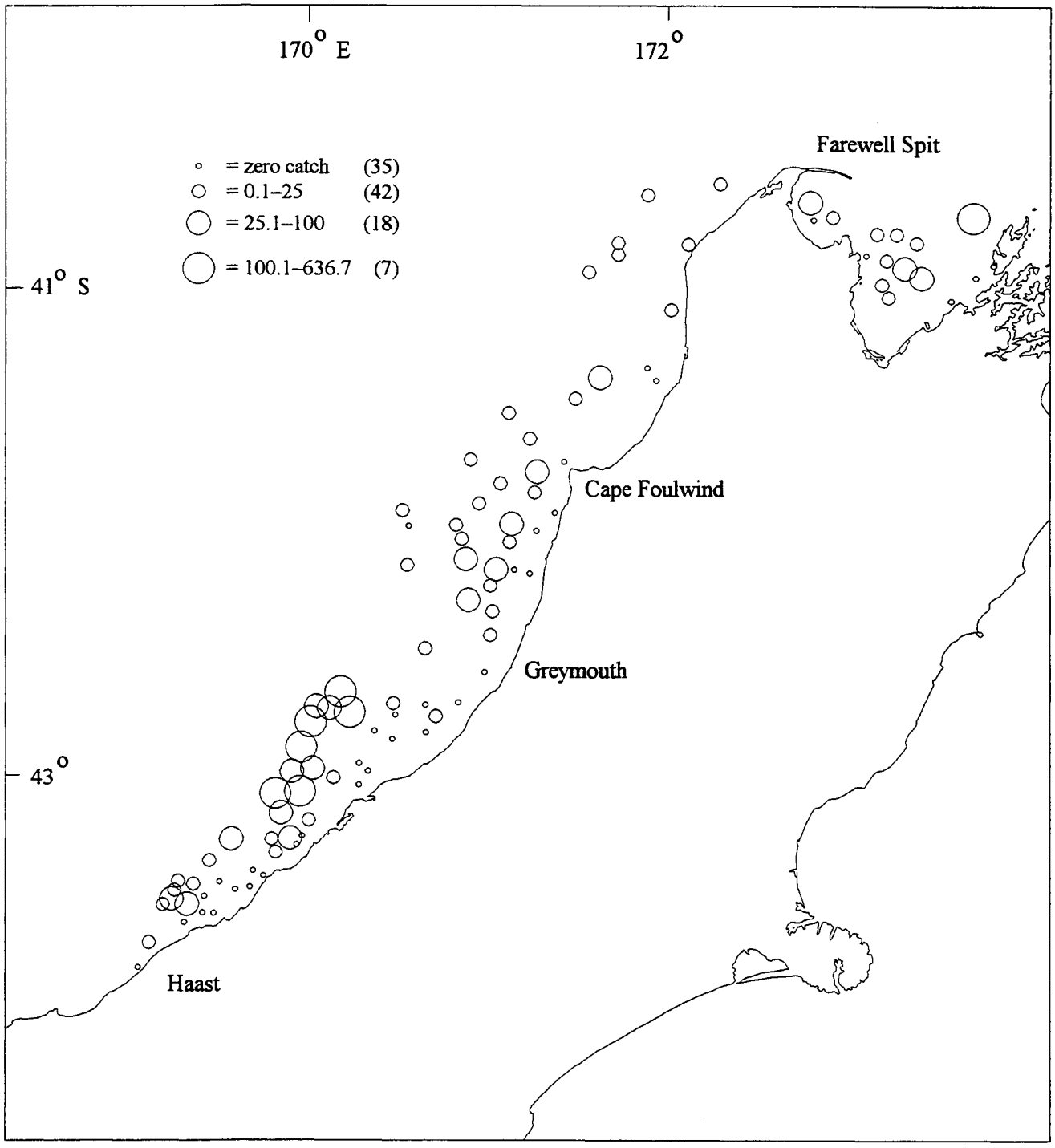


Figure 2— ***continued***

Southern spiny dogfish

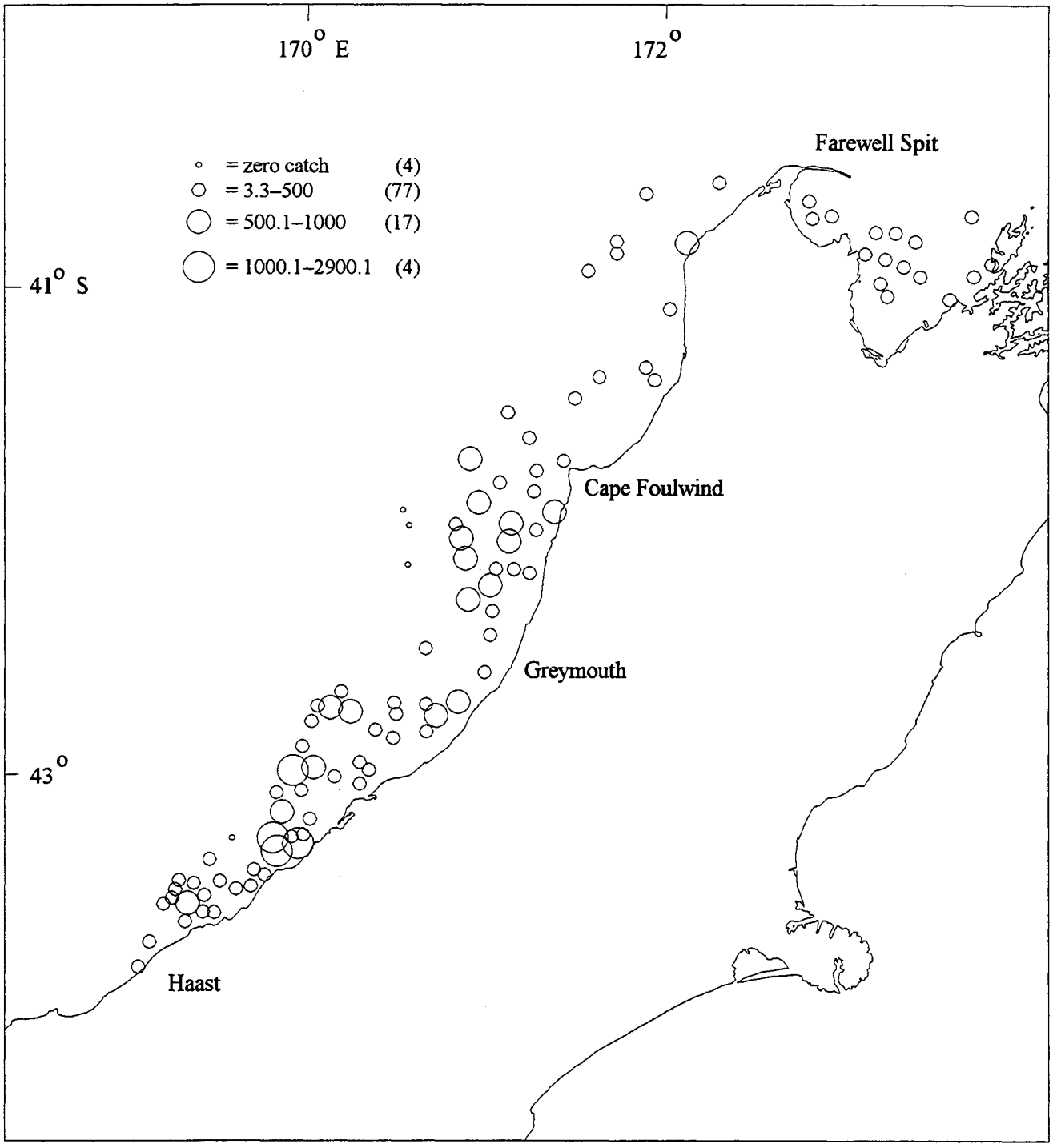


Figure 2— ***continued***

Tarakihi

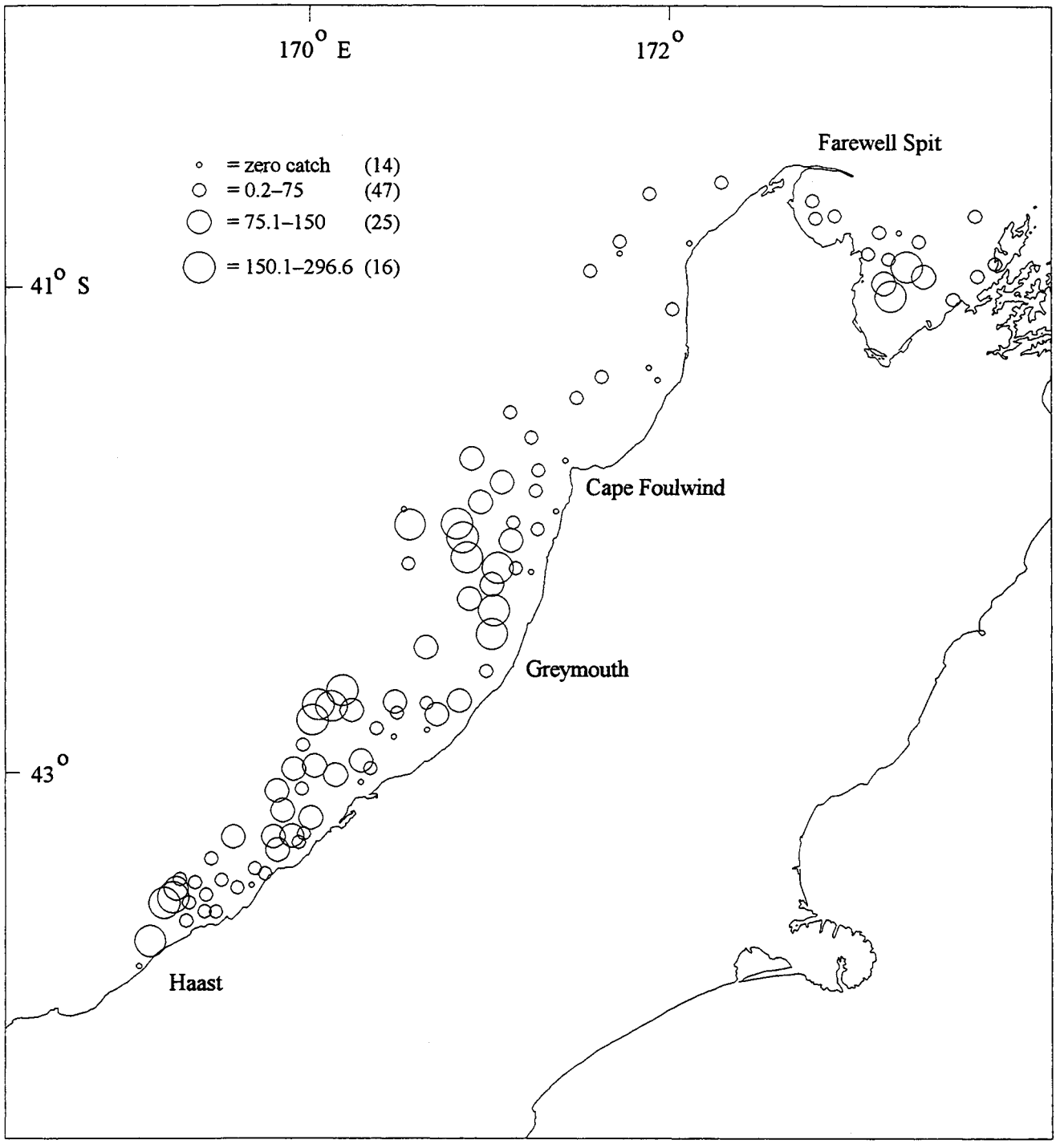


Figure 2— *continued*

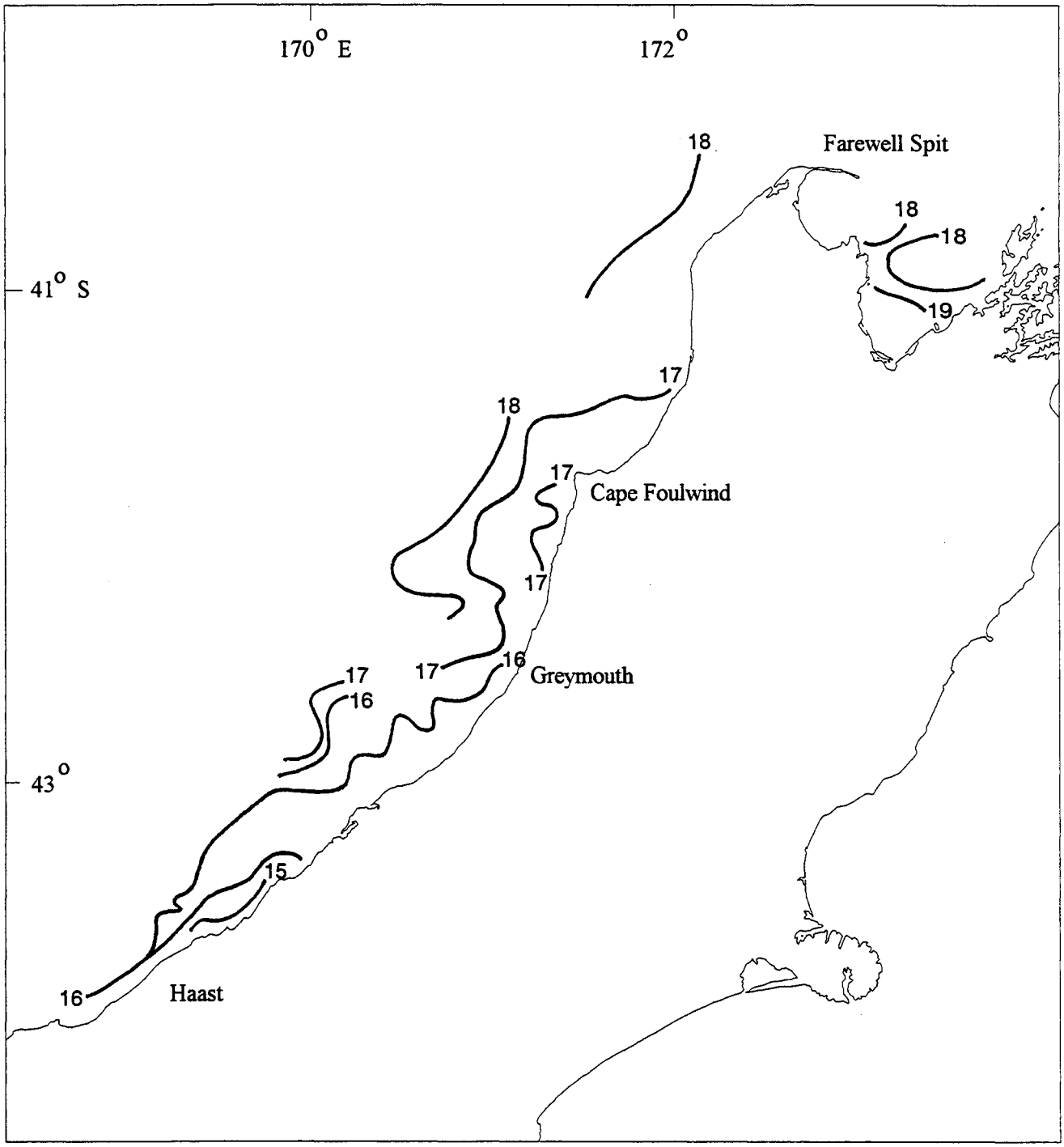


Figure 3a: Sea surface isotherms estimated from station data.

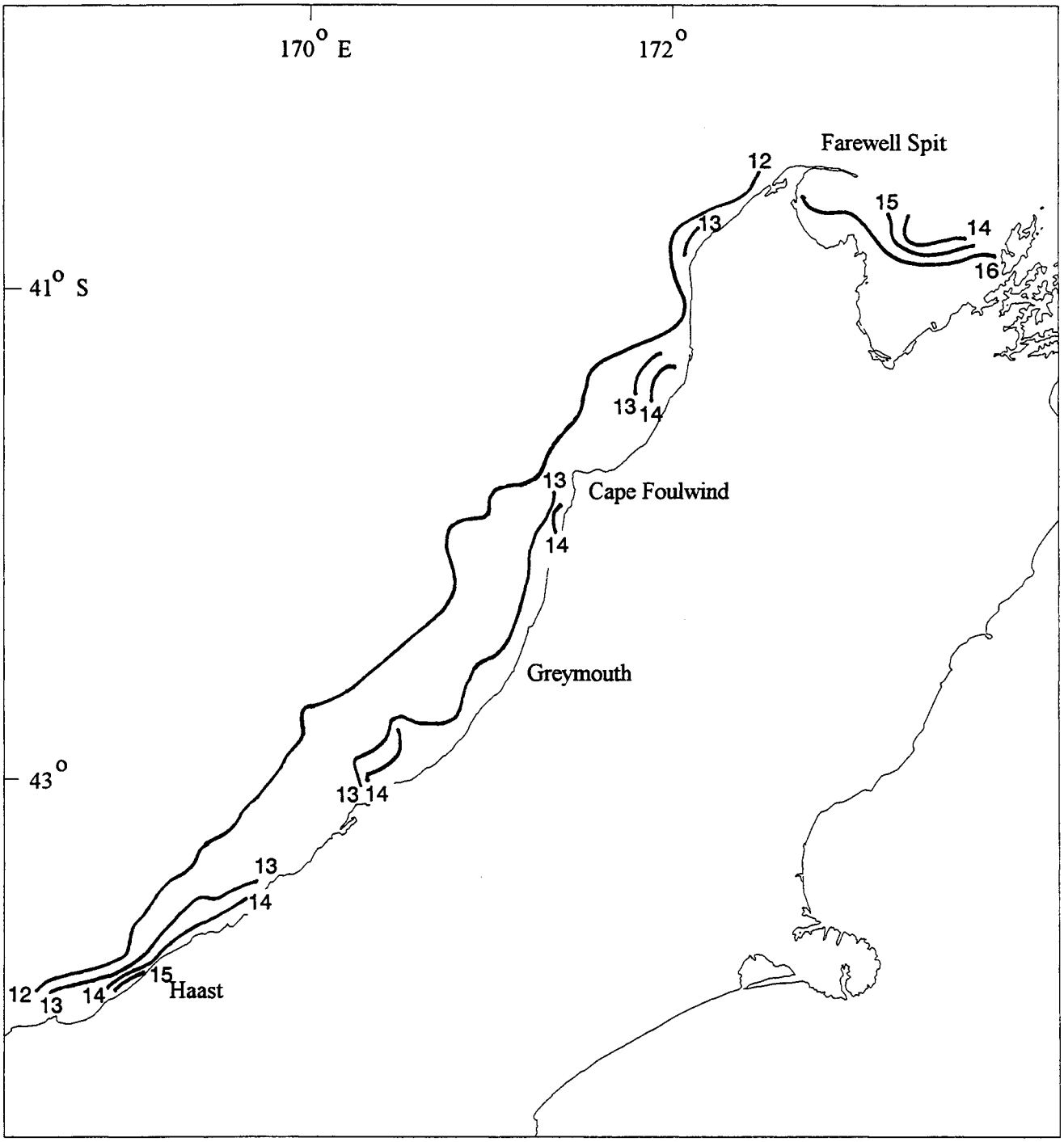


Figure 3b: Bottom isotherms estimated from station data.

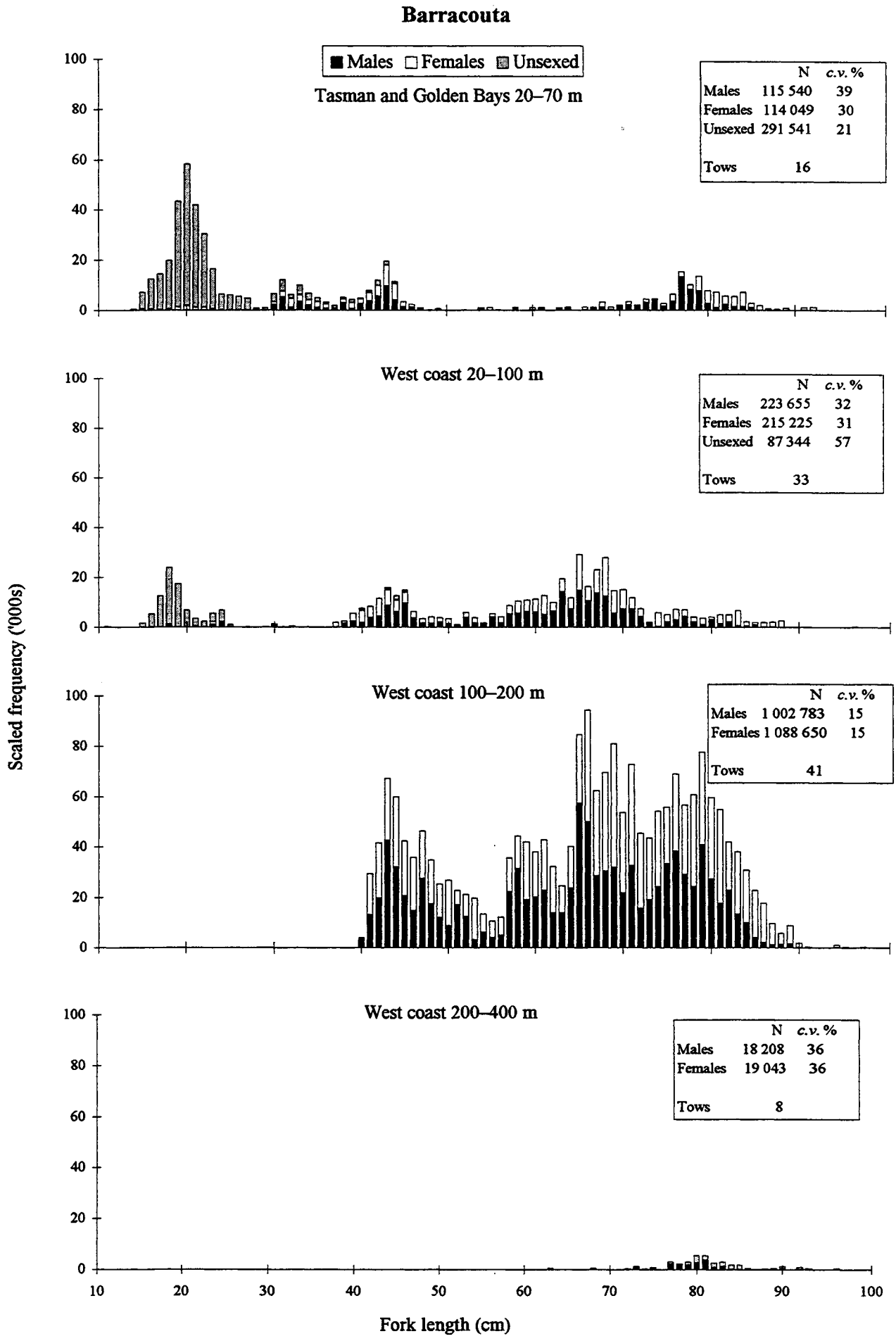


Figure 4: Scaled length frequency distributions for the 11 most abundant ITQ species and other important species (N, estimated population; Tows, number of stations where species was caught).

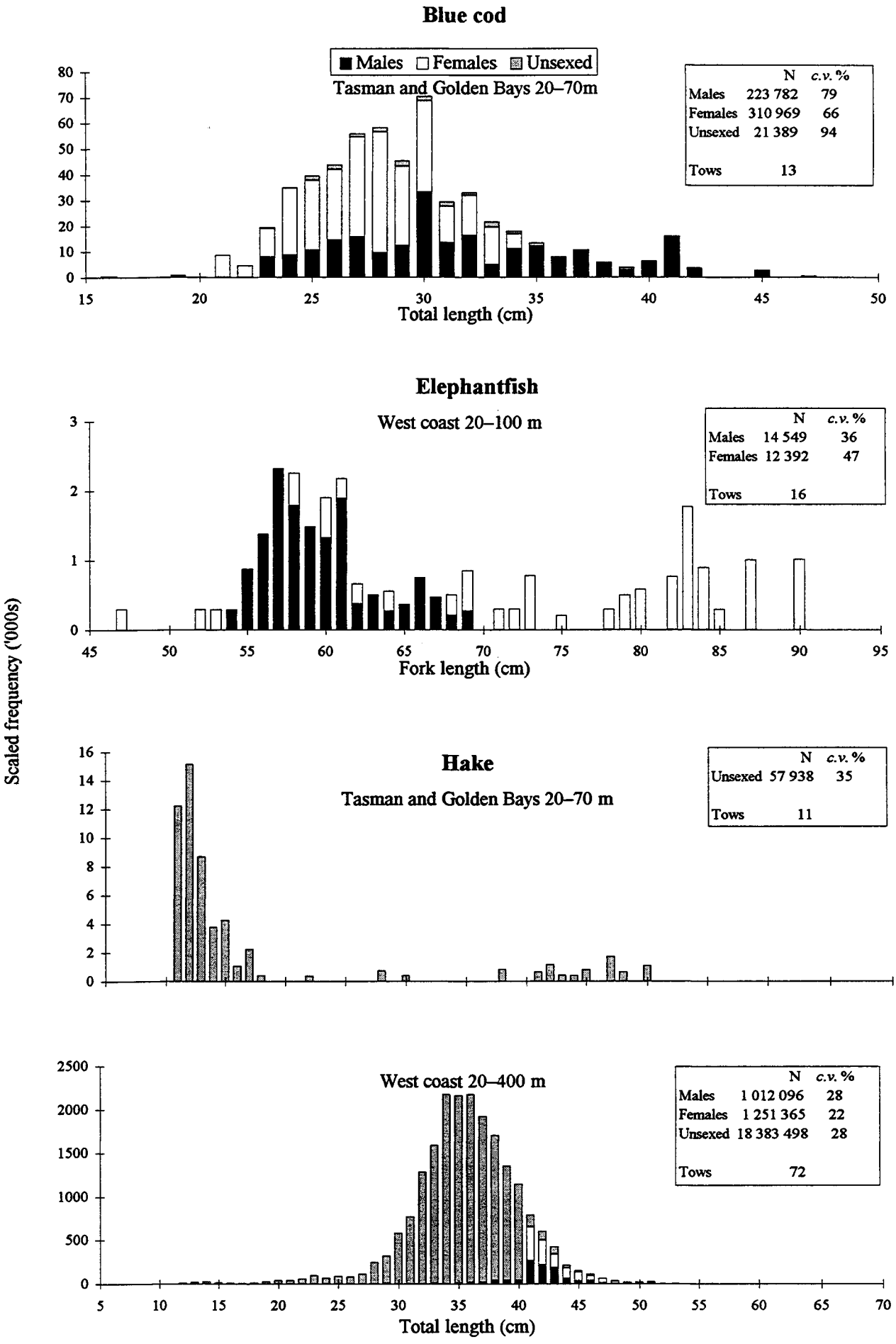


Figure 4—*continued*

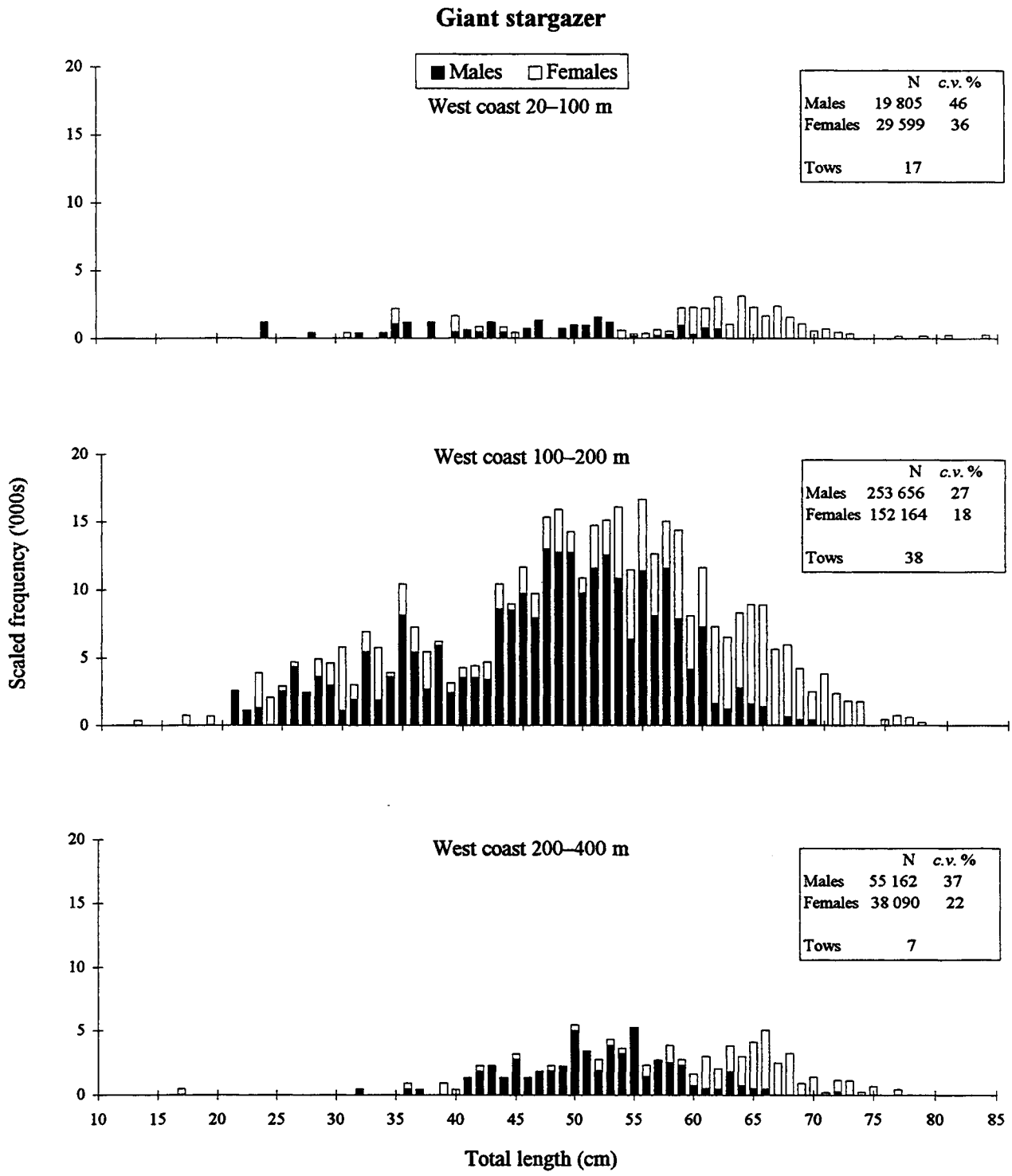


Figure 4—*continued*

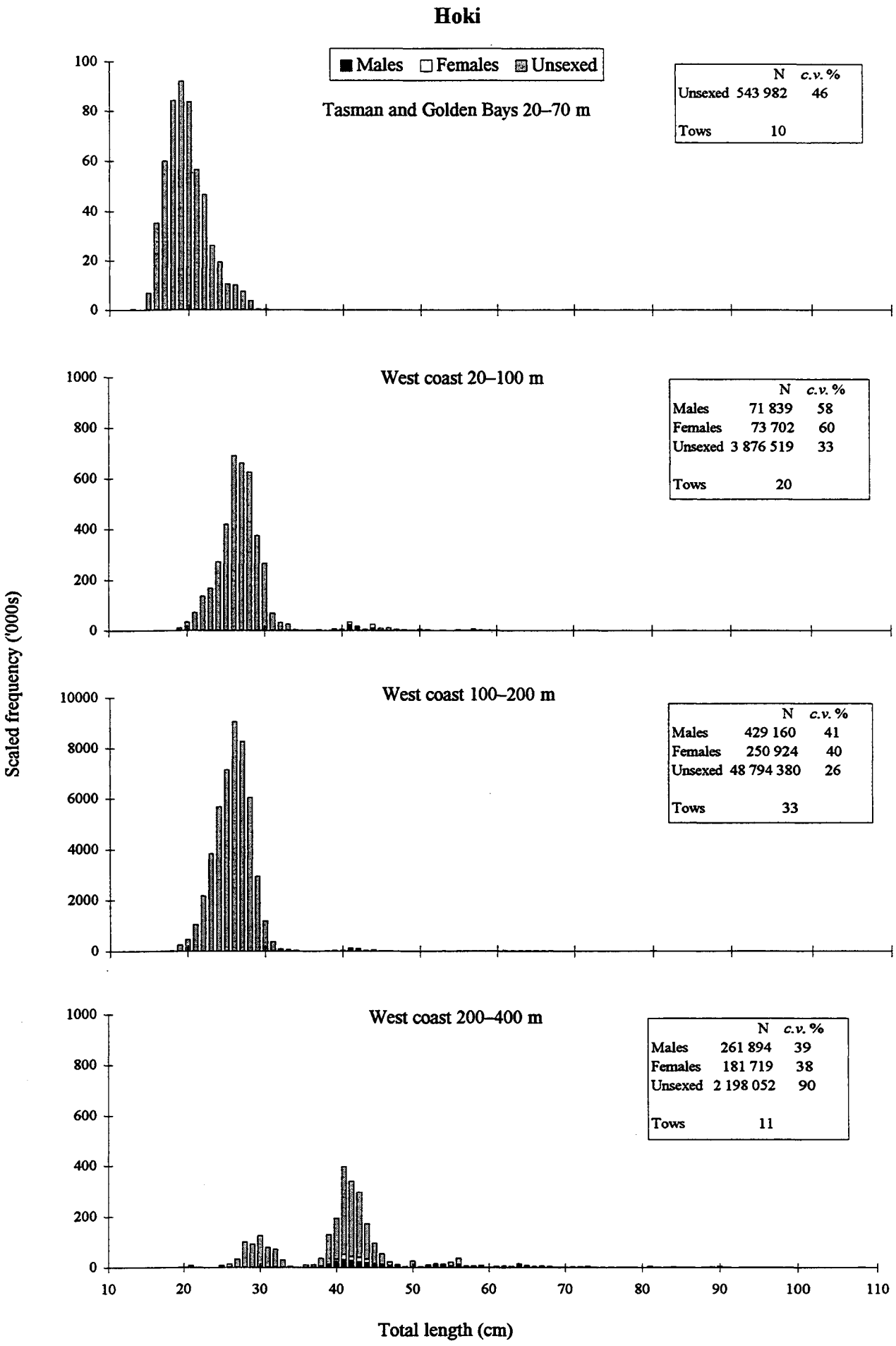
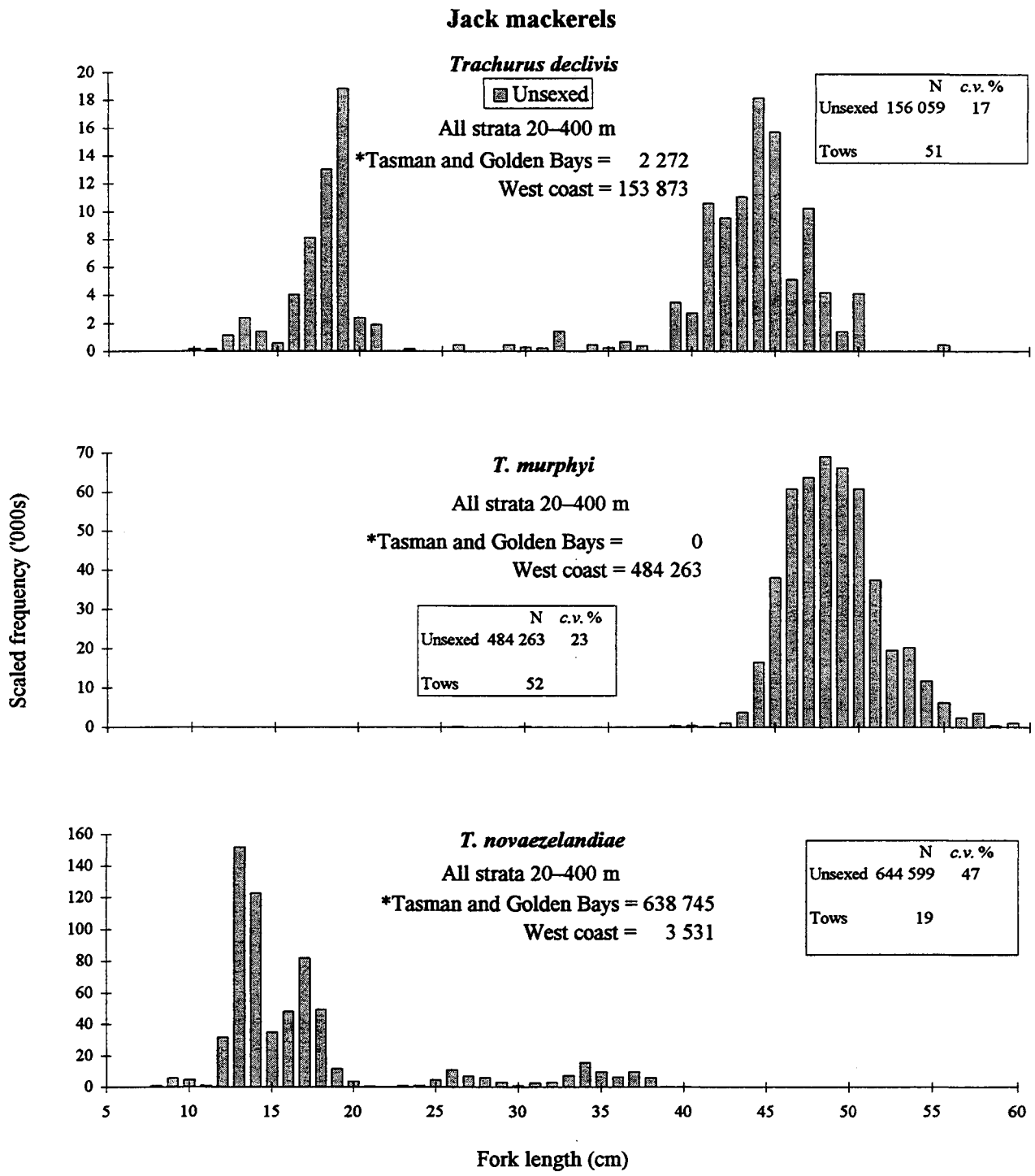


Figure 4—*continued*



* Estimated population size for each subarea

Figure 4—*continued*

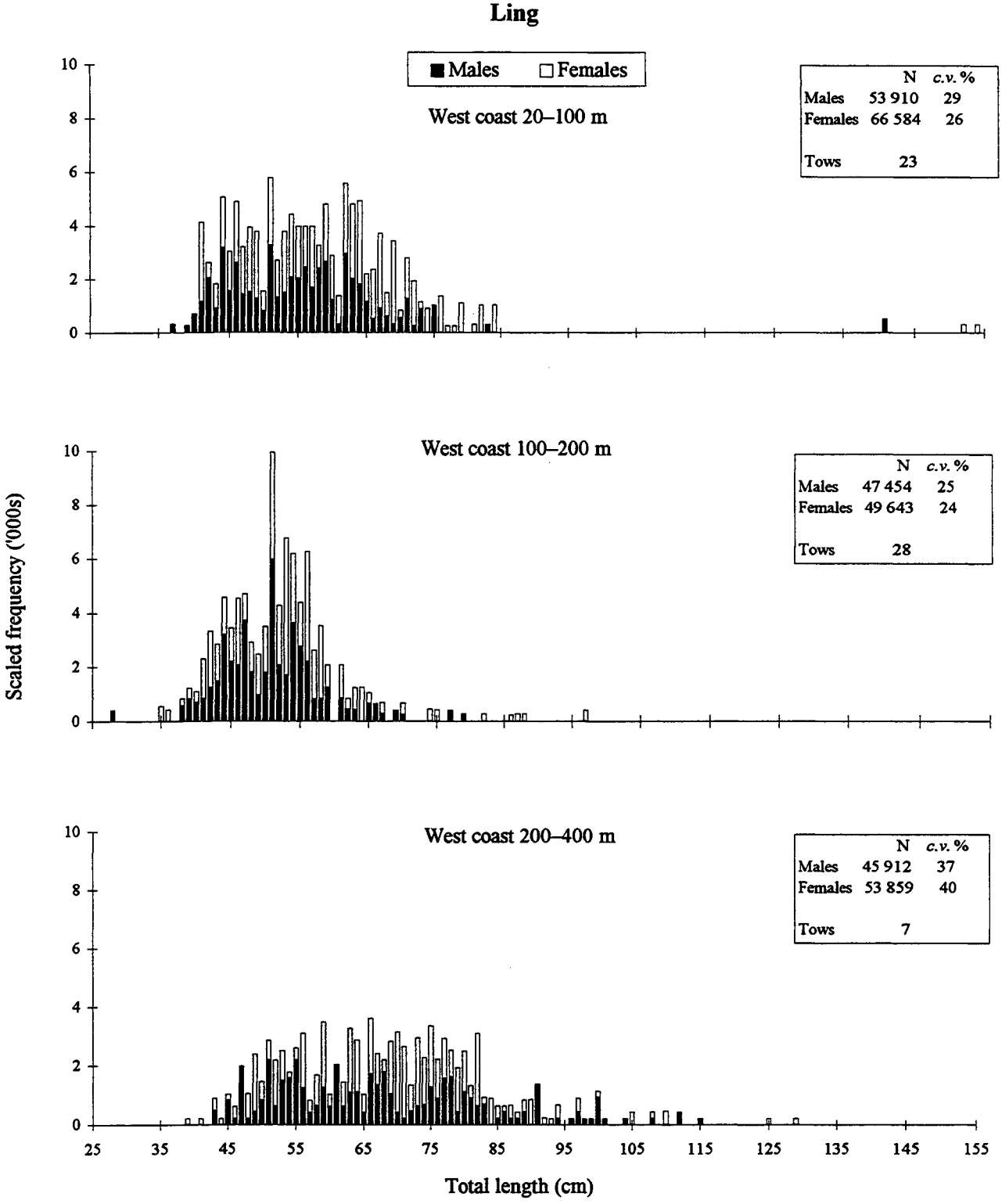


Figure 4—*continued*

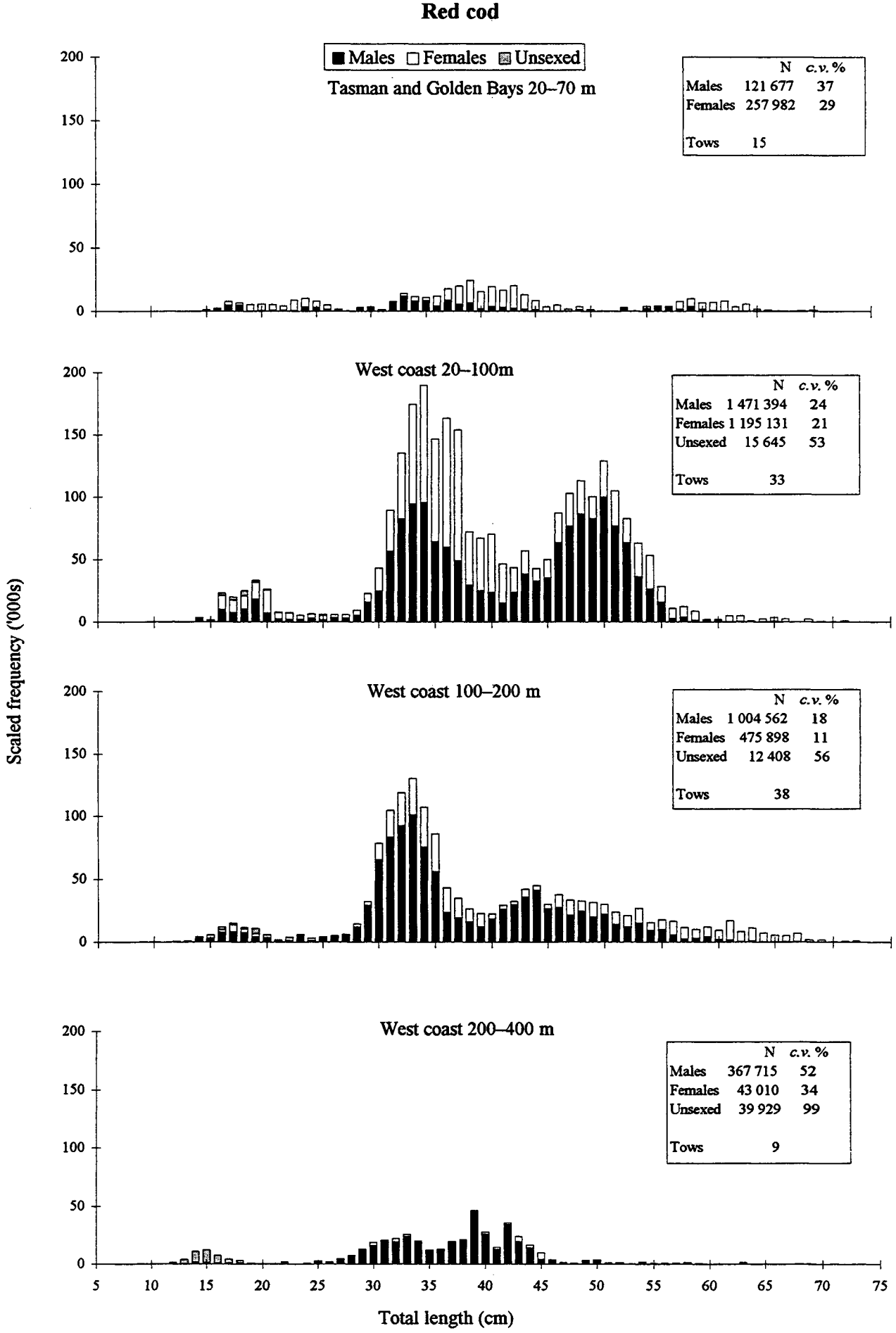


Figure 4—*continued*

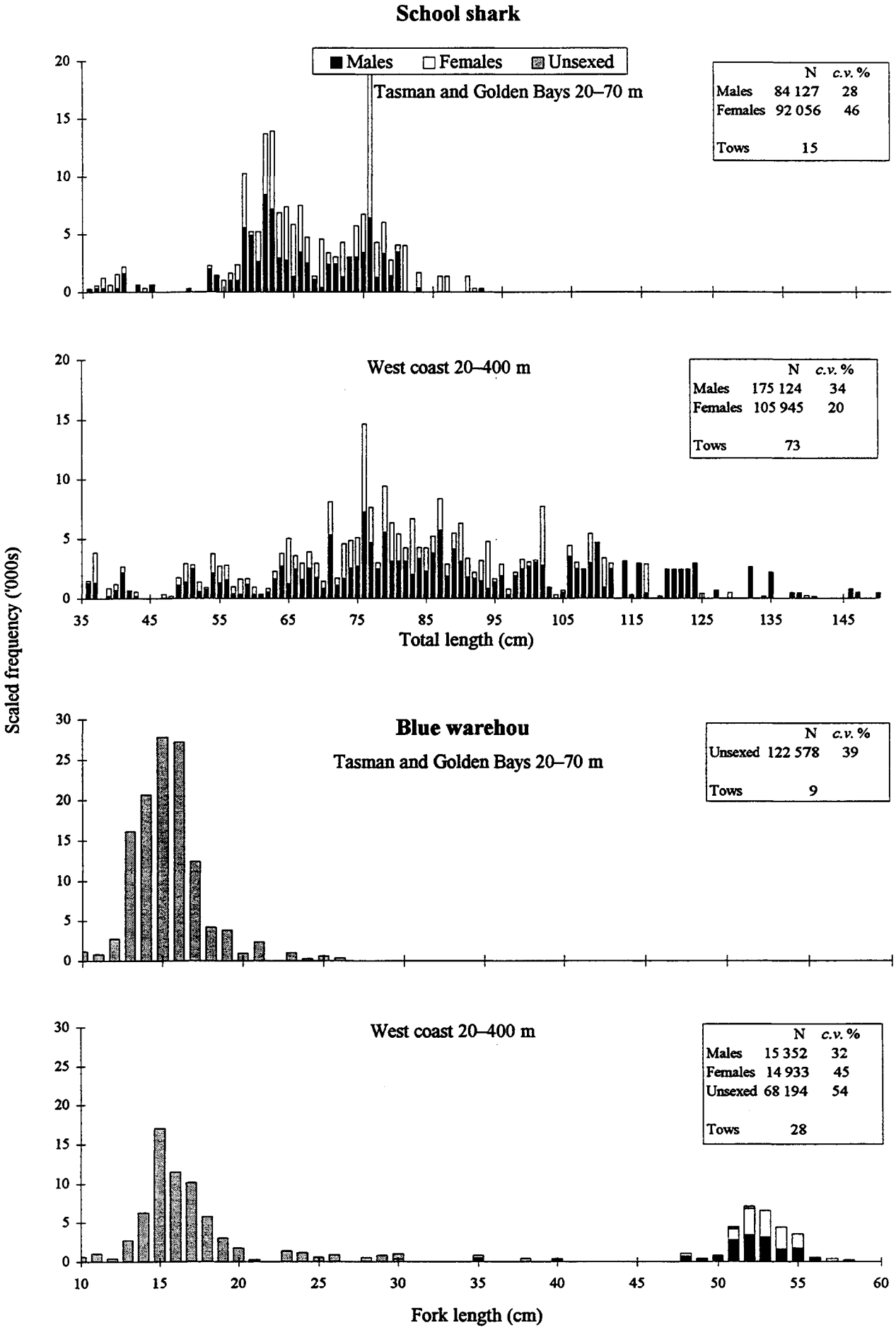


Figure 4–*continued*

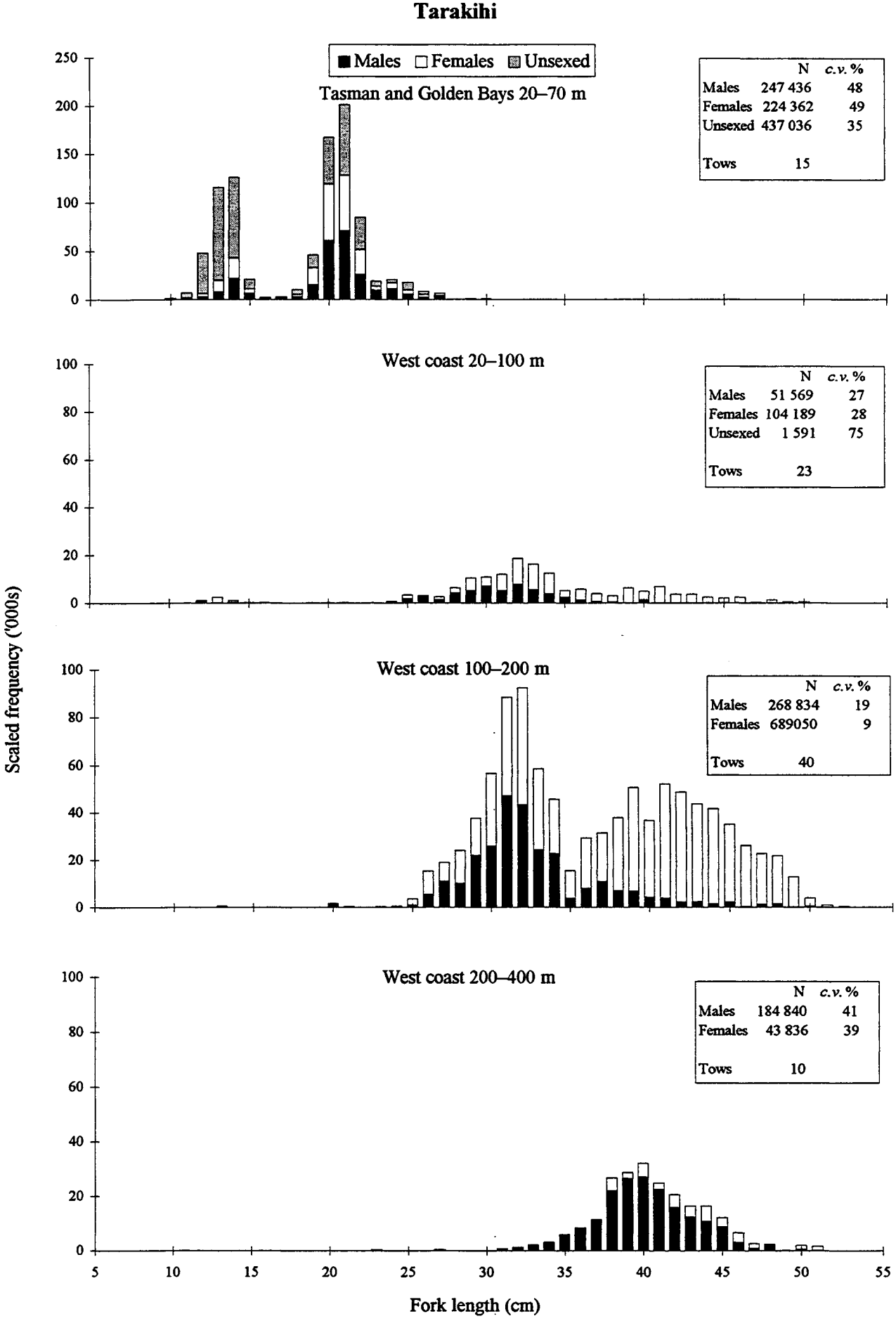
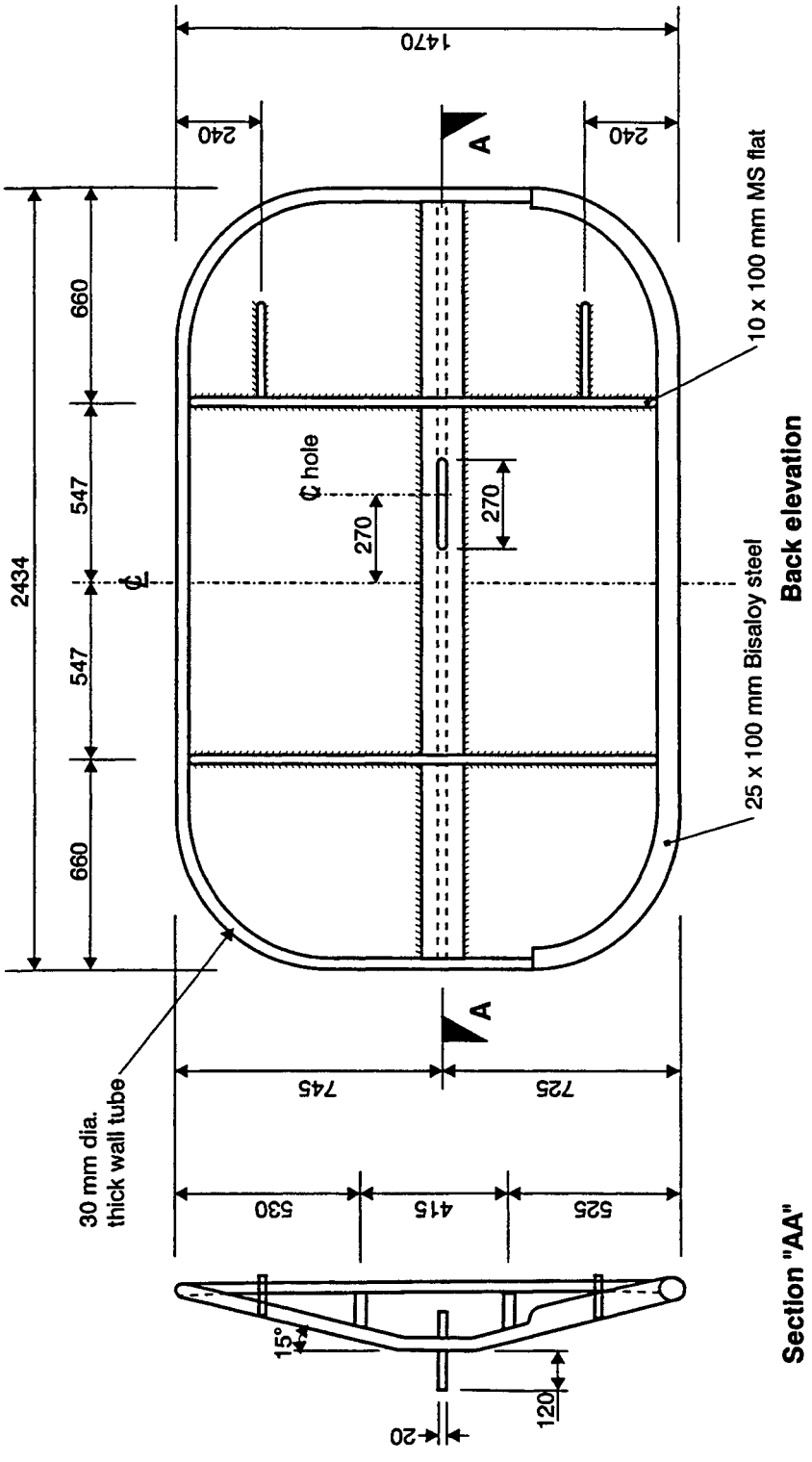


Figure 4—*continued*

Appendix 1: Specifications for the old (used during 1992 and 1994) and new (1995 and beyond) trawl doors.

Attribute	Old	New
Aspect ratio (area/span^2)	Low	Low
Surface area	3.2 m^2	3.2 m^2
Shape	Rectangular "V"	Rectangular "V"
Scanmar brackets fitted	No	Yes
Weight	500 kg (with weighted shoes)	630 kg (dispersed over entire door)

Back elevation and side section of new doors



Appendix 2: Summary of station data

			Start of tow			End of tow		Gear depth (m)		Distance trawled	Doorspread	Surface temp	Bottom temp
Station	Stratum	Date	Time	° ' S	° ' E	° ' S	° ' E	Min.	Max.	(n. miles)	(m)	(°C)	(°C)
1	18	22-Mar-95	0632	40 51.91	173 05.32	40 54.11	173 06.28	33	33	2.31	60.0	18.4	16.3
2	18	22-Mar-95	0910	40 46.70	173 08.86	40 48.56	173 11.92	42	44	2.98	77.3	17.6	15.9
3	18	22-Mar-95	1101	40 53.20	173 12.10	40 55.25	173 14.96	42	42	2.98	77.0	17.7	16.0
4	18	22-Mar-95	1311	40 55.12	173 18.04	40 57.00	173 21.06	45	49	2.97	81.5	17.7	16.6
5	18	22-Mar-95	1559	40 59.17	173 10.52	40 57.94	173 09.29	32	34	1.54	72.0	18.4	16.3
6	17	23-Mar-95	0634	40 38.87	172 46.80	40 40.81	172 50.05	22	27	3.13	69.0	17.2	15.7
7	17	23-Mar-95	0820	40 43.22	172 47.93	40 44.81	172 51.24	22	23	2.97	68.0	17.2	16.4
8	17	23-Mar-95	0959	40 42.62	172 54.15	40 44.19	172 57.55	30	31	3.02	73.0	17.3	16.1
9	19	23-Mar-95	1256	40 48.91	173 22.00	40 50.59	173 25.31	51	52	3.02	85.1	17.5	13.6
10	18	23-Mar-95	1510	40 57.58	173 23.53	40 59.69	173 26.56	46	48	3.12	77.4	17.7	13.6
11	19	24-Mar-95	0640	40 54.34	173 45.94	40 51.37	173 44.64	36	43	3.13	73.0	17.4	16.1
12	19	24-Mar-95	0853	40 42.57	173 39.68	40 39.89	173 37.95	58	62	2.98	73.9	17.4	–
13	19	24-Mar-95	1148	40 57.48	173 40.33	40 59.63	173 37.30	44	45	3.14	77.5	18.1	16.8
14	18	24-Mar-95	1327	41 03.20	173 32.82	41 03.80	173 29.05	37	38	2.91	74.2	18.4	16.7
15	18	24-Mar-95	1549	41 02.45	173 12.70	41 00.45	173 09.64	32	36	3.05	71.2	19.2	16.7
16	19	25-Mar-95	1616	40 46.78	173 15.42	40 44.05	173 14.39	49	50	2.84	75.3	18.4	13.1
17	2	26-Mar-95	0637	40 56.12	171 33.43	40 54.85	171 36.83	152	165	2.87	99.3	18.2	12.5
18	2	26-Mar-95	0835	40 51.80	171 43.18	40 54.78	171 43.29	137	146	2.98	96.0	18.0	12.9
19	1	26-Mar-95	1139	41 05.52	172 00.83	41 07.95	171 58.48	68	75	3.00	78.2	17.7	12.7
20	5	26-Mar-95	1412	41 19.91	171 52.99	41 22.78	171 51.70	51	57	3.03	76.2	17.3	13.5
21	5	26-Mar-95	1609	41 22.93	171 55.96	41 25.65	171 54.53	41	43	2.92	74.5	17.2	14.9
22	8	27-Mar-95	0627	41 58.54	170 49.28	41 55.67	170 50.67	193	198	3.05	92.5	17.2	12.2
23	8	27-Mar-95	0824	41 53.21	170 57.04	41 50.35	170 58.38	174	179	3.03	87.0	17.0	11.5
24	6	27-Mar-95	1118	41 37.13	171 13.88	41 34.59	171 15.77	146	150	2.91	95.3	16.8	11.5
25	6	27-Mar-95	1401	41 27.42	171 29.07	41 24.72	171 30.52	134	136	2.92	93.8	17.1	12.7
26	6	27-Mar-95	1600	41 22.15	171 37.19	41 19.22	171 37.98	126	127	2.98	89.2	17.3	13.1
27	2	28-Mar-95	0635	40 48.97	171 43.21	40 46.38	171 44.97	153	154	2.91	87.3	18.2	12.8
28	2	28-Mar-95	0857	40 37.09	171 53.24	40 35.14	171 56.31	150	156	3.03	85.0	18.3	12.6
29	1	28-Mar-95	1209	40 34.31	172 17.27	40 36.37	172 14.52	49	84	2.94	72.5	17.3	12.7

Appendix 2—*continued*

Station	Stratum	Date	Start of tow			End of tow		Gear depth (m)		Distance trawled	Doorspread	Surface temp	Bottom temp
			Time	° ' S	° ' E	° ' S	° ' E	Min.	Max.	(n. miles)	(m)	(°C)	(°C)
30	1	28-Mar-95	1443	40 49.37	172 06.63	40 47.20	172 09.51	52	73	3.08	73.9	17.3	13.7
31	6	31-Mar-95	0828	41 30.95	171 06.81	41 33.08	171 03.83	166	172	3.08	89.6	18.0	11.8
32	6	31-Mar-95	1101	41 42.42	170 54.14	41 44.79	170 51.19	197	203	3.23	82.0	18.4	11.9
33	9	31-Mar-95	1419	41 54.92	170 31.66	41 58.24	170 31.70	441	467	3.32	91.0	19.0	11.0
34	9	31-Mar-95	1645	41 58.81	170 33.73	42 01.99	170 33.89	381	403	3.17	92.5	18.4	10.8
35	5	1-Apr-95	0700	41 42.90	171 25.22	41 45.66	171 22.77	69	73	3.31	69.9	16.7	12.8
36	8	1-Apr-95	0848	41 45.34	171 16.26	41 48.42	171 15.27	137	140	3.16	83.2	16.9	11.9
37	8	1-Apr-95	1030	41 50.38	171 15.31	41 52.62	171 12.55	126	137	3.03	84.7	17.1	12.2
38	7	1-Apr-95	1239	41 55.49	171 22.14	41 58.50	171 20.55	41	42	3.23	72.1	17.0	14.7
39	7	1-Apr-95	1418	41 59.86	171 16.07	42 02.76	171 14.57	62	63	3.01	70.8	17.8	13.7
40	7	1-Apr-95	1617	42 10.50	171 13.88	42 13.18	171 11.93	32	33	3.04	73.9	16.7	13.6
41	8	2-Apr-95	0647	42 06,94	170 52.53	42 09.57	170 53 96	194	197	2.84	90.9	17.0	12.2
42	7	2-Apr-95	0947	42 09.57	171 08.58	42 12.40	171 07.59	80	83	2.92	79.3	16.7	12.8
43	8	2-Apr-95	1140	42 13.50	171 00.84	42 16.41	170 59.75	133	133	3.02	87.2	17.4	12.3
44	8	2-Apr-95	1345	42 17.04	170 50.45	42 20.01	170 53.82	169	172	3.00	89.3	18.0	12.2
45	7	2-Apr-95	1612	42 25.68	171 00.72	42 28.55	170 59.34	96	101	3.07	83.9	17.2	12.1
46	11	3-Apr-95	0632	42 34.78	170 58.89	42 36.77	170 55.53	55	79	3.17	71.7	16.0	14.7
47	11	3-Apr-95	0906	42 42.23	170 50.12	42 44.27	170 47.50	66	73	2.81	77.7	15.9	12.1
48	11	3-Apr-95	1308	42 45.63	170 42.70	42 44.69	170 38.60	57	72	3.16	79.2	16.2	12.1
49	11	3-Apr-95	1536	42 42.88	170 39.39	42 41.07	170 35.94	79	97	3.12	81.8	16.2	11.9
50	11	4-Apr-95	0635	42 49.12	170 22.55	42 46.37	170 24.07	90	92	2.87	74.6	15.6	12.3
51	12	4-Apr-95	0829	42 42.51	170 28.67	42 44.93	170 18.15	119	127	3.05	86.3	15.4	12.2
52	12	4-Apr-95	1050	42 44.56	170 14.27	42 47.28	170 12.15	143	150	3.10	79.7	15.6	12.2
53	12	4-Apr-95	1400	42 39.66	170 11.17	42 41.92	170 08.47	165	190	3.01	92.4	16.0	12.0
54	12	4-Apr-95	1613	42 43.55	170 07.68	42 46.44	170 06.69	164	173	2.97	86.1	15.8	12.2
55	11	5-Apr-95	1110	42 49.62	170 39.54	42 51.48	170 35.91	31	35	3.25	70.8	16.0	–
56	11	5-Apr-95	1337	42 59.15	170 20.43	43 00.52	170 16.65	42	52	3.09	72.4	15.7	14.1
57	11	5-Apr-95	1523	43 02.52	170 17.49	43 04.32	170 14.02	30	30	3.12	71.0	15.7	–
58	12	6-Apr-95	0706	43 00.68	170 09.06	42 58.51	170 10.98	116	117	2.59	75.1	15.9	12.6

Appendix 2—*continued*

Station	Stratum	Date	Start of tow			End of tow		Gear depth (m)		Distance trawled	Doorspread	Surface temp	Bottom temp
			Time	° ' S	° ' E	° ' S	° ' E	Min.	Max.	(n. miles)	(m)	(°C)	(°C)
59	12	6-Apr-95	0903	42 58.42	170 02.12	43 00.57	169 59.46	169	170	2.90	90.0	15.6	12.2
60	13	6-Apr-95	1126	42 59.26	169 55.26	42 57.88	169 58.82	212	229	2.95	89.0	15.7	12.1
61	13	6-Apr-95	1435	42 46.97	170 01.51	42 44.64	174 04.09	214	256	3.00	91.6	17.5	12.0
62	13	8-Apr-95	1120	42 53.23	169 58.36	42 55.79	169 57.05	288	303	2.74	96.3	17.6	12.5
63	12	8-Apr-95	1346	43 04.17	169 58.06	43 06.02	169 54.82	165	174	3.01	88.0	16.0	12.3
64	12	8-Apr-95	1601	43 04.73	169 49.77	43 07.41	169 48.13	191	196	2.94	91.7	16.6	12.1
65 *	14	9-Apr-95	0640	43 49.65	168 44.88	43 48.18	168 47.14	83	88	2.23	76.4	15.5	13.4
66	15	9-Apr-95	1017	43 41.44	169 07.93	43 43.38	169 04.56	110	123	3.12	89.1	16.0	12.3
67	9	14-Apr-95	1206	42 08.48	170 33.21	42 11.50	170 33.50	372	404	3.03	106.5	17.6	–
68	13	14-Apr-95	1530	42 29.03	170 39.11	42 32.10	170 39.22	246	258	3.07	89.7	17.4	–
69	15	15-Apr-95	0649	43 32.25	169 12.56	43 29.75	169 14.95	144	146	3.04	85.7	16.2	12.2
70	15	15-Apr-95	0911	43 30.82	169 15.38	43 28.95	169 18.57	135	139	2.98	87.7	15.9	12.2
71	15	15-Apr-95	1207	43 32.13	169 20.54	43 30.31	169 23.51	109	119	2.85	87.7	16.2	12.3
72	15	15-Apr-95	1421	43 28.67	169 16.44	43 27.07	169 20.00	135	140	3.05	83.8	16.4	12.3
73	15	15-Apr-95	1605	43 27.09	169 22.64	43 24.42	169 25.21	127	173	3.26	82.4	16.5	12.2
74	14	16-Apr-95	0644	43 28.52	169 36.72	43 27.12	169 40.30	36	41	2.96	68.7	15.3	14.0
75	14	16-Apr-95	0936	43 25.06	169 45.83	43 23.12	169 49.01	27	33	3.02	68.9	15.0	–
76	14	16-Apr-95	1129	43 23.87	169 42.43	43 23.95	169 37.80	63	66	3.37	80.0	15.6	12.7
77	16	16-Apr-95	1358	43 21.32	169 27.90	43 19.90	169 31.53	278	295	3.00	93.0	16.2	12.1
78	16	16-Apr-95	1612	43 15.96	169 35.31	43 13.59	169 36.48	331	370	2.52	95.2	16.5	12.2
79	16	17-Apr-95	0657	43 26.45	169 17.70	43 24.30	169 20.80	240	248	3.12	92.5	15.9	12.1
80	15	17-Apr-95	1035	43 19.27	169 49.96	43 17.10	169 53.05	117	120	3.12	75.1	15.6	12.2
81	15	17-Apr-95	1306	43 16.03	169 48.60	43 15.09	169 52.59	148	174	3.06	77.5	16.3	12.2
82	12	17-Apr-95	1552	43 15.74	169 54.80	43 13.18	169 57.45	114	119	3.21	80.9	16.5	12.3
83	12	18-Apr-95	0700	43 09.49	169 51.77	43 11.72	169 48.78	179	187	3.13	83.7	16.3	–
84	12	18-Apr-95	0928	43 11.24	170 01.01	43 12.95	169 57.33	98	125	3.18	80.3	16.2	12.3
85	14	18-Apr-95	1154	43 17.31	169 57.09	43 15.35	170 00.16	43	56	2.98	74.6	16.4	12.9
86	13	18-Apr-95	1640	42 43.17	170 03.45	42 40.69	170 05.40	266	275	2.87	91.1	16.9	12.2
87	8	19-Apr-95	0653	41 58.32	171 07.88	41 55.50	171 09.60	143	143	3.09	83.3	16.8	12.2

Appendix 2—*continued*

Station	Stratum	Date	Start of tow			End of tow		Gear depth (m)		Distance trawled	Doorspread	Surface temp	Bottom temp
			Time	° ' S	° ' E	° ' S	° ' E	Min.	Max.	(n. miles)	(m)	(°C)	(°C)
88	14	21-Apr-95	0720	43 34.29	169 25.70	43 35.58	169 21.49	59	79	3.30	71.1	14.8	15.5
89	14	21-Apr-95	1005	43 36.52	169 19.75	43 38.48	169 16.73	88	97	2.95	81.7	15.7	13.6
90	14	21-Apr-95	1333	43 47.58	169 04.01	43 45.78	169 07.38	13	27	3.02	70.0	16.4	15.9
91	14	22-Apr-95	0651	43 34.34	169 29.43	43 32.04	169 33.10	30	32	3.20	74.3	15.0	–
92	14	22-Apr-95	0853	43 30.14	169 26.14	43 28.18	169 29.59	76	91	3.13	85.1	15.6	13.4
93	14	22-Apr-95	1101	43 26.67	169 31.34	43 24.93	169 34.85	70	73	3.07	86.0	16.0	13.4
94	14	22-Apr-95	1258	43 27.91	169 41.46	43 25.80	169 44.79	29	29	3.15	74.3	15.6	–
95	11	22-Apr-95	1531	43 15.22	169 58.67	43 12.76	170 01.49	63	64	3.20	83.4	16.5	14.2
96	11	23-Apr-95	0656	42 57.20	170 17.44	42 54.91	170 20.22	77	79	3.03	84.7	16.1	13.5
97	11	23-Apr-95	0922	42 51.22	170 28.42	42 48.50	170 30.57	43	43	3.12	72.4	16.9	13.4
98	11	23-Apr-95	1104	42 45.21	170 29.41	42 45.83	170 33.49	45	59	3.02	77.9	16.8	14.4
99	8	23-Apr-95	1544	42 19.81	171 01.46	42 16.74	171 02.55	110	113	3.14	78.0	17.0	12.4
100	8	24-Apr-95	0657	42 09.49	171 02.71	42 06.74	171 04.53	132	135	3.03	84.4	16.8	12.2
101	8	24-Apr-95	0925	42 01.96	170 51.22	41 59.19	170 51.41	187	191	2.90	90.0	17.1	12.2
102	8	24-Apr-95	1205	42 02.73	171 07.12	42 00.06	171 09.20	124	128	3.01	87.9	16.8	11.9
103	8	24-Apr-95	1443	41 48.18	171 04.01	41 45.34	171 04.36	157	160	2.85	92.5	17.2	12.0

* Station not used for biomass calculations
– No data

Appendix 3a: **Length-weight coefficients *a* and *b* calculated using the geometric mean functional relationship from data collected during the 1995 survey, and used to scale length frequencies and calculate biomass above a minimum size***

	a	*b*	*N*	Range (cm)
Giant stargazer	0.0079	3.22	771	12–83
Red gurnard	0.0058	3.17	765	20–56
Red cod	0.0120	2.93	1 757	8–71
Tarakihi	0.0159	3.05	1 396	11–50

Appendix 3b: **Additional length-weight coefficients *a* and *b* used to scale length frequencies and calculate biomass above a minimum size***

	a	*b*	Source	*N*	Range (cm)
Barracouta	0.0052	2.98	TAN9301	919	15–96
Blue cod	0.0076	3.20	TAN9301	75	27–59
Blue warehou	0.0191	3.03	TAN9301	281	29–67
Elephantfish	0.0105	2.99	TAN9301	62	58–92
Hake	0.0018	3.31	TAN9401	444	39–125
Hoki	0.0046	2.88	SHI8301	525	22–110
Ling	0.0010	3.36	SHI8302	398	45–135
Rig	0.0005	3.47	Francis (1979)	120	65–137
School shark	0.0070	2.91	Seabrook-Davidson (unpub.)	804	30–166
Trachurus declivis	0.0165	2.93	COR9001	200	15–53
T. murphyi	0.0255	2.77	TAN9301	90	44–62
T. novaezelandiae	0.1630	2.92	COR9001	200	15–40

* Determined from $W = aL^b$: W, weight (g); L, length (cm); N, sample size.

Appendix 4: Catch (kg) at each station of the 10 most abundant commercial species (species codes are given in Table 2)

Station	SPD	HAK	HOK	RCO	BAR	SQU	STA	TAR	SCH	GUR	Total	All species
1	21.1	2.1	0.5	8.2	4.0	5.1	0.0	4.0	2.8	41.0	88.8	247.2
2	128.9	1.9	1.1	50.5	102.5	13.6	1.3	0.6	36.4	60.2	397.0	504.1
3	17.3	0.5	0.5	8.1	67.4	15.9	0.0	9.9	34.5	34.0	188.1	419.4
4	19.8	0.0	5.2	226.5	52.8	24.9	3.6	120.7	75.5	20.1	549.1	755.5
5	28.7	0.0	0.0	10.0	9.6	6.4	0.0	28.8	11.7	44.1	139.3	252.5
6	27.7	0.5	1.6	6.3	4.7	8.5	0.0	22.0	1.6	40.0	112.9	322.1
7	62.1	1.8	2.9	8.7	1.8	5.5	0.0	3.1	10.9	46.8	143.6	262.2
8	15.5	0.8	4.7	12.8	13.9	18.9	0.1	11.5	3.9	21.7	103.8	229.5
9	155.0	0.1	0.8	35.7	2.5	24.0	6.5	0.2	1.9	14.6	241.3	365.5
10	31.4	0.0	0.0	15.1	20.6	34.3	1.7	50.5	48.4	6.7	208.7	440.7
11	2.8	0.0	0.0	0.0	85.9	236.8	0.0	0.1	122.5	10.3	458.4	528.3
12	134.8	0.9	0.0	0.6	91.6	21.8	0.0	1.2	0.0	3.7	254.6	524.6
13	21.1	0.0	0.0	1.0	31.8	26.6	0.0	0.1	20.2	5.8	106.6	190.4
14	44.4	0.7	7.1	78.4	31.0	67.3	0.0	0.5	37.0	52.3	318.7	433.5
15	47.7	2.3	0.0	95.2	38.1	18.2	0.0	77.0	18.3	65.2	362.0	670.4
16	183.6	0.1	4.2	63.9	8.1	10.8	1.5	0.0	10.8	5.4	288.4	338.4
17	180.5	0.0	0.0	3.7	106.8	67.3	0.3	18.3	19.7	0.3	396.9	522.7
18	116.3	0.0	0.0	0.0	6.8	7.4	0.0	0.0	3.3	0.0	133.8	239.5
19	90.2	85.8	0.0	101.7	20.0	3.2	0.0	0.1	11.1	22.0	334.1	581.0
20	47.4	870.7	0.1	64.9	0.2	2.4	0.0	0.0	0.8	21.5	1 008.0	1 368.4
21	54.0	30.7	0.0	70.4	0.0	0.3	0.0	0.0	4.2	0.0	159.6	281.4
22	250.8	18.0	4.3	19.2	219.4	102.1	125.4	99.9	11.2	0.0	850.3	1268.9
23	450.2	276.9	269.1	49.7	460.9	163.3	165.1	40.6	78.7	1.7	1956.2	2 000.4
24	195.1	1.2	57.9	20.5	81.0	117.9	1.5	20.6	26.2	4.2	526.1	641.8
25	160.2	10.2	91.9	41.2	233.4	43.0	0.4	37.0	9.2	2.0	628.5	791.1
26	75.1	6.9	58.2	11.9	92.5	27.8	1.9	11.4	6.0	1.1	292.8	489.8
27	138.9	0.0	0.0	0.0	100.7	65.0	0.0	1.4	177.6	0.0	483.6	615.0
28	26.8	0.0	0.0	0.0	54.9	5.9	0.0	6.8	0.0	0.0	94.4	144.4
29	91.4	0.4	0.0	0.3	74.6	4.6	12.1	0.4	10.4	1.1	195.3	269.5
30	349.2	0.0	0.0	15.9	7.9	39.0	0.0	0.0	1.3	33.2	446.5	609.2
31	101.5	5.1	0.0	9.5	101.1	28.4	7.0	27.2	3.3	0.0	283.1	402.4
32	429.5	0.0	0.0	2.2	40.1	46.6	148.9	39.0	0.0	0.0	706.3	847.6
33	0.0	0.0	359.2	0.3	0.0	134.9	0.0	0.0	0.0	0.0	494.4	753.9
34	0.0	0.0	3.4	0.2	8.8	343.3	0.0	89.1	0.0	0.0	444.8	506.2
35	43.1	10.8	0.8	24.3	2.5	13.8	0.0	0.0	0.0	2.0	97.3	403.2
36	33.1	30.8	2.0	29.7	24.9	35.1	52.2	11.2	4.5	0.0	223.5	503.2
37	104.1	121.6	23.0	18.2	77.0	26.2	30.2	13.0	4.3	0.0	417.6	576.4
38	230.1	125.1	0.0	204.0	9.1	1.9	4.5	0.0	2.6	2.0	579.3	655.7
39	92.3	831.0	0.0	78.2	14.3	9.5	0.0	6.8	21.5	26.1	1 079.7	1 241.0
40	1.4	8.9	0.0	43.6	160.7	3.3	0.0	0.0	7.6	87.3	312.8	369.0
41	327.6	78.2	85.6	93.4	166.6	37.2	96.8	93.9	24.8	0.0	1 004.1	1 411.2
42	53.5	8.6	0.9	10.1	16.4	8.6	11.9	13.3	5.7	26.3	155.3	242.2
43	340.2	99.6	114.5	64.0	175.1	70.6	18.1	48.6	36.1	1.1	967.9	1 176.5
44	420.2	308.5	358.4	139.0	586.3	62.3	37.6	49.6	29.2	0.0	1 991.1	2 190.8
45	76.7	84.6	37.8	14.7	18.7	17.4	89.9	84.6	7.1	4.9	436.4	718.1
46	138.9	1 152.1	22.2	107.0	28.3	36.7	27.8	26.9	5.8	17.2	1 562.9	2 169.0
47	219.7	3 578.2	10.4	145.4	74.5	53.6	8.0	44.3	14.8	42.6	4 191.5	4 660.7
48	283.5	124.1	275.8	49.3	70.5	36.1	35.1	39.6	21.9	10.1	946	1 393.5
49	151.1	11.8	108.6	35.7	833.7	25.6	172.8	15.1	43.4	1.2	1 399.0	1 498.1
50	54.5	75.5	124.3	27.2	15.0	13.3	23.2	18.5	2.3	18.6	372.4	646.0
51	233.5	293.5	374.0	40.0	191.5	73.7	60.4	68.6	21.1	3.8	1 360.1	1 615.5
52	268.7	95.1	297.1	21.6	510.2	295	53.7	40.4	39.7	0.0	1 621.5	1 917.4
53	158.7	7.4	10.5	39.9	681.6	225.4	178.2	126.6	2.6	0.0	1 430.9	1 651.9
54	449.5	54.8	345.4	64.7	621	410.5	226.1	113.6	9.3	0.0	2 294.9	2 504.4
55	191.7	800.4	1.3	486.7	24.7	1.6	0.0	0.0	24.7	9.2	1 540.3	1 649.4
56	142.3	185.9	1.1	837.8	3.2	3.6	12.7	4.4	29.8	6.2	1 227.0	1 429.6
57	48.1	26.5	0.0	581.7	3.0	2.2	0.0	0.0	41.0	13.2	715.7	827.5
58	177.5	63.1	21.4	30.8	1.7	9.1	41.7	33.6	1.9	1.5	382.3	531.7
59	426.7	67.7	32.9	54.0	13.0	70.3	25.6	57.2	19.9	0.0	767.3	1 031.2
60	1 126.6	39.8	220.9	57.4	81.5	236.7	116.7	36.6	5.6	0.0	1 921.8	2 481.9
61	55.3	0.0	2.2	14.4	9.8	563.4	217.1	79.2	0.0	0.0	941.4	1 343.6
62	95.1	0.0	44.2	251.7	14.3	249.9	75.5	22.8	15.0	0.0	768.5	1 111.1
63	211.1	132.6	38.8	48.3	37.5	108.0	68.1	27.3	9.1	0.0	680.8	1 085.9
64	206.9	7.3	62.4	47.5	126.2	132.0	86.5	52.5	7.5	0.0	728.8	967.5
65	172.1	0.0	0.0	1.7	5.8	111.3	33.8	130.7	10.2	3.3	468.9	575.7
66	129.5	151.4	104.3	76.1	244.3	33.8	315.6	152.7	10.0	0.0	1 217.7	1 685.6
67	0.0	0.0	2.1	0.0	0.0	64.7	0.0	1.8	0.0	0.0	68.6	121.7
68	211.0	1.2	4.7	19.4	63.6	85.9	227.8	70.9	0.0	0.0	684.5	728.1
69	34.8	1.0	327.5	332.1	241.1	34.3	55.4	127.1	0.0	0.0	1 153.3	1 448.9

Appendix 4—*continued*

Station	SPD	HAK	HOK	RCO	BAR	SQU	STA	TAR	SCH	GUR	Total	All species
70	107.3	7.2	2 399.5	453.4	408	23.9	77.6	77.9	18.8	0.0	3 573.6	3 695.7
71	256.0	101.5	132.1	21.0	107.8	36.7	35.5	12.1	30.0	0.0	732.7	847.1
72	9.8	0.2	41.1	21.9	112.1	18.6	16.5	70.4	2.2	0.0	292.8	388.6
73	96.2	15.5	57.8	119.6	40.4	19.0	47.4	15.2	11.7	0.0	422.8	859.0
74	145.2	10.1	0.0	669.0	14.5	18.0	0.0	7.5	24.5	22.5	911.3	1 152.9
75	121.2	0.0	0.0	0.0	39.0	4.9	0.0	1.8	4.5	159.7	331.1	384.4
76	116.4	21.7	0.1	142.3	25.6	89	18.3	2.6	5.5	1.8	423.3	527.4
77	111.0	32.5	187.3	31.0	3.5	38.4	116.3	25.2	8.1	0.0	553.3	1 237.6
78	0.0	2.1	54.4	0.0	0.0	55.9	59.1	53.4	35.9	0.0	260.8	476.3
79	15.5	5.3	77.2	159.2	22.1	17.3	0.0	33.1	0.0	0.0	329.7	878.6
80	675.1	50.3	852.4	49.3	134.9	124.8	132.6	39.0	21.1	0.0	2 079.5	2 390.7
81	1 057.1	118.1	1 423.9	63.2	493.6	68.9	75.5	36.6	2.3	0.0	3 339.2	3 677.4
82	237.0	61.4	192.5	48.4	30.8	57.4	89.2	41.2	6.9	0.0	764.8	1 306.0
83	375.6	67.8	180.2	47.3	135.3	62.3	71.7	49.5	0.0	0.0	989.7	1 341.9
84	225.1	176.7	484.8	27.3	72.9	91.7	69.0	54.1	23.7	0.0	1 225.3	1 669.8
85	1 194.0	1 519.5	44.3	1 455.2	123.6	19.4	0.0	10.9	19.7	4.8	4 391.4	4 840.9
86	48.2	0.0	74.7	34.1	28.6	105.5	24.3	117.7	0.0	0.0	433.1	518.6
87	247	70.8	0.0	46.6	17.2	52.6	31.6	27.0	20.5	0.0	513.3	747.6
88	147.7	960.9	75.6	28.6	19.6	87.1	17.3	2.7	147.5	88.3	1 575.3	2 001.3
89	191.8	586.8	171.0	100.0	56.8	180.1	131.7	6.3	2.5	0.9	1 427.9	1 921.4
90	162.6	2.5	0.2	10.1	23.2	1.2	0.0	0.0	3.9	156.3	360.0	431.6
91	30.1	1.1	0.0	91.5	29.2	7.3	0.0	2.1	27.7	17.4	206.4	305.6
92	129.1	35.2	74.3	29.1	72.7	77.5	20.2	33.8	47.0	0.9	519.8	894.1
93	192.8	19.8	23.6	22.5	86	63.2	2.8	2.8	19.7	0	433.2	576.8
94	72	1.3	0.0	426.6	28.2	0.3	0.0	0.0	69.5	2.5	600.4	665.3
95	187.5	718.3	58.7	113.7	35.4	64.8	0.0	10.8	20.6	2.1	1 211.9	1 662.7
96	82	1 145.1	36.4	55.3	9.9	22	39.2	41.7	23.7	19.9	1 475.2	2 255.4
97	12.7	11.0	0.0	38.3	36.5	4.2	0.0	0.0	33.7	54.8	191.2	289.2
98	159.9	41.4	0.0	70.3	19.8	13.1	8.7	15.7	87.5	337	753.4	1 016.2
99	72.6	25.4	7.7	32.3	45.7	26.8	22.9	90.9	25.1	0.0	349.4	825.0
100	111.2	99.1	3.9	40.1	52.6	48.6	20.5	75.6	74.8	0.0	526.4	870.7
101	248.1	15.9	15.4	308.5	95	9.4	123.3	123.5	0.0	0.0	939.1	1 019.1
102	272.2	41.2	145.4	20.0	141.8	19.9	20.2	54.1	25.5	0.0	740.3	1 176.3
103	220.3	0.0	0.0	142.2	48.5	19.2	3.1	48.4	2.5	6.0	490.2	575.8
Total	17 938.4	15 860.4	10 742.3	10 040.1	9 933.8	6 452.6	4 154.8	3 517.0	2 125.0	1 710.5	82 474.9	106 807.7

Appendix 5a: Results of gear trials undertaken off the coast of the South Island in June 1995 (KAH9506) comparing the trawl gear configurations used in 1995 (KAH9504) with those used in 1992 (KAH9204) and 1994 (KAH9404)

Objective: To compare efficiency and spread of the old Kaharoa trawl doors with those of the new doors at selected depths using the standard warp to depth ratios used on past surveys.

Depth range (m)	Target depth (m)
0–25	20
25–50	40
50–75	60
75–100	90
100–200	150
200–300	250
300–400	350

At each target depth the aim was to complete one tow with the tide and prevailing weather and one tow in the opposite direction. During each tow doorspread was recorded at about 5 min intervals until three to six measurements were obtained. These measurements were averaged to obtain a mean doorspread for each depth range. The first series of tows was done in all depth ranges with the new doors. The old doors were then fitted and the tows repeated.

	New doors				Old doors			
Depth range (m)	Mean depth (m)	Number of recordings	Mean doorspread (m)	Standard deviation	Mean depth (m)	Number of recordings	Mean doorspread (m)	Standard deviation
0–25	20	12	73.8	1.82	18	10	72.5	0.62
25–50	37	10	75.1	1.14	39	10	83.7	0.70
50–75	64	10	80.2	0.70	64	10	88.9	0.55
75–100	87	8	84.1	1.55	95	10	92.7	1.50
100–200	150	10	90.2	1.08	152	8	93.2	1.52
200–300	238	10	97.4	2.80	239	12	100.1	1.47
300–400*	370	5	99.7	1.74	368	5	104.4	0.55

* Tows in one direction only

Appendix 5b: Optimum wing end spread and optimum sweep angles for the South Island bottom trawl net (see Drummond & Stevenson 1995a for specifications).

Optimum wingspread

= 0.5 * headline length (Prado 1990)

= 0.5 * 24.7 m

= 12.35 m

Optimum doorspread

= 2 sin(sweep angle) * net length + optimum wingspread (Prado 1990)

Where net length = 118 m

Doorspread (m)	Sweep angles
69.4	14°
73.4	15°
77.4	16°
81.4	17°
85.4	18°
89.4	19°

Appendix 6: Adjusted relative biomass estimates for the 20 most abundant species from the 1992 (KAH9204 and 1994 (KAH9404) inshore trawl surveys of the west coast South Island and Tasman and Golden Bays*

	1992		1994	
Common name	Biomass (t)	*c.v.* (%)	Biomass (t)	*c.v.* (%)
Southern spiny dogfish	3 919	15	7 145	7
Arrow squid	2 960	18	1 199	9
Red cod (all)	2 719	13	3 169	18
Red cod (40 + cm)	1 582	14	2 338	20
Barracouta	2 478	14	5 298	16
Common roughy	1 804	96	166	62
Tarakihi (all)	1 409	14	1 420	14
Tarakihi (25 + cm)	1 269	14	1 225	12
Giant stargazer	1 302	12	1 350	17
School shark	933	22	1 151	41
Rattails	901	23	2 736	42
Carpet shark	642	20	722	9
Red gurnard (all)	573	16	559	15
Red gurnard (30 + cm)	454	15	478	16
Hoki (all)	405	17	826	49
Hoki (65 + cm)	52	42	72	21
Hake	391	25	—	—
Smooth skate	339	19	341	18
Ling	286	19	261	20
Silver warehou	292	38	—	—
Rig	288	14	380	10
Sea perch	242	22	426	18
Witch	237	17	229	22
Silver dory	155	44	—	—
Dark ghost shark	—	—	722	14
Scaly gurnard	—	—	370	19
Elephantfish	—	—	167	33

* Estimates above a given size are recruited biomass.
— Not a top 20 species for that year

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