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Contents

Introduction

This report presents the results from the second in a planned summer time series of inshore trawl surveys along the east coast of the South Island from the Waiau River to Shag Point in waters between 10 and 400 m deep. The survey design was optimised for elephantfish, red gurnard, giant stargazer, and pre-recruit red cod. The survey also collected useful data on other important commercial species, including barracouta, spiny dogfish, tarakihi, sea perch, ling, and dark ghost shark.

Red cod support the major east coast South Island inshore trawl fishery, with an average catch in 1994–95 to 1996–97 of about 11 000 t (Annala & Sullivan 1997). Catches of elephantfish, giant stargazer, and red gurnard, combined, have averaged about 2000 t in the same period and have all approached or exceeded quota limits.

Since 1990, seven trawl surveys have been completed, six in early winter (May-June) using *Kaharoa* (Beentjes & Wass 1994, Beentjes 1995a, 1995b, 1998a, 1998b). This winter series covered depths of 30–400 m and the main objective was to monitor abundance of pre-recruit and adult red cod. A summer series began in December 1996–January 1997 because there was a need to monitor the abundance of other important commercial species in the survey area for which the winter series was inappropriate. These included red gurnard (survey depth range not shallow enough) and elephantfish (survey depth range not shallow enough and fish more abundant in summer). The pilot summer survey in December 1996–January 1997 (Stevenson 1997) included a shallower depth range (10–30 m) and used a smaller mesh codend to sample 0+ red cod juveniles. Rig were dropped as a target species after the pilot survey because of low catches and high coefficients of variation (*c.v.*s). This pilot survey was successful for all the other target species and therefore is the first in the time series of summer surveys.

This report fulfils part of the requirements of the Ministry of Fisheries contract INT9702, "Estimation of inshore fish abundance along the east coast of the South Island using trawl surveys".

Programme objective

To determine the relative abundance and distribution of inshore fish abundance along the east coast of the South Island.

Survey objectives

1. To determine the relative abundance and distribution primarily of elephantfish, red gurnard, giant stargazer, and pre-recruit red cod (under 41 cm), along the east coast of the South Island by carrying out a trawl survey. The target coefficients of variation (*c.v.*s) of the biomass estimates for these species are as follows: elephantfish, 30–35%; red gurnard, 25–30%; giant stargazer, 15–20%; and juvenile red cod under 41 cm total length, 30–35%.
2. To collect the data and to determine the length frequency, length-weight relationship, and reproductive condition of elephantfish, red gurnard, stargazer, and red cod caught on the survey.
3. To record the catch weights all species caught and collect length frequency data on all ITQ and other commercially important species.
4. To collect otoliths or spines from the target species (elephantfish, red gurnard, stargazer, red cod) for ageing.
5. To collect length-weight and reproductive condition data for selected other important commercial species.

6. To collect scales from salmon for ageing (by Martin Unwin, NIWA, Christchurch).
7. To collect blue cod and hapuku otoliths for ageing.
8. To trial the new electronic measuring and recording system.
9. To collect samples of invertebrate bycatch for the NIWA collection.

Objectives 1 and 2 are Ministry of Fisheries project objectives. Target *c.v.*s for this survey were based on the results from the first survey.

Timetable and personnel

The voyage started and finished in Wellington and was divided into two parts, the first from 2 to 22 December 1997 and the second from 3 January to 8 January 1997.

Rosie Hurst was project leader and Michael Stevenson was voyage leader and was also responsible for final database editing. The skipper was Arthur Muir.

Methods

Survey area and design

The survey area (Figure 1) covered depths of 10–400 m off the east coast of the South Island from the Waiau River to Shag Point, except for the 10–30 m depth range at the northern and southern ends of the survey area (i.e., from the Kowai River to Waiau River and from Cape Wanbrow to Shag Point). These areas were excluded because they contained inshore rocky reefs which would have different species composition from other parts of the survey area.

The survey area of 26 935 km^2, including untrawlable (foul) ground, was initially divided into 20 strata by area and depth (10–30, 30–100, 100–200, and 200–400 m) (Table 1, Figure 1). Strata were the same as those used for the first survey except that strata 14 and 15 (200–400 m) were combined because of the steep nature of the bottom and difficulty of locating suitable tow positions. The results of the first survey indicated that the four 10–30 m strata were important for sampling inshore species such as red gurnard and elephantfish and were retained for this survey.

In order to achieve the required *c.v.*s on the target species, a simulation study of precision versus number of stratified random stations completed was made using data from the first survey (R. I. C. C. Francis, NIWA, pers. comm.) Allocation of phase 1 stations was proportional to the product of the stratum area and a weighting factor, with the constraint that at least three stations were allocated to each stratum. Phase 1 station allocation was weighted between 1 and 4, based on catch rates of the target species. Phase 2 stations were targeted at species with simulated *c.v.*s above target *c.v.*s, stargazer and elephantfish. Results indicated that a minimum of 100 stations and a two-phase design (*after* Francis 1984) were required to achieve the target 20% *c.v.* on stargazer, with 75% of stations allocated to phase 1.

Before the survey began, sufficient trawl stations to cover both first and second phase stations were generated using the computer program 'Rand_stn v2.1' (Vignaux 1994). The stations were required to be a minimum of 3.7 km (2 n. miles) apart to coincide with the tow length established in the survey design. Non-trawlable ground was identified before the voyage from information collected during previous surveys by RV *Kaharoa*. Seventy-five stations were allocated to phase 1.

Vessel, gear, and trawling procedure

RV *Kaharoa* is a 28 m stern trawler with a beam of 8.2 m, displacement of 302 t, engine power of 522 kW, capable of trawling to depths of 500 m.

The two-panel trawl net used was based on an 'Alfredo' design constructed in 1991 specifically for South Island inshore trawl surveys. Gear specifications are the same as for the first survey (*see* Stevenson 1997, appendix 1 for details). The mesh size of the codend used for the first survey was 28 mm and this sized mesh was used to construct the new codend for this survey. Four new strengthening ropes were placed down the length of the codend to minimise damage (a problem in the first survey) and a blow-out panel was installed about 2 m in front of the codend to further reduce the risk of damage to the codend. The panel was designed to burst automatically when the catch filled the net to that point. The panel burst only once before the net was at the surface and the station was re-shot.

Doorspread and headline height measurements were read off Scanmar monitoring equipment with an average of five readings at 10 min intervals during each tow.

All tows were undertaken in daylight between 0500 and 1700 hours NZST. At each station it was planned to tow 2 n. miles (timed from the gear reaching the bottom to the start of hauling) at 3.0 knots (speed over the ground). Tow direction was dependent on weather conditions, but usually followed the bottom contour or was in the direction of the next station to reduce steaming time.

If untrawlable ground was encountered, an area within a 2 n. mile radius of the station was searched for suitable ground. If no suitable ground could be found within the radius, the next alternative station was chosen from the random station list.

A comparison of tow and gear parameters between this survey and the first survey is given in Table 2. A minimum of 200 m of warp was used. At depths greater than 70 m a variable warp to depth ratio was used starting at 3:1 and decreasing to 2.5:1 (Table 2).

Water temperatures

Sea surface temperatures (SST) were not recorded during the survey because the hull-mounted temperature sensor was not installed. Mean sea surface temperatures from satellite imagery for 15–18 December and 2–3 January were obtained from NIWA SST Archive (NSA), courtesy of Michael Uddstrom. These data are corrected to represent temperature at a depth of 1 m below the surface. Bottom temperatures were recorded from the Scanmar sensor on 137 tows.

Catch and biological sampling

All items caught in each tow were sorted on deck into species and weighed on Seaway 100 kg motion-compensating scales to the nearest 0.1 kg. Finfish, squids, and crustaceans (except crabs) were classified by species: crabs and shellfish were given general classifications because of difficulty in identifying individual species and the limited sorting time available between tows.

Length, to the nearest whole centimetre below actual length, and sex were recorded for all ITQ species and for spiny dogfish, rough skate, smooth skate, and sea perch. Sample sizes were either whole catch or a randomly selected subsample of up to 200 fish.

Individual fish weights and/or reproductive state were collected for the target species and rough skate, smooth skate, hapuku, blue cod, dark ghost shark, and barracouta to enable length-weight relationships to be determined for scaling length frequency data and calculation of biomass for length intervals. Samples were selected non-randomly from the random length frequency sample to ensure as full a size range as possible for each species. Up to four otoliths per sex per centimetre size class were collected from length frequency samples for blue cod, giant stargazer, hapuku, red cod, and red gurnard.

Reproductive maturity stages for elephantfish, rough skate, and smooth skate were recorded. For males the stages were: immature, claspers not extending beyond the pelvic fins; maturing, claspers extend beyond pelvic fins but soft and pliable; mature, claspers extend well beyond pelvic fins and stiff and hard. For females the stages were: immature, no developing eggs visible from an external examination of the ovary; maturing, developing eggs visible but no eggs with yolk; mature, eggs with yolk visible.

Five scales were collected when possible from above the lateral line posterior to the dorsal fin from each quinnat salmon (*Oncorhynchus tshawytscha*) caught (NIWA project SBA805). Blue cod otoliths were collected for NIWA research project IBC704. Invertebrate specimens were collected from trawls when time permitted and placed in plastic bags with an identification label showing trip code and station number and then frozen (NIWA project MTA803).

Data analysis

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

The following assumptions were made.

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

Although these assumptions are unlikely to be correct, they have been retained for this analysis to allow a time series of relative abundance estimates to be developed. Problems with the assumption that relative catchability remains the same between trawl surveys are discussed later.

Biomass estimates were calculated using data from all stations. No stations were excluded on the basis of gear performance. The *c.v.* associated with estimates of biomass was calculated by the method of Vignaux (1994).

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 1. The geometric mean functional relationship was used to calculate length-weight coefficients for the target species, rig, rough skate, smooth skate, dark ghost shark, and barracouta. For coefficients chosen from the database, a selection was made to best match the size range of the fish used to calculate the coefficients and the sample size range. All length frequencies were scaled by the percentage of catch sampled, area swept, and stratum area using the Trawlsurvey Analysis Program.

Results

Survey area and design and gear performance

The survey area, with stratum boundaries and station positions, is shown in Figure 1 and individual station data are given in Appendix 2. The trawlable ground represented 93% of the total survey area with the untrawlable (foul) ground confined to strata 1, 6, 7, 8, 12, 13, 14, and 17.

The distribution of elephantfish presented difficulties during the survey. Information from commercial fishers indicated that elephantfish were closer inshore than in 1996–97 and concentrated in the northern Canterbury Bight. At the conclusion of the 75 planned phase 1 stations, it was decided to place additional phase 1 effort in the inshore Canterbury Bight strata (19 and 20) to improve the sampling for elephantfish. Strata 3 and 4 were also split along the 50 m depth contour and more phase 1 random stations placed into the inshore (30–50 m) areas, numbered 3A and 4A (*see* Table 1, Figure 1). A minimum of six phase 1 stations was completed in each of the new strata. Extra phase 1 stations were also added to the inshore Pegasus Bay stratum (18).

Catches of the target species were low in the 200–400 m depth range, but these strata provided important information on other species, for example ling and dark ghost shark.

Five phase 2 stations were allocated to stratum 7 where the highest catch rates of red gurnard occurred, eight stations were allocated to strata 19 and 20 (four each) for elephantfish, and the remainder to strata with high catch rates of pre-recruit red cod. Catch rates of giant stargazer were not used for allocation of phase 2 stations because the *c.v.* was less than 15% at the completion of phase 1.

A total of 138 successful tows was completed, 119 in phase 1 (stations 1–75 and 78–121) and 19 in phase 2 (stations 76, 77, and 122–138). The completed station density ranged from 1 station per 40 km^2 in stratum 20 to 1 station per 791 km^2 in stratum 6, with an overall density of 1 station per 195 km^2 (*see* Table 1). At least three stations were completed in each stratum and all project and survey objectives were addressed.

Strengthening the codend prevented the damage suffered in the previous survey. The stronger codend allowed almost all tows to be the planned length of 2 n. miles. Only two tows were limited to a length of 1 n. mile to reduce the risk of very large catches. For the total depth range, doorspread varied from 62.3 to 89.6 m. and headline height varied between 4.4 and 5.7 m (*see* Table 2, Appendix 2). For each depth range, and overall, the doorspreads recorded for this survey were lower than, but not significantly different from, those recorded during the first survey. Differences in headline heights between the surveys were not more than 0.1 m overall or 0.2 m for any depth range. There is considerable overlap in the between-survey data for both doorspread and headline height and the differences are not thought to affect comparability. Lower values in depths less than 100 m are partly explained by the greater concentration of tows in shallow water than in the first survey. Comparative data for gear parameters from the first survey (KAH9618) are given in Table 2.

Water temperatures

Bottom temperatures are shown in Figures 2a and 2b. During December, they ranged from 8 to 15 °C across the survey area. Inshore temperatures (in depths less than 50 m) ranged from 12 to 15 °C. The inshore temperatures in early January were up to 1 °C warmer.

Surface temperatures at two intervals mid-December and early January are shown in Figures 3a and 3b. Temperatures near the start of the survey ranged from 11 to 15 °C, with warmer temperatures inshore. During the survey, temperatures across most of the survey area increased by about 2 °C. Comparative data for the 1996–97 survey are shown in Figures 3c and 3d (*see* Discussion).

Catch composition, distribution, and biomass

About 97 t of fish, crustaceans, echinoderms, and molluscs were caught from 138 tows at an average of 703 kg per tow (range 13–7588 kg). A total of 95 species was identified during the survey: 1 agnathan, 16 elasmobranchs, 71 teleosts, 3 cephalopods, 1 echinoderm, and 3 crustaceans. Species codes, common names, and scientific names are given in Appendix 3.

Total catch from all stations but two were weighed and measured. The catches not weighed were estimated at 5.8 t and 7.6 t when the blow-out panel gave way while trying to lift the catch on to the deck. Total catch weight was estimated on the relative amount of fish left in the net compared to what was seen when the net was first lifted. Careful watch was kept when fish floated out of the net to more accurately estimate the proportion of each species that was lost.

The total catch of the 20 most abundant species (catch greater than 500 kg) and other commercially important species is given in Table 3. The most abundant species by weight was spiny dogfish, with an estimated catch of 30.7 t (32% of the total catch). The four most abundant species, spiny dogfish, barracouta, red cod, and dark ghost shark, made up about 66% of the total catch (*see* Table 3). Only spiny dogfish and barracouta were caught in over 75% of the tows. The target species, elephantfish, giant stargazer, red gurnard, and red cod, made up 1.5, 0.4, 0.4, and 7.6 % of the catch, respectively. The catch of the 18 most abundant commercially important species, and all species combined, by station, is given in Appendix 4 and the catch rates by stratum are given in Table 4. Distributions and ranges of catch rates by station for the 22 most abundant (catch greater than 150 kg) commercial species are shown in Figure 4 in alphabetical order by common name. Ranges shown are the same as for 1996–97 (Stevenson 1997) for ease of comparison.

Relative biomass estimates and *c.v.*s for the 20 most abundant species and other commercially important species are given in Table 3 in order of catch abundance. Data for 1996–97 are given for comparison. The most abundant species were again spiny dogfish, barracouta, red cod, and dark ghost shark, making up 70% of the total biomass. Biomass and *c.v.*s for the 18 most abundant commercially important species are given by stratum in Table 5.

A preliminary list of frozen invertebrates identified by Steve O'Shea and Don McKnight (NIWA, Wellington) is given in Appendix 5.

Biological data

The species, length frequency, and biological samples collected and measurement methods are given in Table 6.

Scaled length-frequency distributions of the major commercial species (more than 100 fish measured) and smooth skate are shown in Figure 5 in alphabetical order by common name. Length frequencies are given by depth range for red cod and red gurnard, which were the only target species for which distribution changed with depth.

The distribution for elephantfish shows two clear modes for the 0+ and 1+ cohorts at 12–21 cm and 27–37 cm fork length, respectively (M. Francis, NIWA pers. comm.). The sex ratio (males : females) for elephantfish was 0.81:1 and varied little by depth.

The length frequency distributions for giant stargazer were similar for fish from the 30–100 m and 100–200 m depth zones so a combined graph only is presented. Modal patterns are difficult to interpret. The sex ratio for giant stargazer (0.78:1) also varied little by depth.

The red gurnard length frequency shows a distinct mode for 1+ fish at 14–19 cm but other year classes are again difficult to interpret. Larger fish (over 25 cm) were more common in the 30–100 m depth range, whereas the 1+ were occurred mainly in under 30 m depth. For red gurnard the sex ratios were 1.24:1 overall; 0.42:1 in 10–30 m; and 1.48:1 in 30–100 m.

The length frequency distribution for red cod shows a strong mode for 1+ fish at 15–25 cm and a mode for 0+ fish at 6–14 cm. The 1+ mode was present in depths to 200 m, whereas larger fish were mostly in the 30–100 m range. The sex ratios for red cod were 1.2:1 overall; 0.34:1 in 10–30 m; 1.39:1 in 30–100 m; and 2.22:1 in 100–200 m.

Length at maturity data for rough skate, smooth skate, and elephantfish are shown in Figure 6.

Details of the gonad stages for giant stargazer, red cod, and red gurnard are given in Table 7. All but one giant stargazer under 30 cm were immature or resting, as were 76% of larger fish. For red cod, 82% of 964 fish sampled were immature or resting. For adult fish over 40 cm long, 24% of males and 2% of females were in active reproductive stages (i.e., mature or running ripe: stages 3 and 4). Of 626 adult red gurnard over 31 cm long, 77% of males and 35% of females were maturing. Amongst female red gurnard, a further 47% were mature and 15% were running ripe.

Discussion

All objectives for this survey were met, including the *c.v.*s associated with biomass estimates which were all within target limits for the target species. However, in comparing the results of this survey with those of the 1996–97 survey, there are two important issues that may affect the interpretation and use of these results as a relative time series.

Firstly, the catch rates and biomass estimates of most species were lower than in 1996–97 (*see* Table 3). For two of the target species, red gurnard and giant stargazer, biomass was significantly lower than in 1996-97, but interpretation of these declines is complicated by the declines for most species. Possible explanations include different weather patterns and different survey timing which may have resulted in different relative catchability between surveys. In mid December 1997, surface and bottom temperatures were about 1 °C lower than in mid December 1996 (*see* Figures 2 and 3). However, by early January 1998, surface temperatures had increased by about 2 °C and were at least 1 °C warmer than in mid January 1997. Bottom temperatures also appear to increase during the surveys, but are difficult to interpret because of the more restricted sampling during January. The few data available suggest that the inshore bottom temperatures in January 1998 may have been lower than in January 1997. These temperature differences between surveys may have affected the vertical or areal distribution of fish and resulted in different catchabilities. The 10 day earlier timing of the 1997–98 survey may also have resulted in average bottom temperatures overall being lower than those recorded in the 1996–97 survey. Other environmental variables (wind speed, wind direction, and swell height) were similar for both years. Wind was most often from the northeast (54% in 1996–97, 45% in 1997–98) and the southwest (25%, 31%). The difference in average wind speed (6.3 m/s in 1996–97, 5.8 m/s in 1997–98) during towing is not great, but 5 days were lost to bad weather in 1996–97 and none in 1997–98.

Secondly, major changes in distribution were also noted for barracouta, blue warehou, elephantfish, and rough skate. These species were less commonly caught in over 50 m depth in the Canterbury Bight area in 1997–98. This was particularly a problem for one of the target species, elephantfish. Their shallower distribution in 1997–98 necessitated a major redesign of phase 1 of the survey, based on commercial fishing information received during the survey. However, some catches were also reported to have been taken inside 30m depth. These catches are unlikely to have been recorded on an individual tow basis and it is therefore difficult to assess areal availability from catch data. However, industry also commented that the larger fish did not enter the fishery until later in January (Bob Beggs, pers. comm.) and this is apparent in the length frequency distributions. Fish older than 2+ are poorly represented compared to the 1996–97 survey and the biomass totals only about 300 t, compared with the 1996–97 estimate of about 1100 t (*see* Table 3). This indicates that the 1997–98 survey is best used to compare juvenile elephantfish biomass only.

Results from the fourth target species, red cod, were more comparable with those from the 1996–97. The biomass of red cod under 41 cm length (ages 0+, 1+, and 2+ combined) was similar. However, the relative proportions of each age class were different, as would be expected of species with high recruitment variability. The strong 0+ group in 1996–97 have progressed through to become a strong 1+ group in this survey. The weak 1+ group in 1996–97 have also followed through to become a weak 2+ group in this survey. This indicates that the aim of trying to get 0+ and 1+ indices from the survey may be achievable.

Results of the two surveys suggest that it may be possible to develop recruitment indices for barracouta, elephant fish, giant stargazer, lemon sole, New Zealand sole, red gurnard, sand flounder, school shark, spiny dogfish, tarakihi, and perhaps ling. Time series of such recruitment data are also valuable for validation of ageing techniques.

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This research was funded by the Ministry of Fisheries under contract INT9702. Thanks to Chris Francis for simulations and advice on survey design; the skipper of RV *Kaharoa*, Arthur Muir, and his crew for their support and help during the voyage; scientific staff on board (in alphabetical order) Michael Beentjes, Dave Fisher, John Kapa, Kevin Mackay, Ian Maze, Rob Merrilees, Jill Parkyn, and Darren Stevens — their hard work and dedication was much appreciated. Larry Paul provided helpful comments on an earlier version of this report.

Table 1 : **Stratum depth ranges, survey area, untrawlable (foul) area, number of successful phase 1 and phase 2 stations, and station density**

Stratum	Depth (m)	Area (km^2)	Untrawlable area (km^2)	Number of stations Phase 1	Number of stations Phase 2	Station density (km^2 per station)
1	30–100	984	202	3	0	328
2	30–100	1 242	0	4	1	248
3	50–100	1 920	0	6	0	320
3A	30–50	1 111	0	8	0	139
4	50–100	1 853	0	6	0	309
4A	30–50	845	0	6	0	141
5	30–100	2 486	0	5	0	497
6	30–100	2 373	208	3	0	791
7	30–100	2 089	871	5	5	209
8	100–200	628	17	3	0	209
9	100–200	1 163	0	3	0	388
10	100–200	1 192	0	3	0	397
11	100–200	1 483	0	3	0	494
12	100–200	764	132	3	0	255
13	100–200	997	406	3	0	332
14	200–400	752	17	3	0	251
16	200–400	751	0	3	0	250
17	200–400	724	165	3	0	241
18	10–30	1 276	0	11	0	116
19	10–30	987	0	16	4	49
20	10–30	794	0	16	4	40
21	10–30	520	0	3	5	65
Total (average)		26 935	2 018	119	19	(195)

Table 2 : **Tow and gear parameters by depth range with comparison of gear parameters between this survey (KAH9704) and the 1996–97 summer survey (KAH9618).** ***n*** **, sample size;** ***s.d.*** **, standard deviation**

	KAH9618				KAH9704			
Tow parameters	*n*	Mean	*s.d.*	Range	*n*	Mean	*s.d.*	Range
Tow length (n. mile)								
Tows 1–88	88	1.95	0.197	1–2.03	138	1.97	0.158	1–2.02
Tows 89–118	30	1	0	1–1				
Gear parameters (m)								
10–30 m								
Headline height	23	5.2	0.2	4.9–6.0	59	5.3	0.2	4.9–5.7
Doorspread	23	73.1	3.1	63.1–77	59	71.4	2.9	62.3–77.4
Warp/depth ratio	23	8.5	2.2	6.3–14.3	59	9.5	2.3	6.2–15.4
30–100 m								
Headline height	58	5.2	0.2	4.8–5.8	53	5.2	0.2	4.8–5.4
Doorspread	58	74.4	3.6	66.4–82.1	53	72.9	3.9	67.5–79.0
Warp/depth ratio	58	3.6	1.0	2.5–6.6	53	4.2	1.1	2.8–6.9
100–200 m								
Headline height	23	5.2	0.2	4.8–5.5	18	5.0	0.3	4.4–5.4
Doorspread	23	77.8	4.5	68.5–85.7	18	73.0	5.4	63.0–83.6
Warp/depth ratio	23	2.5	0.2	2.2–2.7	18	3.0	0.3	2.6–3.6
200–400 m								
Headline height	12	5.0	0.1	4.9–5.2	9	5.0	0.2	4.6–5.3
Doorspread	12	89.2	4.3	81.1–95.9	9	78.9	7.0	68.4–89.3
Warp/depth ratio	12	2.4	0.1	2.3–2.6	9	2.6	0.1	2.5–2.9
10–400 m								
Headline height	118	5.2	0.2	4.8–6.0	138	5.2	0.2	4.4–5.7
Doorspread	118	76.4	5.9	63.1–95.9	138	73.2	4.5	62.3–89.6
Warp/depth ratio	118	4.3	2.6	2.2–14.3	138	6.2	3.3	2.5–15.4

Table 3 : **Total catch and relative biomass estimate and coefficients of variation (*c.v.*) of the 21 most abundant (catch greater than 450 kg) species and other commercially important species ***

	Catch				Biomass			
	1996–97		1997–98		1996–97		1997–98	
	Weight (kg)	% of total	Weight (kg)	% of total	(t)	*c.v.* %	(t)	*c.v.* %
Southern spiny dogfish	57 161	44.1	30 656	31.6	35 776	28	29 765	25
Barracouta	19 631	15.1	22 030	22.7	21 513	34	11 843	25
Barracouta (0+, < 20 cm)	–	–	–	–	3	52	⊕	86
Barracouta (1+, 20–39 cm)	–	–	–	–	1 108	35	699	53
Barracouta (2+, 40–52 cm)	–	–	–	–	1 562	29	2 290	48
Red cod (all)	9 509	7.3	9 819	10.1	10 634	23	7 536	23
Red cod (0+, < 15 cm)	–	–	–	–	195	35	12	40
Red cod (1+, 15–24 cm)	–	–	–	–	792	27	1 281	34
Red cod (2+, 25–34 cm)	–	–	–	–	**		2 151	31
Red cod (< 41 cm)	–	–	–	–	4 101	23	4 426	24
Red cod (41 + cm)	–	–	–	–	6 533	30	3 110	27
Dark ghost shark	3 638	2.8	5 560	5.7	3 066	18	5 870	33
Rattails (combined)	9 968	7.7	5 433	5.6	10 394	24		
Two saddle rattail	–	–	4 675	4.8	–	–	4 269	28
Hoki	4 415	3.4	2 726	2.8	3 106	24	2 189	41
Tarakihi (all)	3 445	2.7	2 166	2.2	3 818	21	2 036	21
Tarakihi (0+, < 13 cm)	–	–	–	–	13	53	3	78
Tarakihi (1+, 13–17 cm)	–	–	–	–	577	30	159	30
Tarakihi (2+, 18–23 cm)	–	–	–	–	827	27	599	27
Tarakihi (< 25 cm)	–	–	–	–	1 924	25	1 054	26
Tarakihi (25 + cm)	–	–	–	–	1 894	23	982	19
Elephantfish	1 462	1.1	1 963	2.0	1 127	31	404	18
Elephantfish (0+, < 23 cm)	–	–	–	–	1	78	23	58
Elephantfish (1+, 23–39 cm)	–	–	–	–	11	66	95	45
School shark	361	0.3	1 743	1.8	256	23	476	24
Rough skate	1 319	1.0	1 319	1.4	1 336	16	1 082	13
Sea perch	3 289	2.5	1 279	1.3	4 041	47	1 638	25
Blue warehou	1 705	1.3	899	0.9	2 101	54	619	51
Ling	1 427	1.1	892	0.9	1 202	26	919	64
Arrow squid	1 603	1.2	881	0.9	1 522	17	629	34
Carpet shark	1 013	0.8	836	0.9	1 073	14	765	16
Witch	731	0.6	614	0.6	827	10	704	13
Hake	23	#	536	0.6	24	54	408	84
Smooth skate	698	0.5	529	0.5	721	32	485	21
Bollons' rattail	–	–	526	0.5	–	–	432	51
Red gurnard	857	0.7	477	0.5	765	13	317	16
Red gurnard (0+ & 1+, < 20 cm)	–	–	–	–	⊕	51	2	31
Red gurnard (2+, 20–29 cm)	–	–	–	–	41	26	2	38
Red gurnard (< 30 cm)	–	–	–	–	41	26	4	26
Red gurnard (30+ cm)	–	–	–	–	724	13	313	16
Giant stargazer	764	0.6	470	0.5	897	12	543	11
Silver warehou	261	0.2	417	0.4	307	35	474	90
NZ sole	231	0.2	330	0.3	226	22	128	27
Sand flounder	41.3	#	230	0.2	34	39	71	34
Lemon sole	246	0.2	184	0.2	246	15	228	18
Rig (all)	232	0.2	150	0.2	139	40	35	33
Rig (< 90 cm)	159	0.1	–	–	45	57	25	40
Rig (90 cm +)	73	0.1	–	–	93	35	10	50
All species	129 761		96 975				78 246	12

* Includes commercial species of which more than 150 kg were caught.
– Actual catch data not available; biomass calculated from scaled length frequency data.
⊕ Less than 0.5 t
** 2+ year class not distinguishable from length frequency
# Less than 0.05%

Table 4 : **Catch rates (kg.km^{-2}) with standard deviations (in parentheses) by stratum, for the 18 most abundant commercially important species***

										Species code
Stratum	Depth (m)	BAR	ELE	GSH	GUR	HAK	HOK	LIN	RCO	RSK
1	30–100	619	0	0	27	0	0	11	996	60
		(505)	(0)	(0)	(19)	(0)	(0)	(19)	(812)	(55)
2	30–100	127	11	1 464	2	0	0	5	1 397	11
		(234)	(25)	(3 274)	(5)	(0)	(0)	(6)	(1 582)	(18)
3	50–100	185	0	46	3	1	2	369	1 030	0
		(306)	(0)	(111)	(5)	(2)	(6)	(747)	(1 380)	(0)
3A	30–50	101	52	0	14	2	0	4	502	44
		(231)	(56)	(0)	(16)	(5)	(0)	(8)	(1 321)	(100)
4	50–100	23	0	109	6	9	0	3	29	73
		(55)	(0)	(118)	(4)	(22)	(0)	(3)	(61)	(61)
4A	30–50	2 956	17	0	62	0	0	0	0	37
		(6 843)	(25)	(0)	(84)	(0)	(0)	(0)	(0)	(64)
5	30–100	101	1	0	3	0	0	+	2	90
		(109)	(2)	(0)	(5)	(0)	(0)	(+)	(2)	(58)
6	30–100	283	0	0	7	0	0	1	0	71
		(433)	(0)	(0)	(2)	(0)	(0)	(2)	(0)	(45)
7	30–100	972	3	0	68	185	342	3	230	87
		(852)	(9)	(0)	(59)	(517)	(641)	(2)	(321)	(73)
8	100–200	623	0	341	6	0	0	7	77	18
		(995)	(0)	(105)	(6)	(0)	(0)	(6)	(134)	(31)
9	100–200	67	0	1 344	0	0	0	2	22	0
		(116)	(0)	(330)	(0)	(0)	(0)	(2)	(19)	(0)
10	100–200	62	0	492	0	0	12	22	396	0
		(76)	(0)	(226)	(0)	(0)	(15)	(11)	(457)	(0)
11	100–200	12	0	323	1	0	0	1	11	0
		(22)	(0)	(436)	(2)	(0)	(0)	(2)	(16)	(0)
12	100–200	30	0	6	2	0	0	3	3	22
		(43)	(0)	(11)	(3)	(0)	(0)	(5)	(5)	(8)
13	100–200	1 208	0	0	4	0	0	8	28	46
		(2 043)	(0)	(0)	(4)	(0)	(0)	(5)	(34)	(79)
14	200–400	49	0	680	0	0	76	52	3	6
		(85)	(0)	(1 003)	(0)	(0)	(107)	(34)	(3)	(11)
16	200–400	0	0	451	0	0	1149	24	14	7
		(0)	(0)	(598)	(0)	(0)	(1505)	(29)	(3)	(13)
17	200–400	225	0	84	0	0	740	99	37	23
		(376)	(0)	(40)	(0)	(0)	(1112)	(82)	(18)	(9)
18	10–30	807	17	0	3	0	0	+	7	32
		(1 030)	(31)	(0)	(3)	(1)	(0)	(1)	(17)	(36)
19	10–30	1 198	124	0	19	0	+	+	7	47
		(2 346)	(137)	(0)	(33)	(0)	(+)	(+)	(13)	(79)
20	10–30	576	205	0	3	0	0	1	112	9
		(1 614)	(337)	(0)	(5)	(1)	(0)	(2)	(404)	(22)
21	10–30	879	5	0	1	0	0	1	1 942	42
		(1 003)	(11)	(0)	(2)	(1)	(0)	(2)	(3 586)	(48)

* Species codes are given in Appendix 3

+ < 0.5

Table 4—continued

		Species code								
Stratum	Depth (m)	SCH	SPD	SPE	SQU	SSK	STA	SWA	TAR	WAR
1	30–100	0	9 068	10	8	0	27	5	346	0
		(0)	(9 921)	(17)	(7)	(0)	(31)	(10)	(479)	(0)
2	30–100	0	7 350	4	2	0	4	0	72	0
		(0)	(6 922)	(6)	(2)	(0)	(9)	(0)	(120)	(0)
3	50–100	0	1 446	21	148	24	25	0	89	0
			(2 451)	(43)	(235)	(38)	(29)	(0)	(130)	(0)
3A	30–50	(0)	313	1	1	0	6	0	122	+
		(5)	(533)	(2)	(3)	(0)	(8)	(0)	(342)	(1)
4	50–100	0	101	9	7	90	43	1	319	0
		(0)	(95)	(11)	(2)	(65)	(14)	(2)	(343)	(0)
4A	30–50	0	21	0	1	0	2	0	67	1
		(0)	(44)	(0)	(1)	(0)	(3)	(0)	(135)	(2)
5	30–100	16	296	20	3	30	32	2	36	0
		(19)	(301)	(43)	(6)	(41)	(28)	(3)	(29)	(0)
6	30–100	0	397	16	4	0	19	8	135	0
		(0)	(50)	(26)	(139)	(0)	(14)	(13)	(9)	(0)
7	30–100	0	248	47	3	15	29	0	16	288
		(0)	(246)	(66)	(4)	(46)	(42)	(0)	(28)	(476)
8	100–200	0	125	16	89	93	54	12	1	0
		(0)	(132)	(15)	(8)	(162)	(28)	(20)	(1)	(0)
9	100–200	0	943	16	6	18	12	4	1	0
		(0)	(402)	(15)	(47)	(23)	(11)	(5)	(2)	(0)
10	100–200	0	212	459	8	4	25	0	2	0
		(0)	(88)	(426)	(31)	(7)	(20)	(1)	(2)	(0)
11	100–200	0	1582	157	27	7	4	0	23	0
		(0)	(1 820)	(188)	(3)	(13)	(5)	(0)	(40)	(0)
12	100–200	0	328	169	21	0	5	0	20	0
		(0)	(112)	(268)	(19)	(0)	(7)	(1)	(13)	(0)
13	100–200	0	194	347	2	7	64	426	23	0
		(0)	(76)	(284)	(5)	(6)	(27)	(738)	(40)	(0)
14	200–400	0	116	0	11	13	6	2	0	0
		(0)	(181)	(0)	(50)	(11)	(7)	(3)	(0)	(0)
16	200–400	186	627	5	21	14	2	1	0	0
		(221)	(835)	(8)	(1)	(12)	(4)	(2)	(0)	(0)
17	200–400	158	306	129	42	25	43	5	0	0
		(321)	(282)	(158)	(211)	(32)	(30)	(9)	(0)	(0)
18	10–30	50	220	0	+	5	+	0	0	1
		(78)	(339)	(0)	(21)	(17)	(+)	(0)	(0)	(4)
19	10–30	5	344	0	56	0	+	0	15	3
		(7)	(351)	(0)	(206)	(0)	(+)	(1)	(39)	(7)
20	10–30	1	137	0	6	8	+	0	0	14
		(4)	(247)	(0)	(3)	(35)	(+)	(1)	(0)	(34)
21	10–30	2	874	0	5	25	0	0	223	1
		(4)	(1 332)	(0)	(2)	(72)	(0)	(0)	(455)	(2)

* Species codes are given in Appendix 3

+ < 0.5

Table 5 **: Estimated biomass (t) and coefficient of variation (*c.v.*) by stratum of the 18 most abundant commercially important species***

									Species code
Stratum	BAR	ELE	GSH	GUR	HAK	HOK	LIN	RCO	RSK
1	609	0	0	27	0	0	11	980	59
	(47)			(40)			(97)	(47)	(53)
2	158	14	1 819	3	0	0	7	1 736	13
	(82)	(100)	(100)	(100)			(48)	(51)	(75)
3	355	0	87	5	2	5	607	1 978	0
	(68)		(100)	(69)	(84)	(100)	(83)	(55)	
3A	112	57	0	16	2	0	4	558	49
	(81)	(38)		(39)	(92)		(76)	(93)	(80)
4	43	0	202	10	17	0	5	53	136
	(96)		(44)	(31)	(100)		(40)	(87)	(34)
4A	2 497	14	0	52	0	0	0	0	32
	(95)	(62)		(55)					(70)
5	251	2	0	8	0	0	+	4	225
	(48)	(100)		(64)			(100)	(57)	(29)
6	672	0	0	18	0	0	3	0	168
	(88)			(15)			(85)		(37)
7	2 031	6	0	142	387	714	6	481	183
	(28)	(100)		(28)	(88)	(59)	(29)	(44)	(27)
8	391	0	214	4	0	0	4	48	11
	(92)		(18)	(58)			(48)	(100)	(100)
9	78	0	1 564	0	0	0	3	26	0
	(100)		(14)				(52)	(49)	
10	74	0	587	0	0	14	26	472	0
	(71)		(27)			(73)	(29)	(67)	
11	18	0	479	2	0	0	2	17	0
	(100)		(78)	(100)			(75)	(79)	
12	23	0	5	2	0	0	2	2	17
	(82)		(100)	(100)			(100)	(94)	(22)
13	1 205	0	0	4	0	0	8	28	45
	(98)			(57)			(34)	(69)	(100)
14	37	0	512	0	0	57	39	2	5
	(100)		(85)			(81)	(37)	(55)	(100)
16	0	0	339	0	0	863	18	10	6
			(77)			(76)	(70)	(13)	(100)
17	163	0	61	0	0	536	71	27	17
	(96)		(27)			(87)	(48)	(27)	(22)
18	1 030	22	0	3	+	0	+	9	41
	(38)	(53)		(30)	(68)		(100)	(73)	(33)
19	1 182	123	0	19	+	+	+	7	47
	(44)	(25)		(38)	(85)	(100)	(78)	(43)	(38)
20	457	163	0	2	+	0	1	89	7
	(1)	(37)		(41)	(76)		(64)	(81)	(53)
21	457	3	0	1	+	0	1	1 009	22
	(40)	(71)		(66)	(100)		(50)	(65)	(40)

* Species codes are given in Appendix 3

\+ < 0.5 t.

Table 5 —continued

	Species code								
Stratum	SCH	SPD	SPE	SQU	SSK	STA	SWA	TAR	WAR
1	0	8 925	10	8	0	26	5	341	0
		(63)	(98)	(53)		(67)	(100)	(80)	
2	0	9 132	5	3	0	5	0	90	0
		(42)	(65)	(44)		(100)		(74)	
3	0	2 777	41	285	46	47	0	172	0
		(69)	(81)	(60)	(65)	(49)	(76)	(60)	
3A	4	348	1	1	0	7	0	136	+
	(100)	(60)	(100)	(82)		(47)	(100)	(99)	(100)
4	0	188	16	13	168	80	2	591	0
		(38)	(54)	(27)	(29)	(13)	(73)	(44)	
4A	0	17	0	1	0	2	0	56	1
		(86)		(92)		(74)		(83)	(100)
5	34	736	51	7	74	80	4	89	0
	(38)	(45)	(95)	(32)	(62)	(38)	(89)	(37)	
6	0	942	38	9	0	45	18	321	0
		(7)	(97)	(22)		(41)	(100)	(4)	
7	0	519	98	7	31	60	0	34	601
		(31)	(45)	(54)	(98)	(45)	(67)	(55)	(52)
8	0	79	10	56	59	34	7	0	0
		(61)	(55)	(90)	(100)	(30)	(95)	(100)	
9	0	1098	18	7	21	14	4	1	0
		(25)	(55)	(38)	(73)	(55)	(78)	(100)	
10	0	253	547	9	5	30	0	2	0
		(24)	(54)	(56)	(100)	(46)	(100)	(71)	
11	0	2 345	232	41	11	6	0	34	0
		(66)	(69)	(99)	(100)	(61)		(100)	
12	0	250	129	16	0	4	0	15	0
		(20)	(92)	(86)		(77)	(100)	(37)	
13	0	193	346	2	7	64	425	23	0
		(23)	(47)	(92)	(51)	(24)	(100)	(100)	
14	0	87	0	8	10	5	1	0	0
		(90)		(100)	(50)	(58)	(100)		
16	237	471	3	16	10	2	1	0	0
	(36)	(77)	(100)	(13)	(50)	(100)	(100)		
17	156	222	93	30	18	31	4	0	0
	(45)	(53)	(71)	(70)	(74)	(41)	(100)		
18	40	281	0	1	7	+	0	0	2
	(35)	(46)		(92)	(100)	(100)	(67)		(80)
19	3	340	0	55	0	+	0	14	3
	(49)	(23)		(82)		(69)	(42)	(59)	(59)
20	2	109	0	5	6	+	0	0	11
	(100)	(40)		(82)	(100)	(77)	(56)	(100)	(53)
21	2	454	0	3	13	0	0	116	1
	(100)	(54)		(50)	(100)			(72)	(59)

* Species codes are given in Appendix 3

\+ < 0.5 t.

Table 6 **: Numbers of length frequency and biological samples collected (species codes are given in Appendix 3)**

	Length frequency data						Biological data+		
Species code	Measurement method	No. of samples	No. of fish	No. of males	No. of females		No. of samples	No. of fish	No. of otolith spine, or scale samples
BAR	1	104	5 255	2 456	2 721		11	430	–
BCO	2	12	45	30	15		10	42	40
BRI	2	12	16	#	#		–	–	–
BUT	2	1	1	#	#		–	–	–
BWS	2	1	1	#	#		–	–	–
ELE	1	63	1 572	734	837		62	820	197
ESO	2	56	1 239	#	#		–	–	–
GFL	2	15	50	#	#		–	–	–
GSH	G	28	1 966	881	1 078		6	333	–
GSP	G	3	28	2	26		–	–	–
GUR	1	77	848	360	455		77	678	186
HAK	2	19	319	53	50		–	–	–
HAP	2	24	47	21	26		24	47	47
HOK	2	14	911	438	472		–	–	–
JDO	2	1	1	1	0		–	–	–
JMD	1	1	1	#	#		–	–	–
JMM	1	9	12	8	3		–	–	–
JMN	1	1	1	#	#		–	–	–
KAH	1	23	52	25	27		–	–	–
LDO	2	6	68	4	64		–	–	–
LIN	2	61	595	293	297		–	–	–
LSO	2	66	645	#	#		–	–	–
MOK	1	3	9	1	6		–	–	–
RBM	1	2	6	2	4		–	–	–
RCO	2	81	4 086	1 692	2 072		70	1 074	349
RSK	5	72	508	240	267		72	508	–
SAM	1	11	38	16	7		1	5	15
SBW	2	1	1	1	0		–	–	–
SCH	2	56	1 565	794	771		–	–	–
SFL	2	35	530	#	#		–	–	–
SPD	2	127	8 130	5 188	2 937		1	31	–
SPE	2	43	1 912	863	899		–	–	–
SPO	2	22	133	77	56		20	124	–
SPZ	2	14	25	15	10		–	–	–
SQU	4	76	1 484	394	425		–	–	–
SSK	5	28	50	25	25		28	50	–
STA	2	61	364	149	196		59	360	221
SWA	1	33	309	94	82		–	–	–
TAR	1	63	3 004	1 289	1 228		1	18	–
THR	2	2	2	1	1		–	–	–
TRU	1	1	1	#	#		–	–	–
WAR	1	36	1 013	89	152		–	–	–
WSQ	4	3	3	0	3		–	–	–
WWA	1	3	28	14	14		–	–	–
YBF	2	11	87	#	#		–	–	–
YCO	2	3	4	1	3		–	–	–

Measurement methods: 1, fork length; 2, total length; 4, mantle length; 5, pelvic length; G, total length less tail filament;
+ Data include one or more of the following: fish weight, gonad stage, otoliths, vertebrae, dorsal spines
# Not sexed
– No data.

Table 7 : **Numbers of giant stargazer, red cod, and red gurnard sampled at each reproductive stage***

Total length (cm)	Males Gonad stage 1	2	3	4	5	Females Gonad stage 1	2	3	4	5	
Giant stargazer											
11–20	8	0	0	0	0	8	0	0	0	0	
21–30	27	0	0	0	0	31	1	0	0	0	
31–40	56	10	0	0	0	43	13	0	0	0	
41–50	19	21	0	0	0	49	15	2	0	0	
51–60	2	3	1	0	0	15	6	2	0	0	
61–70	1	0	1	0	0	2	4	2	1	0	
71–80	0	0	0	0	0	0	1	0	0	0	
Total	113	34	2	0	0	148	40	6	1	0	344
Red cod											
11–20	35	0	0	0	0	26	0	0	0	0	
21–30	125	1	0	0	0	208	1	0	0	0	
31–40	91	10	0	0	0	104	6	0	0	0	
41–50	48	22	9	7	0	82	14	0	1	0	
51–60	3	13	6	5	0	50	46	4	0	0	
61–70	0	1	0	0	0	21	22	1	0	0	
71–80	0	0	0	0	0	2	0	0	0	0	
Total	302	47	15	12	0	493	89	5	1	0	964
Red gurnard											
11–20	47	0	0	0	0	46	0	0	0	0	
21–30	6	9	0	0	0	10	0	0	0	0	
31–40	23	136	12	0	0	5	56	60	13	2	
41–50	8	26	3	1	1	0	49	78	29	1	
51–60	0	0	0	0	0	0	0	3	2	0	
Total	84	171	15	1	1	61	105	141	44	3	626

* Small fish of indeterminate sex are not included.
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.

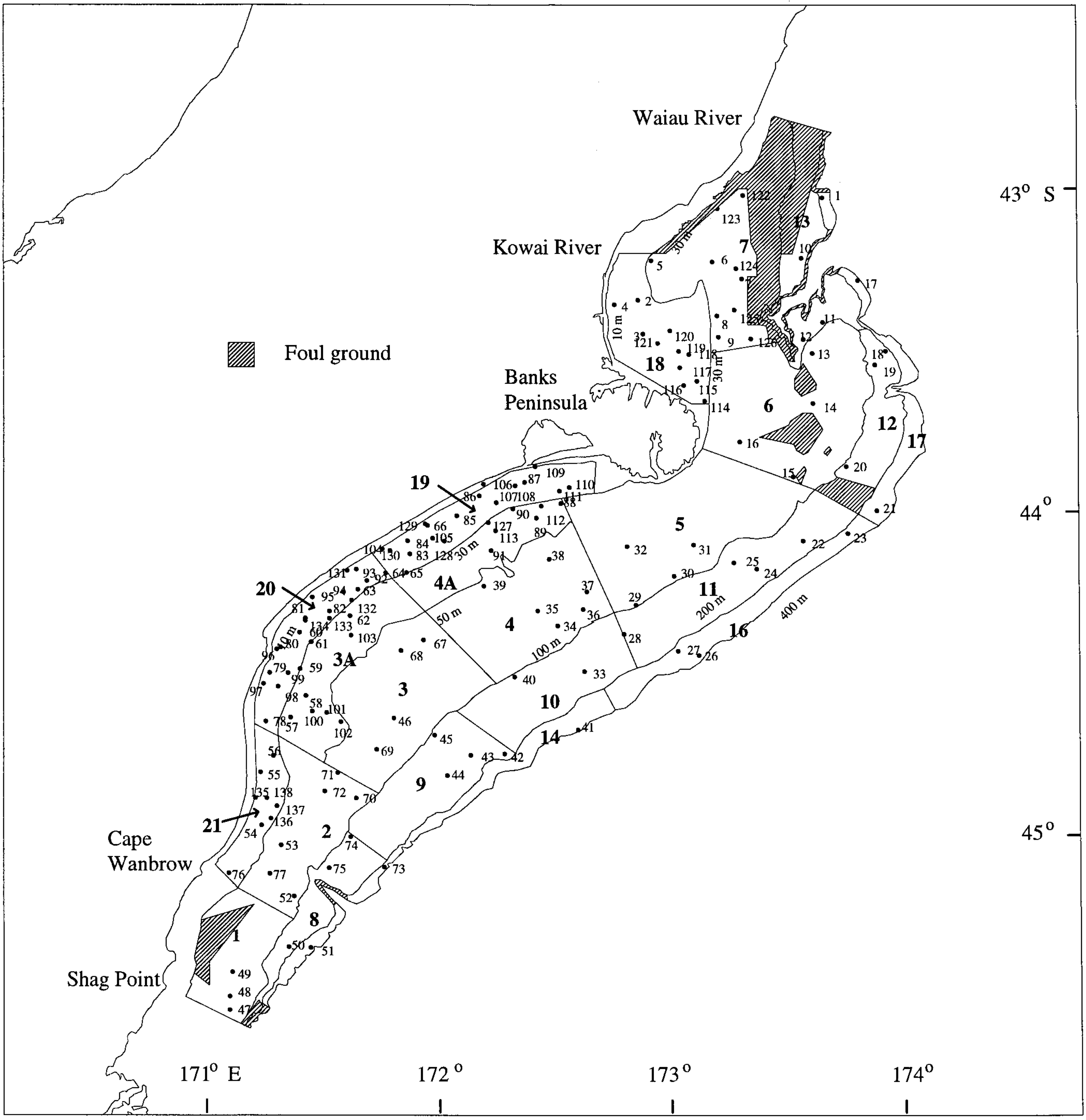

Figure 1 **: Trawl survey area showing strata boundaries (bold type), areas of untrawlable (foul) ground, and trawl station positions.**

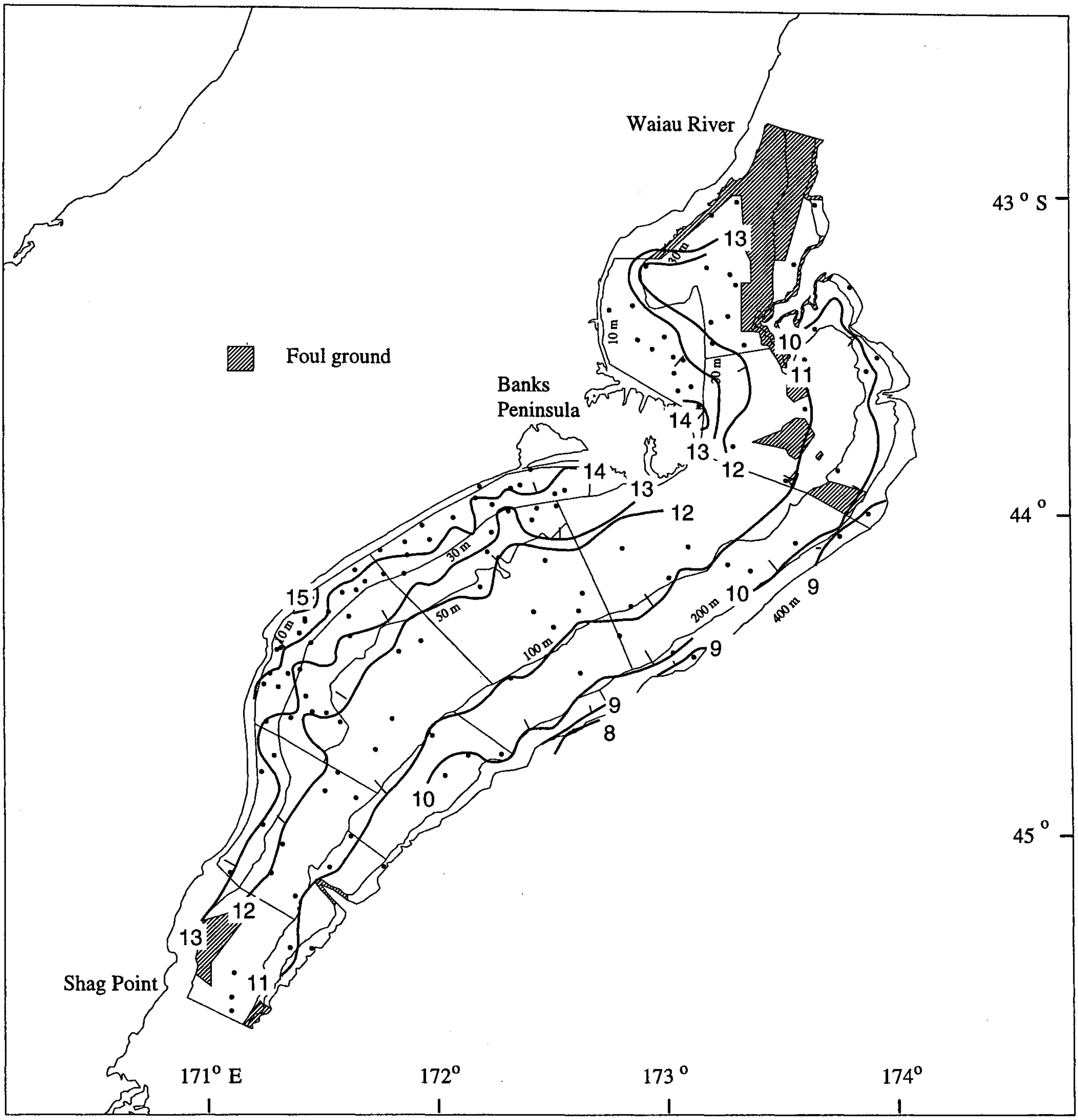

Figure 2a: Positions of bottom temperature recordings in December and isotherms estimated from these data.

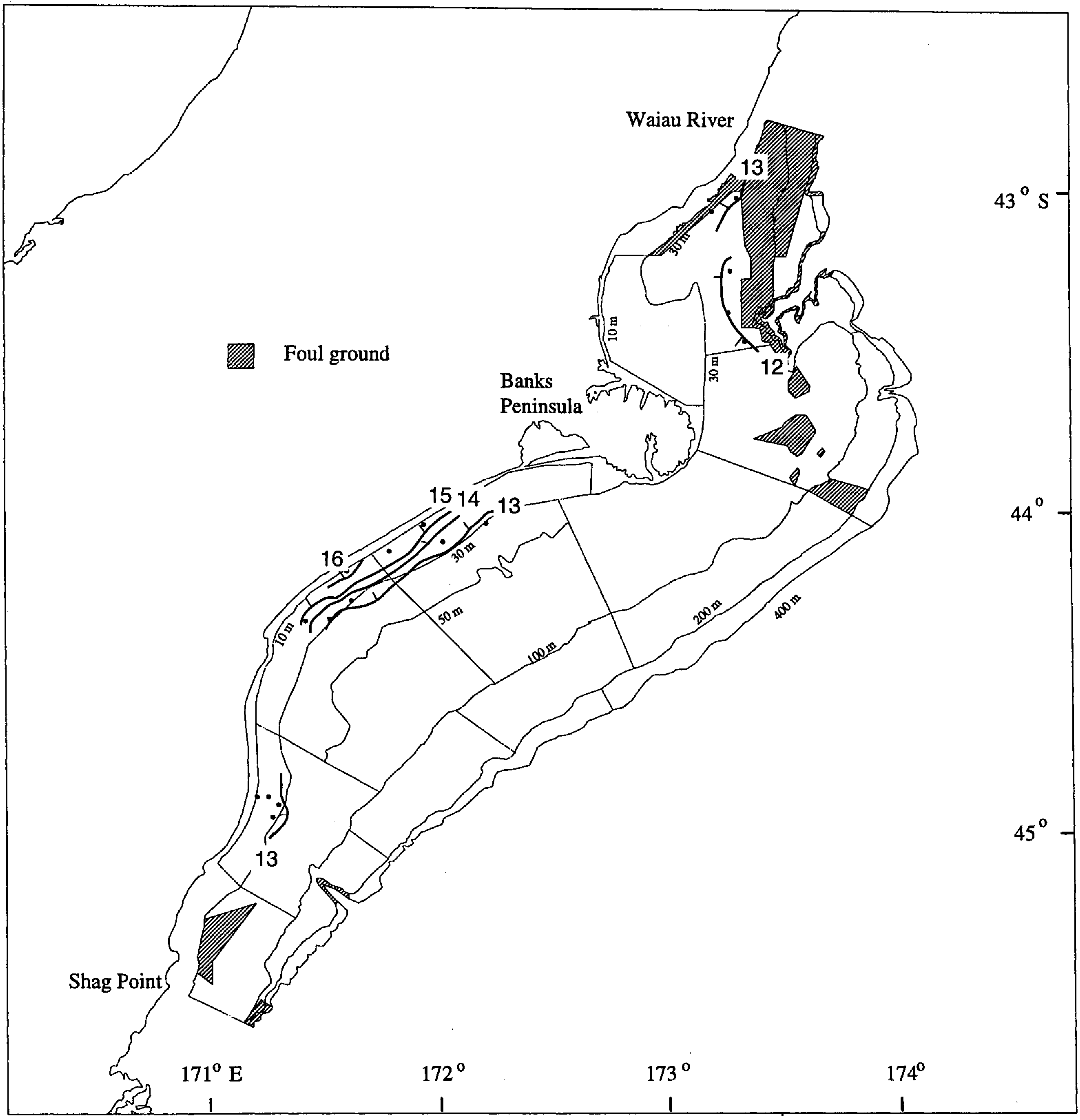

Figure 2b: Positions of bottom temperature recordings in January and isotherms estimated from these data.

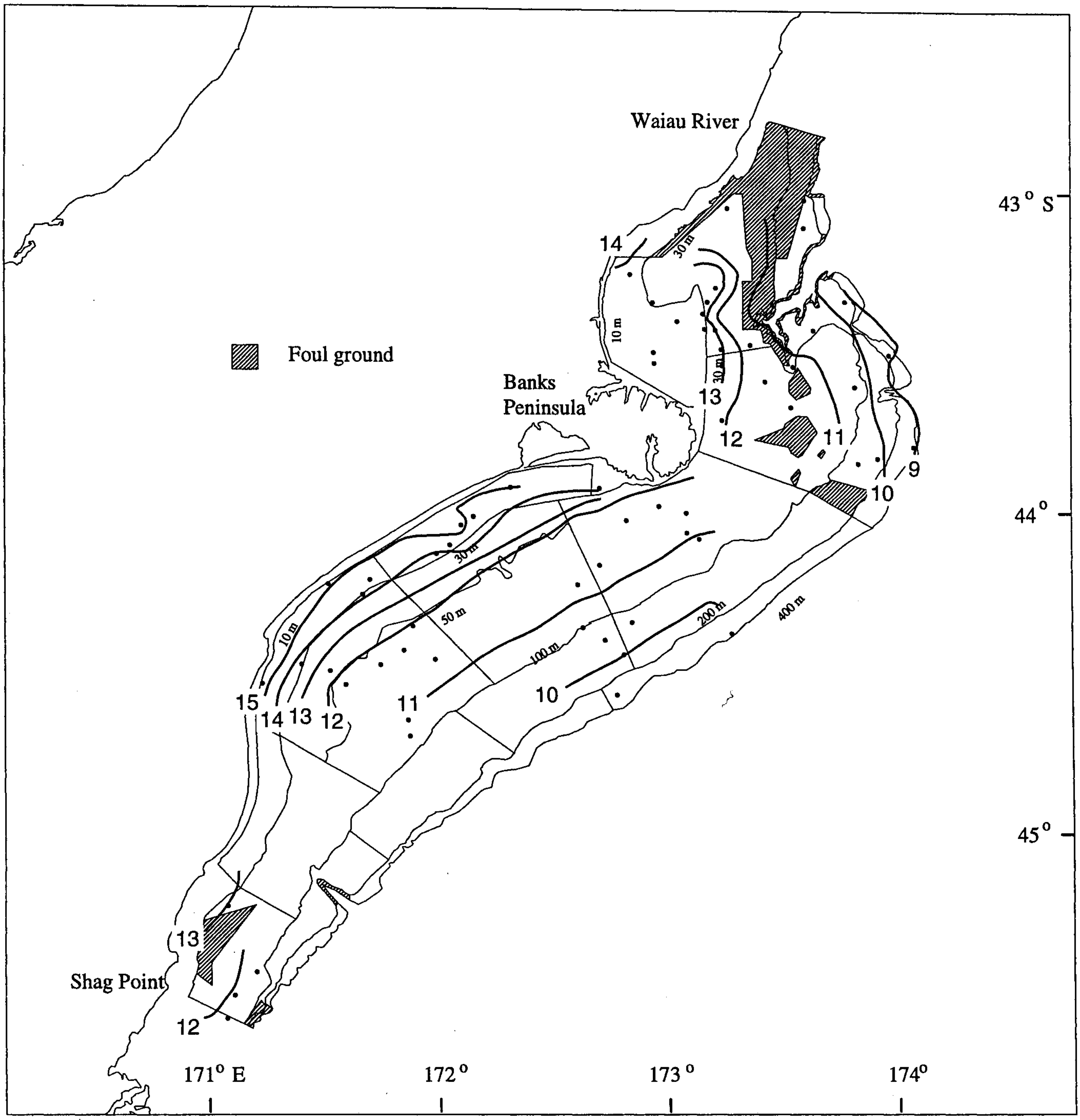

Figure 2c: Positions of bottom temperature recordings in December 1996 and isotherms estimated from these data.

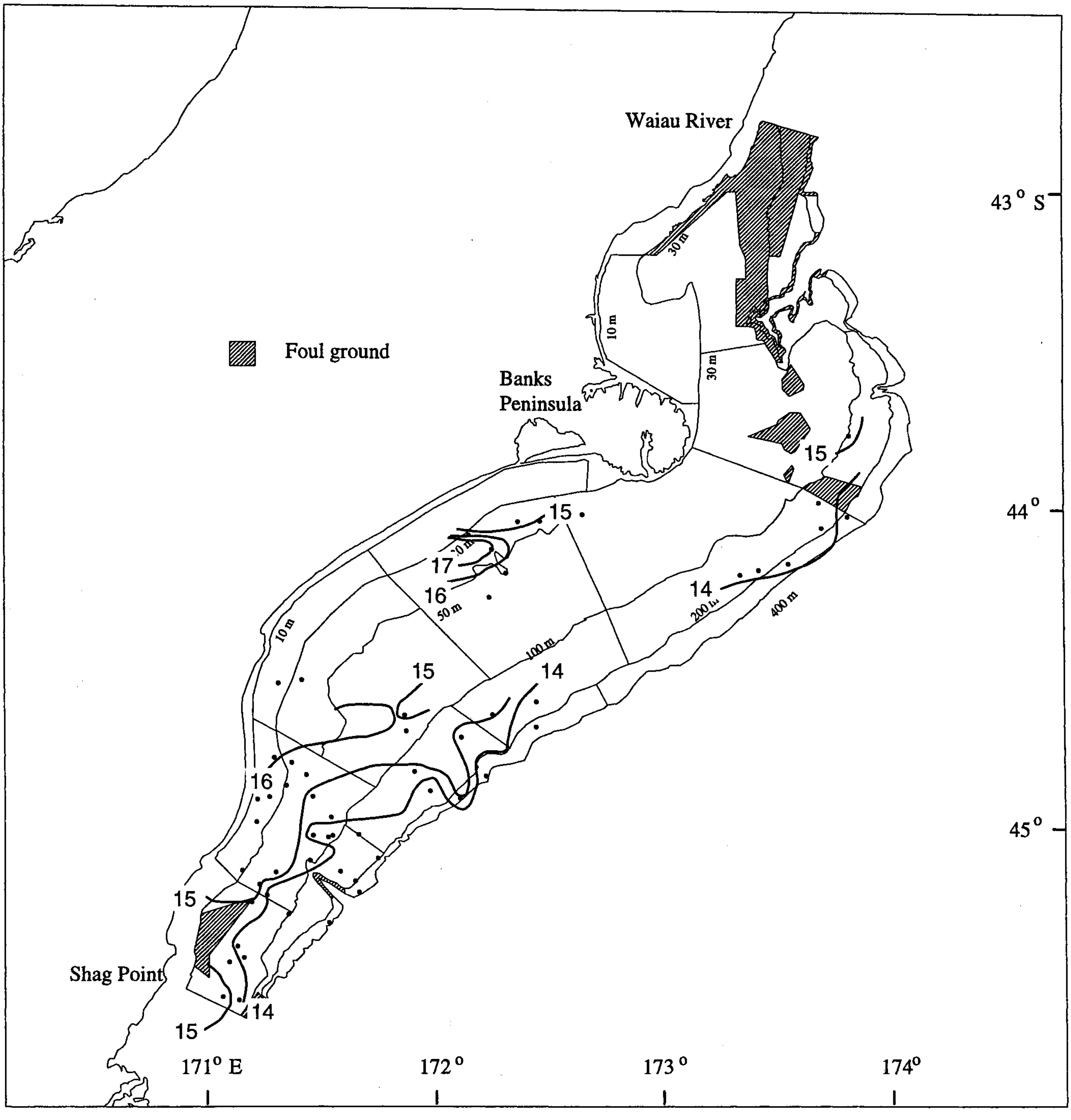

Figure 2d: Positions of bottom temperature recordings in January 1997 and isotherms estimated from these data.

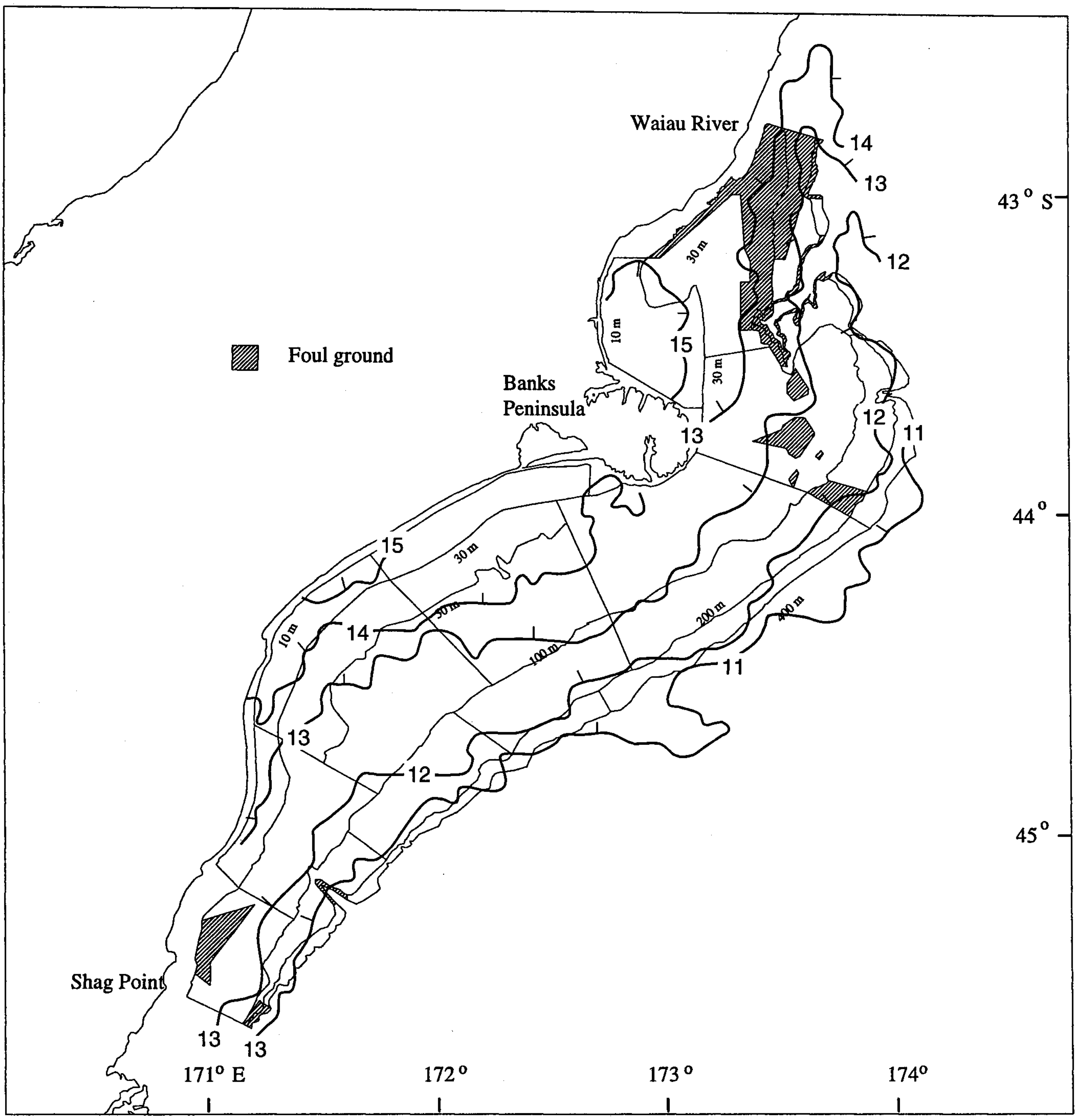

Figure 3a: Mean sea surface isotherms for 15–18 December (from NIWA SST Archive (NSA) courtesy of Michael Uddstrom).

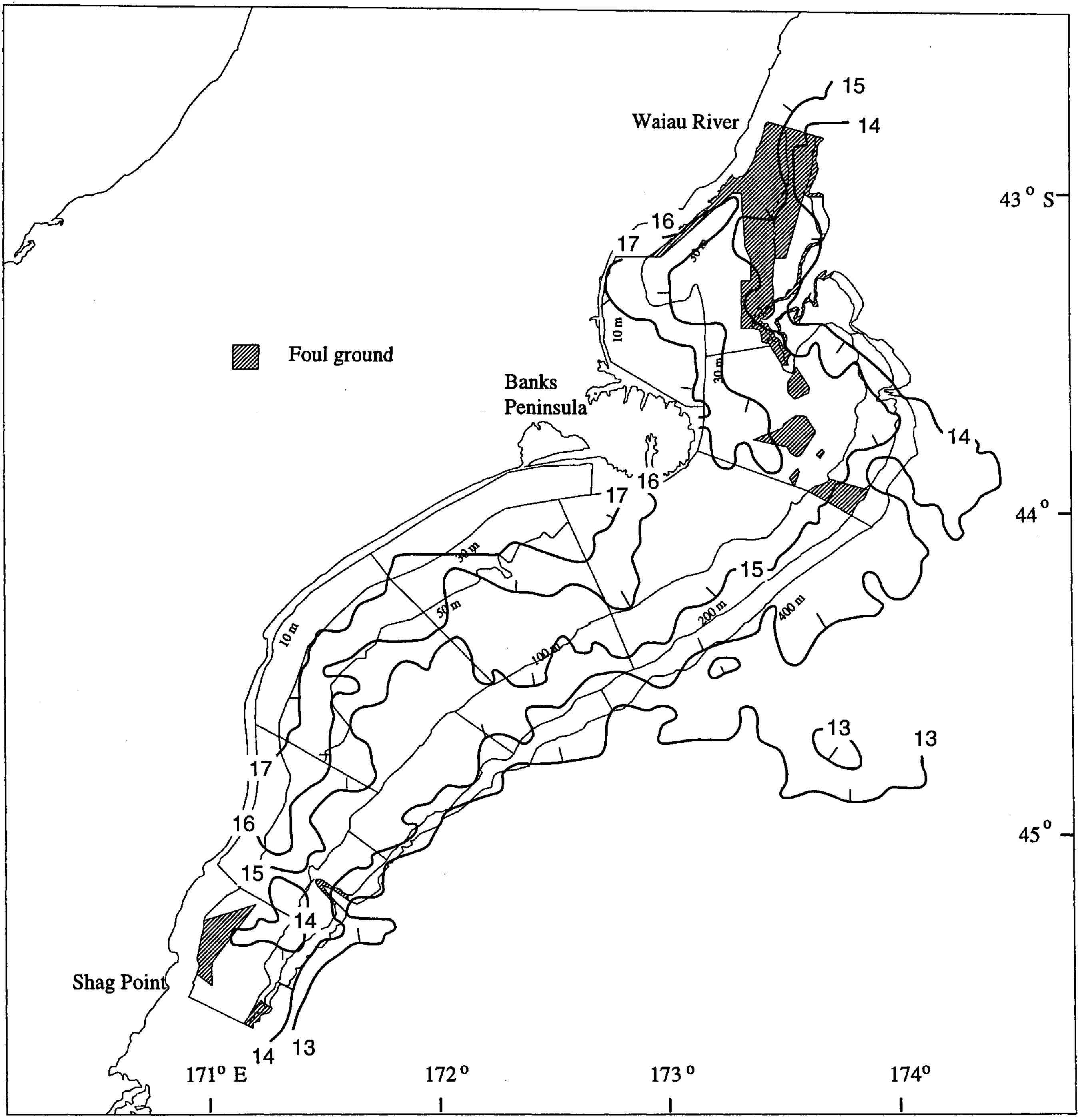

Figure 3b: Mean sea surface isotherms for 2–3 January (from NIWA SST Archive (NSA) courtesy of Michael Uddstrom).

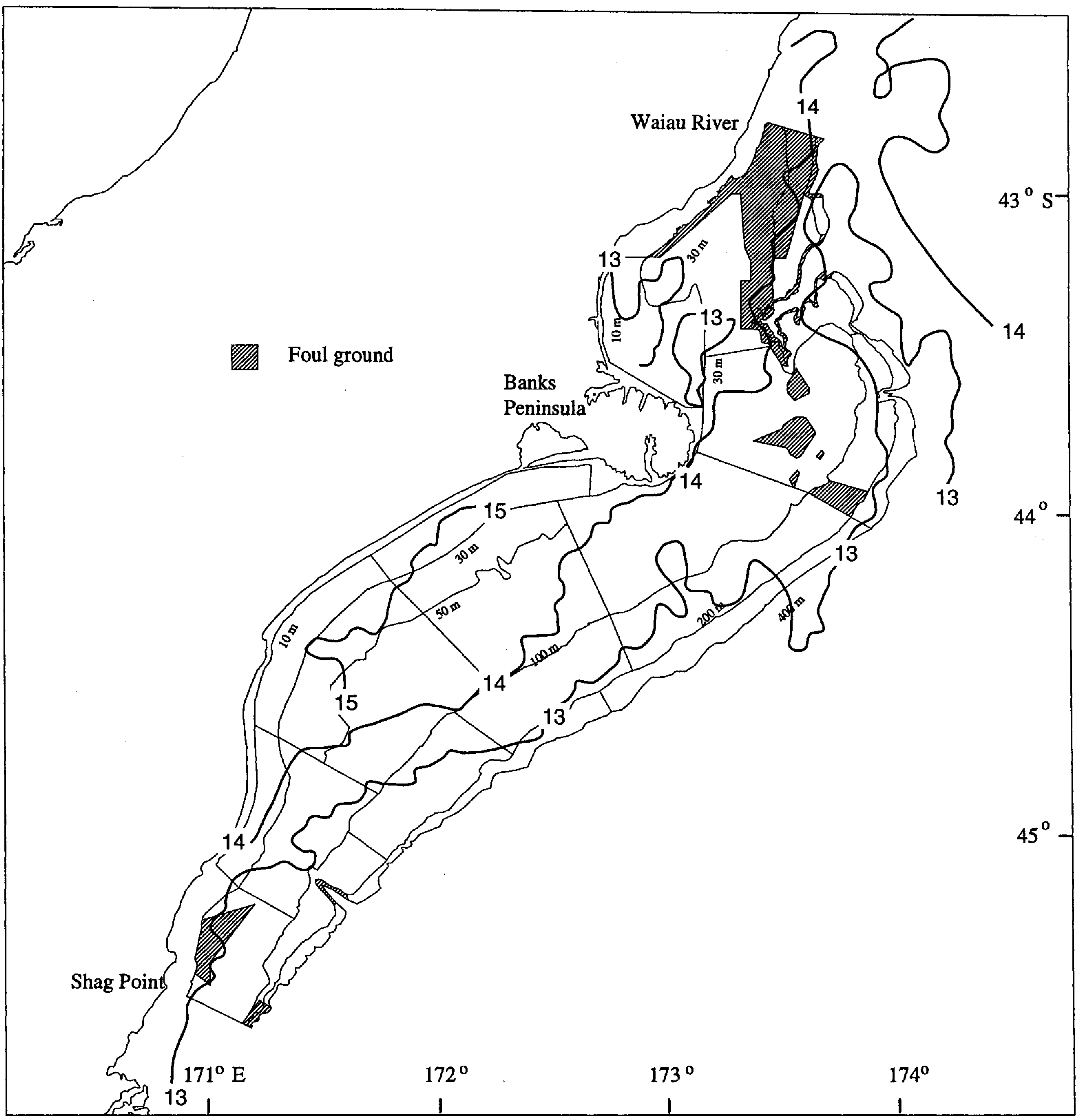

Figure 3c: Mean sea surface isotherms for 14–17 December 1996 (from NIWA SST Archive (NSA) courtesy of Michael Uddstrom).

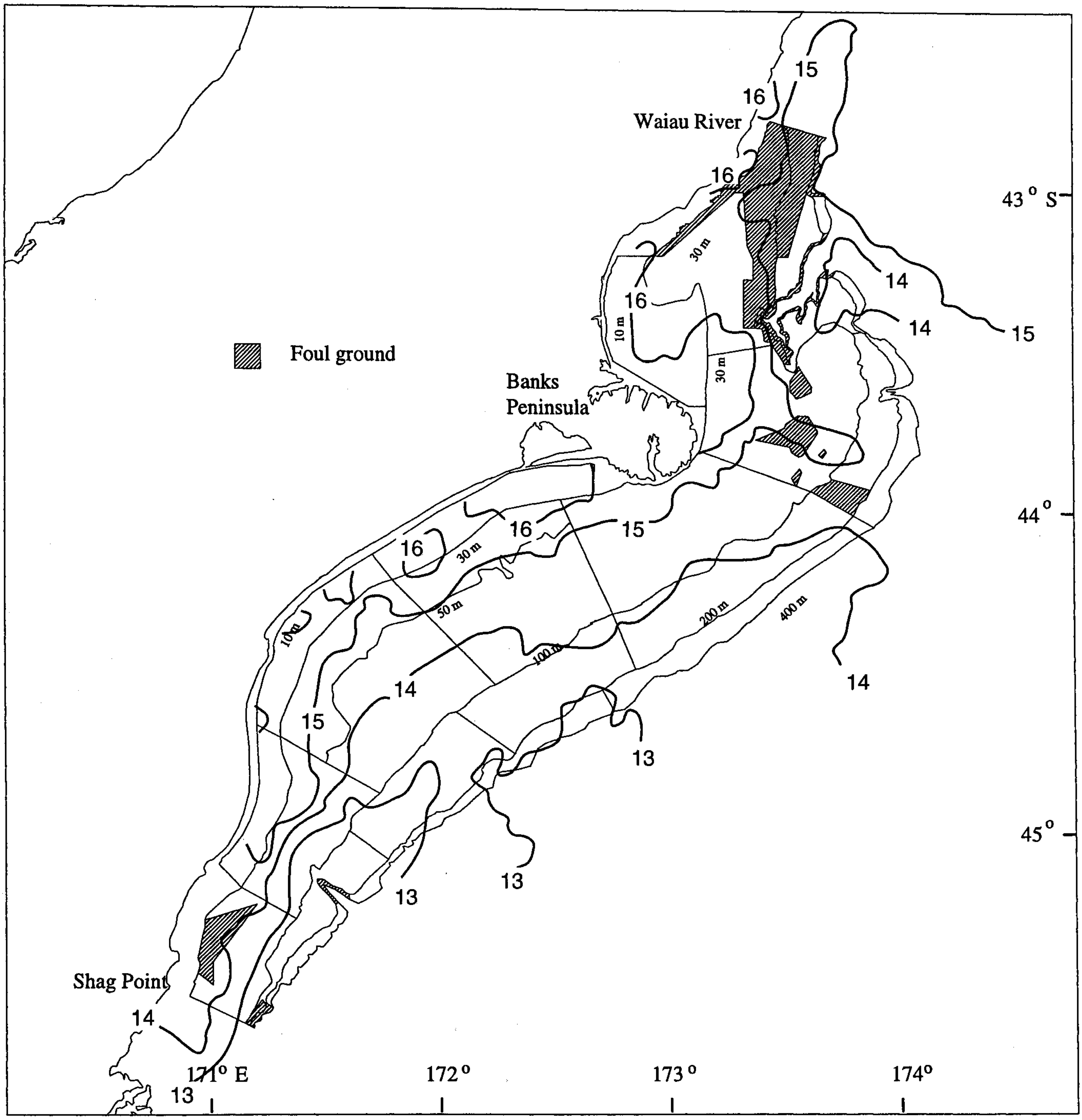

Figure 3d: Mean sea surface isotherms for 6–15 January 1997 (from NIWA SST Archive (NSA) courtesy of Michael Uddstrom).

Arrow squid

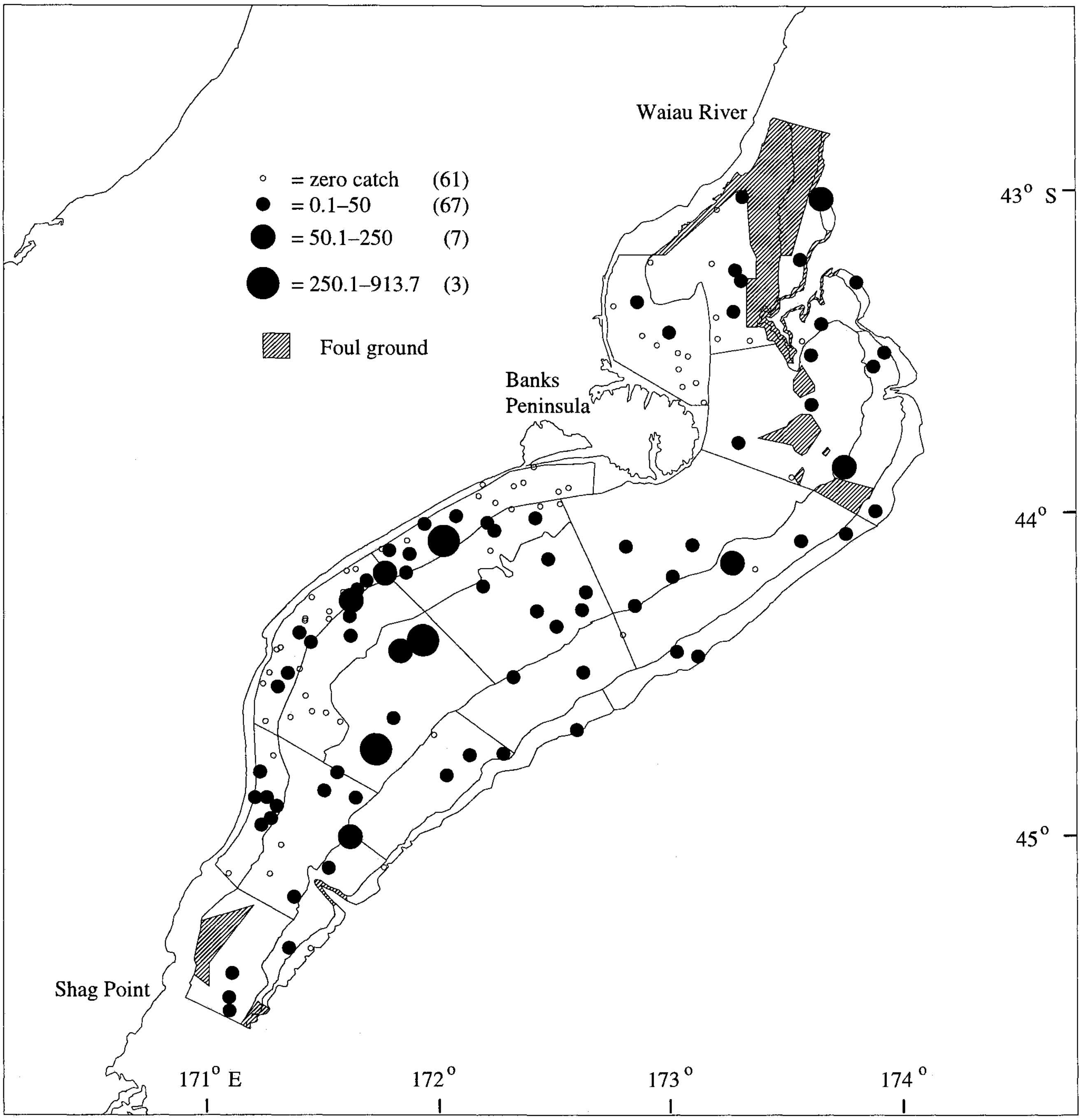

***Figure 4*: Catch rates (kg.km^{-2}) of the major commercial species (numbers in parenthesis are the number of stations at the given catch rate).**

Barracouta

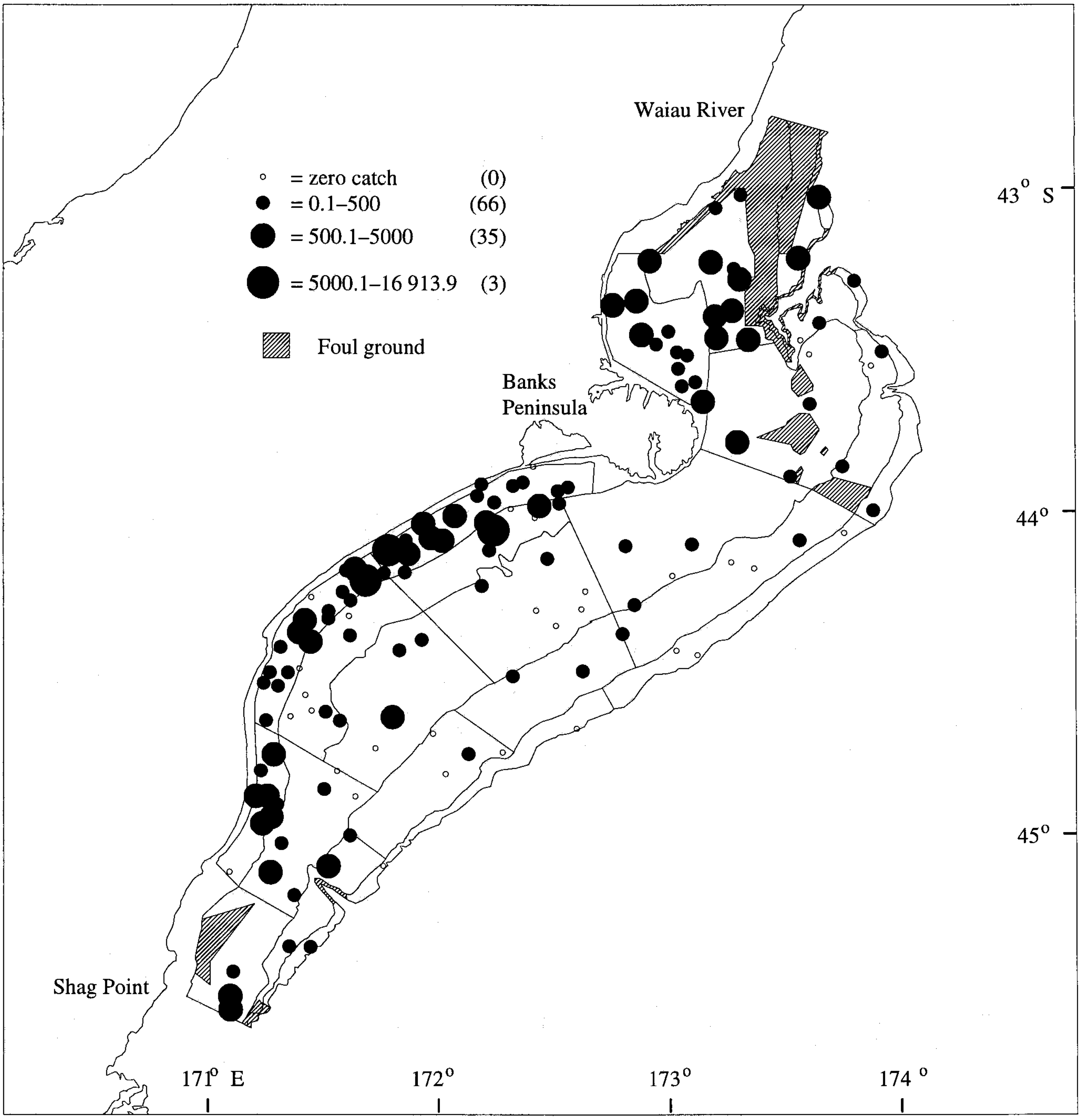

Figure 4— continued

Blue warehou

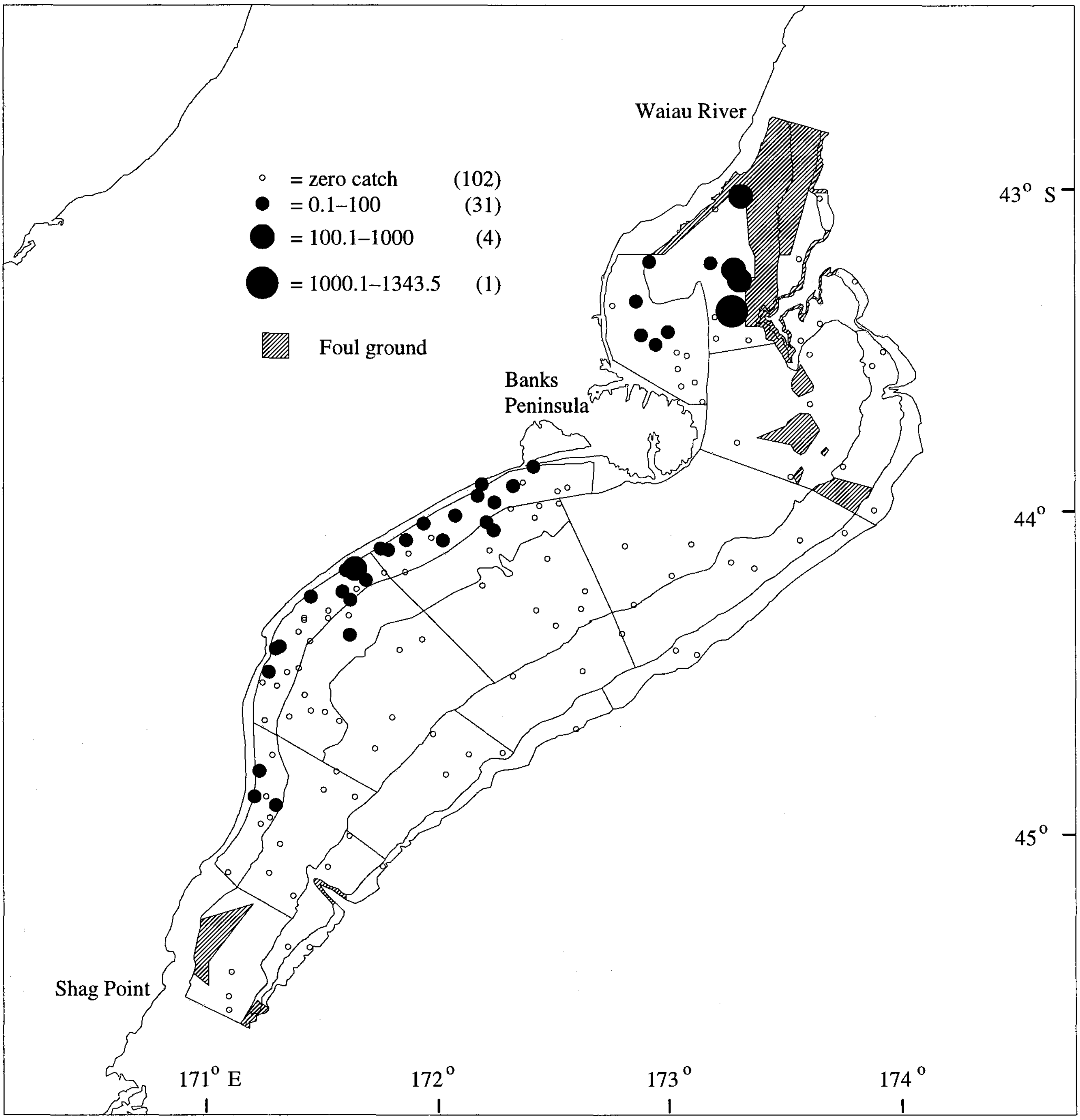

Figure 4— continued

Dark ghost shark

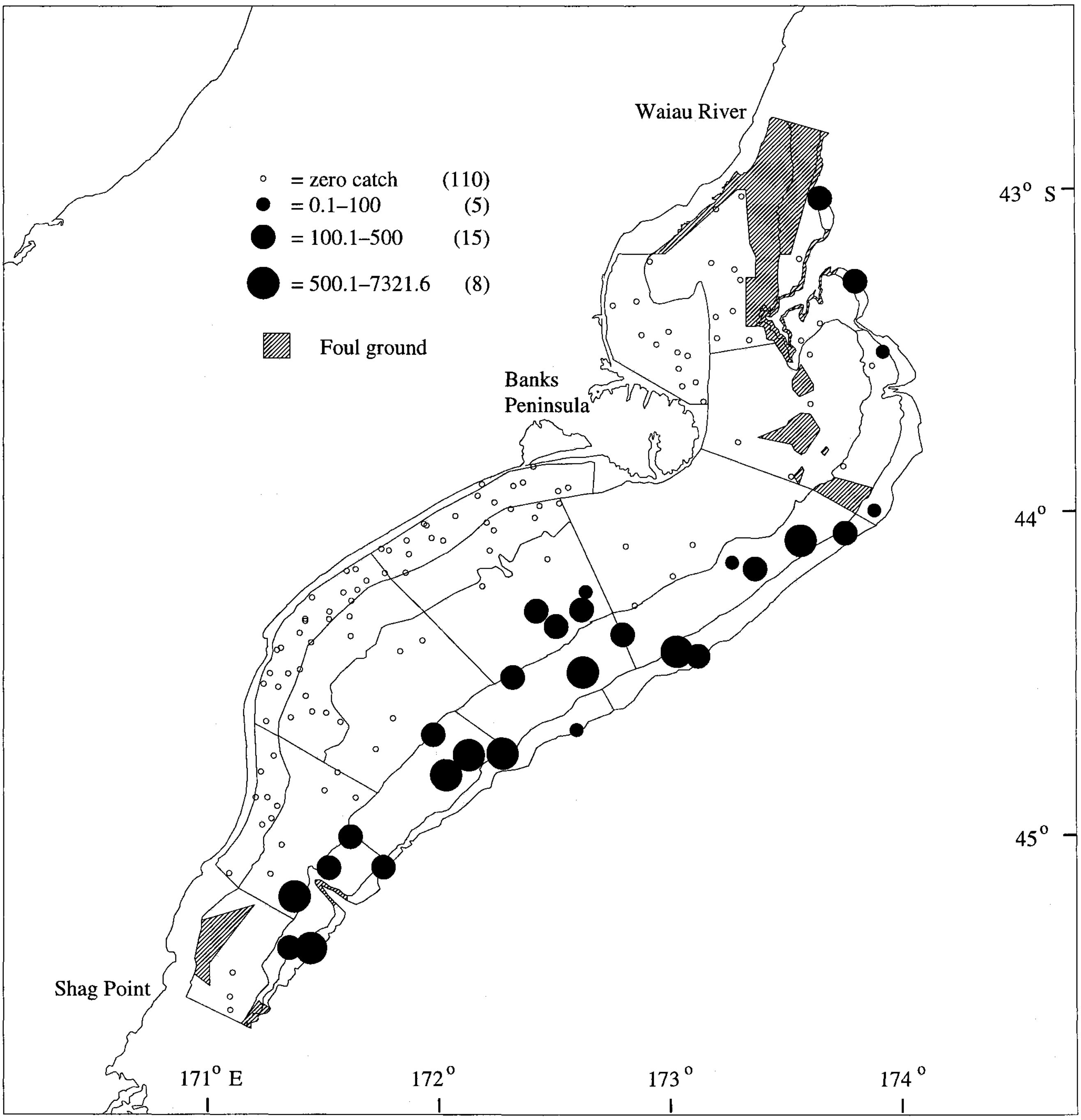

Figure 4— continued

Elephantfish

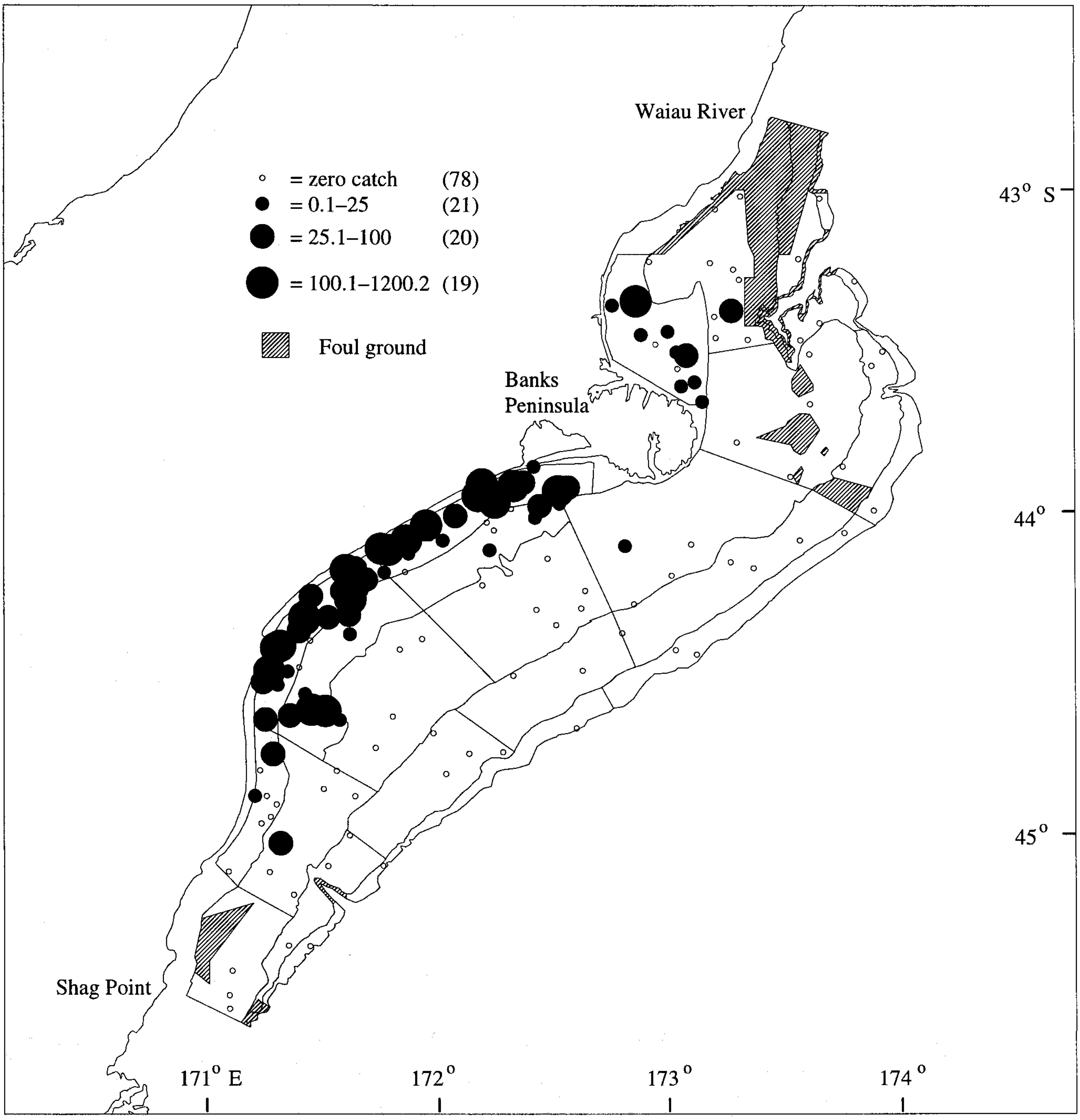

Figure 4— continued

Giant stargazer

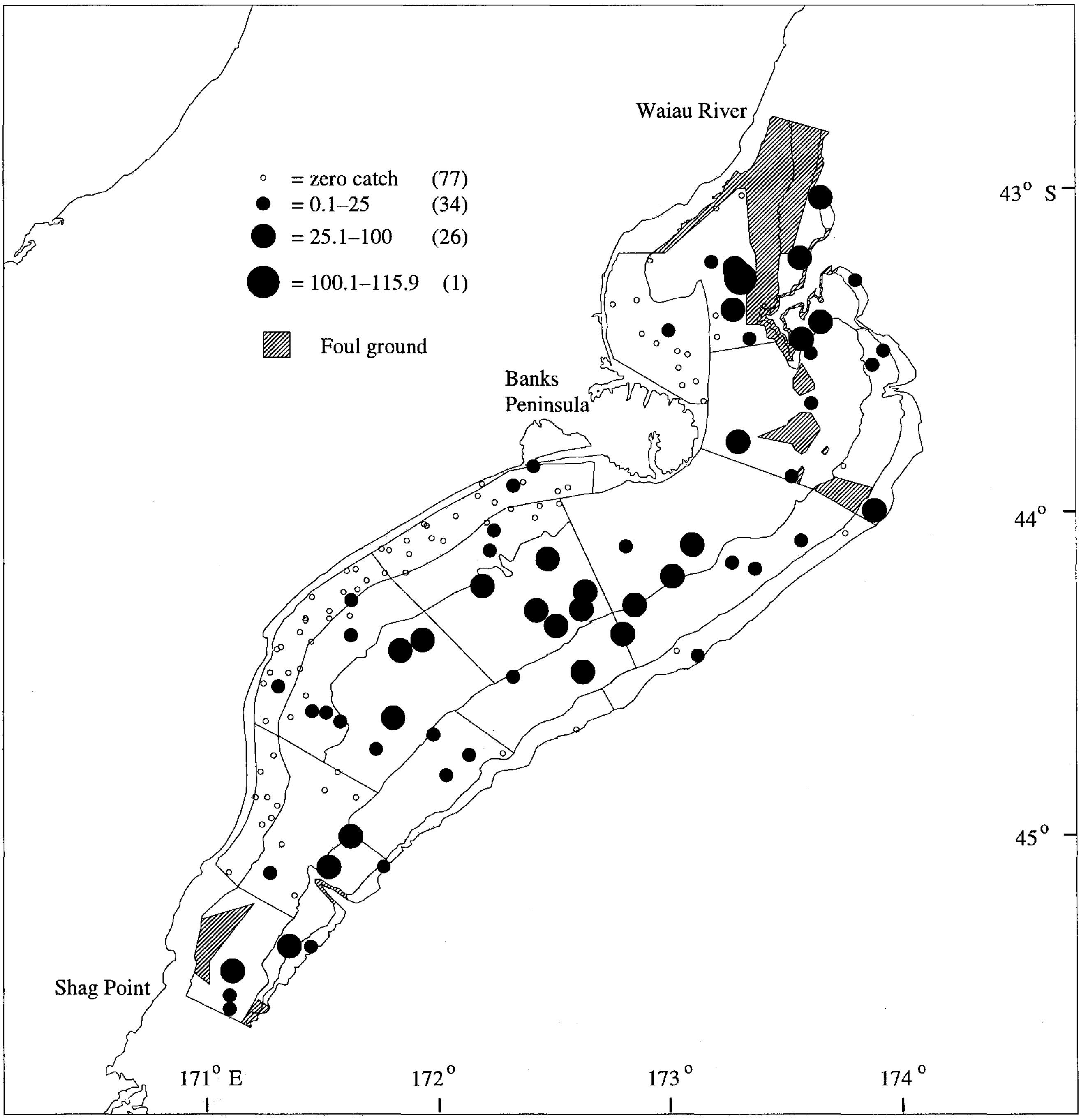

Figure 4— continued

Hake

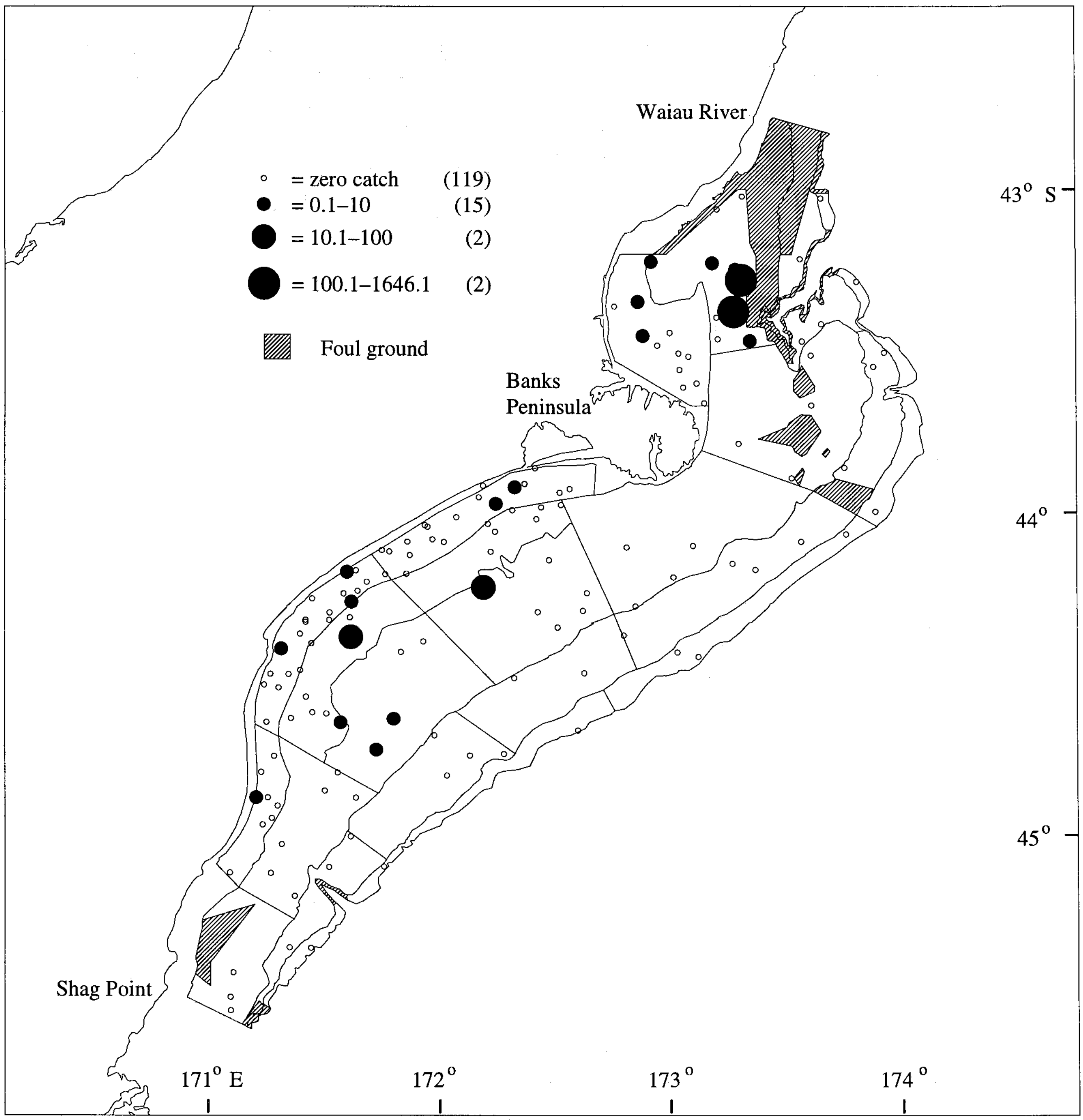

Figure 4— continued

Hoki

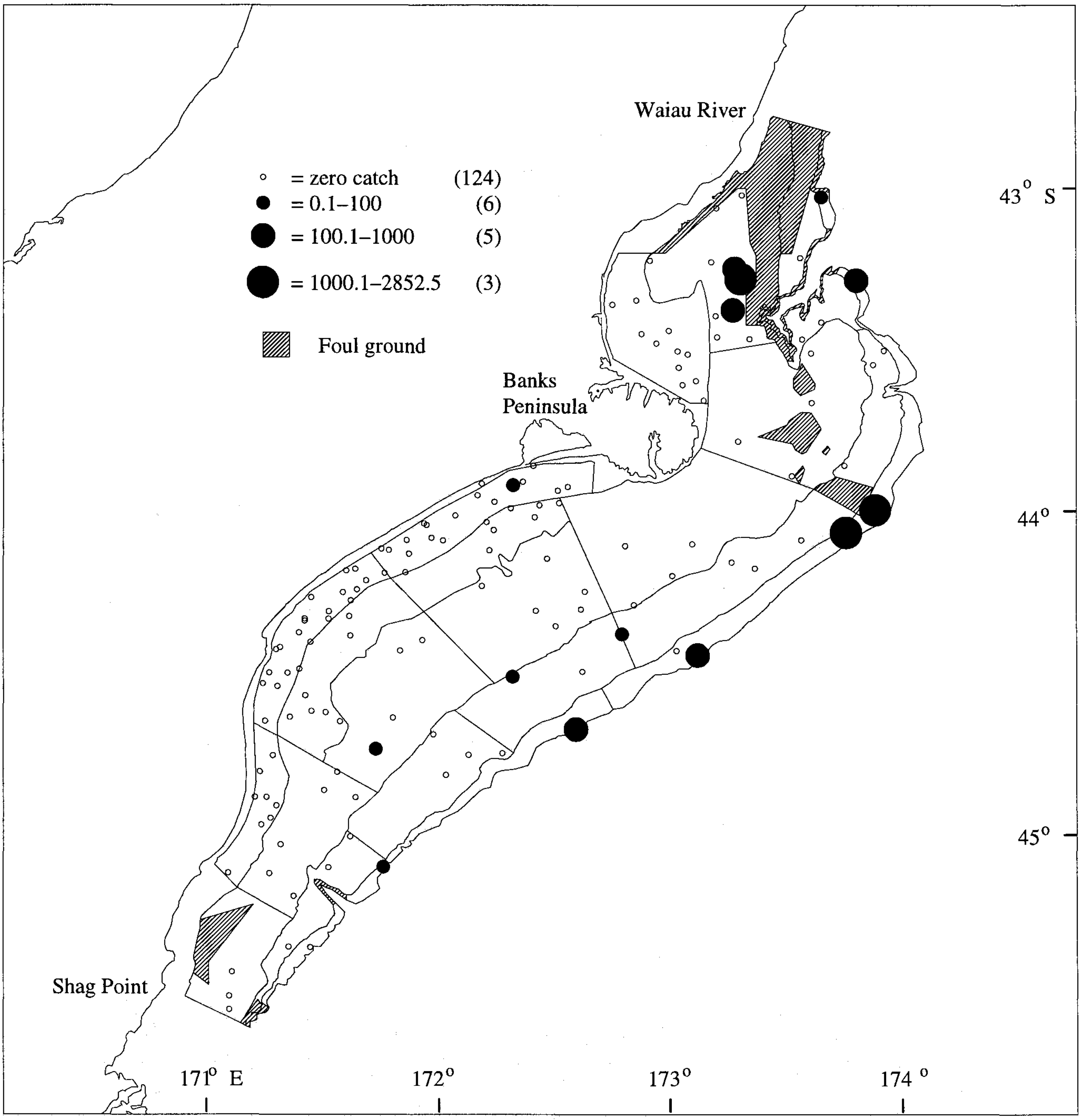

Figure 4— continued

Ling

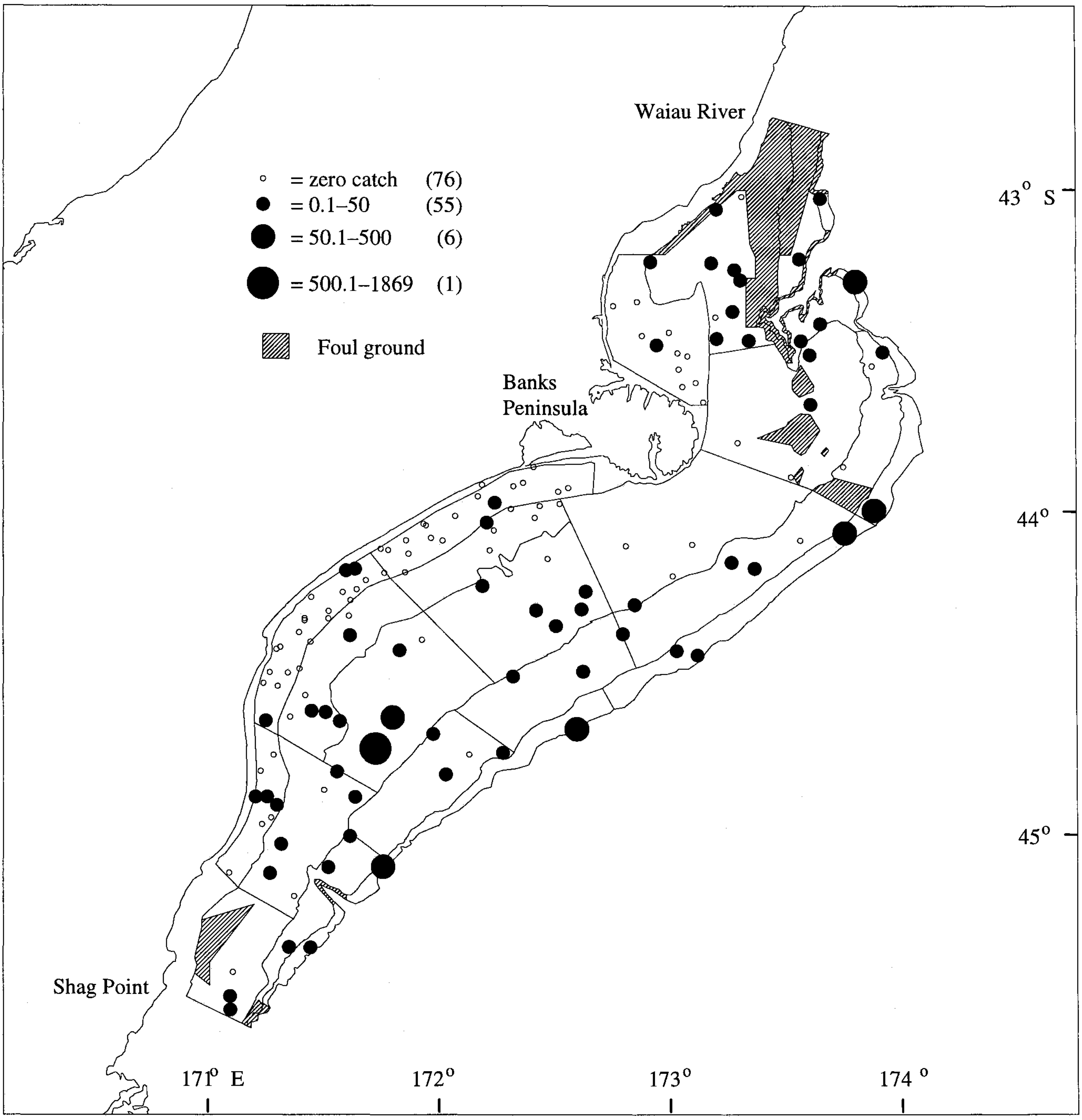

Figure 4— continued

Lemon sole

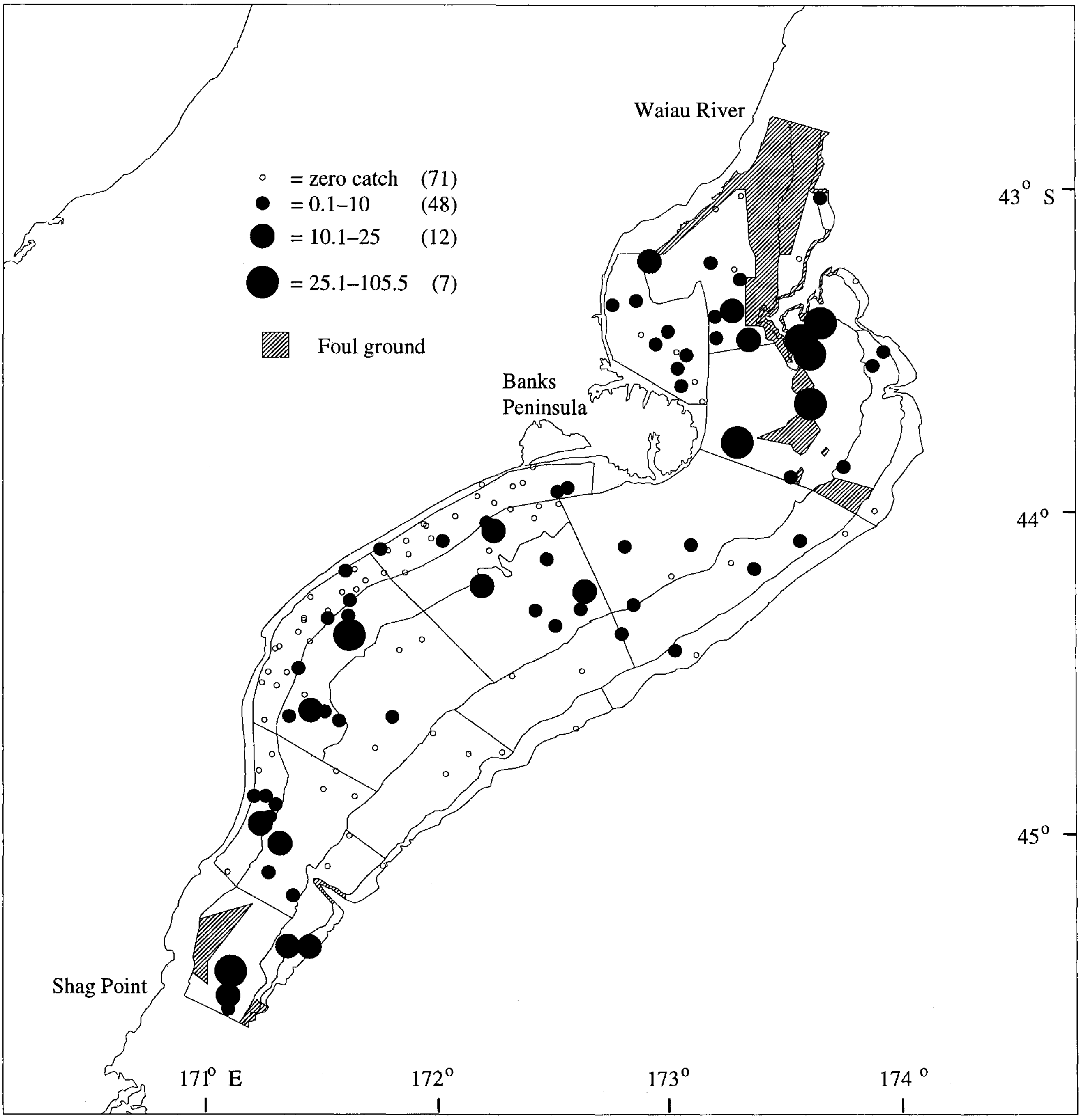

Figure 4— continued

New Zealand sole

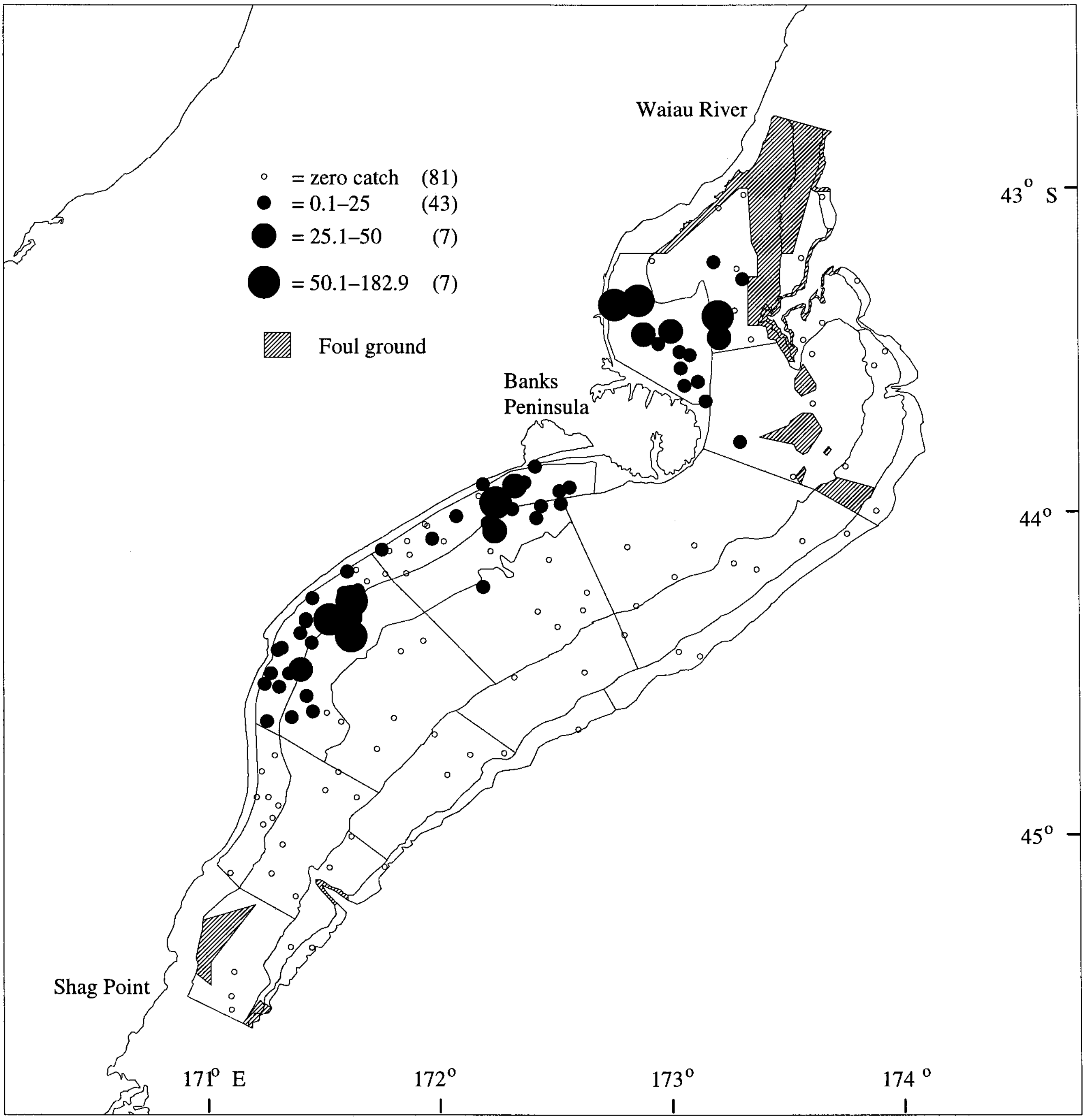

Figure 4— continued

Red cod

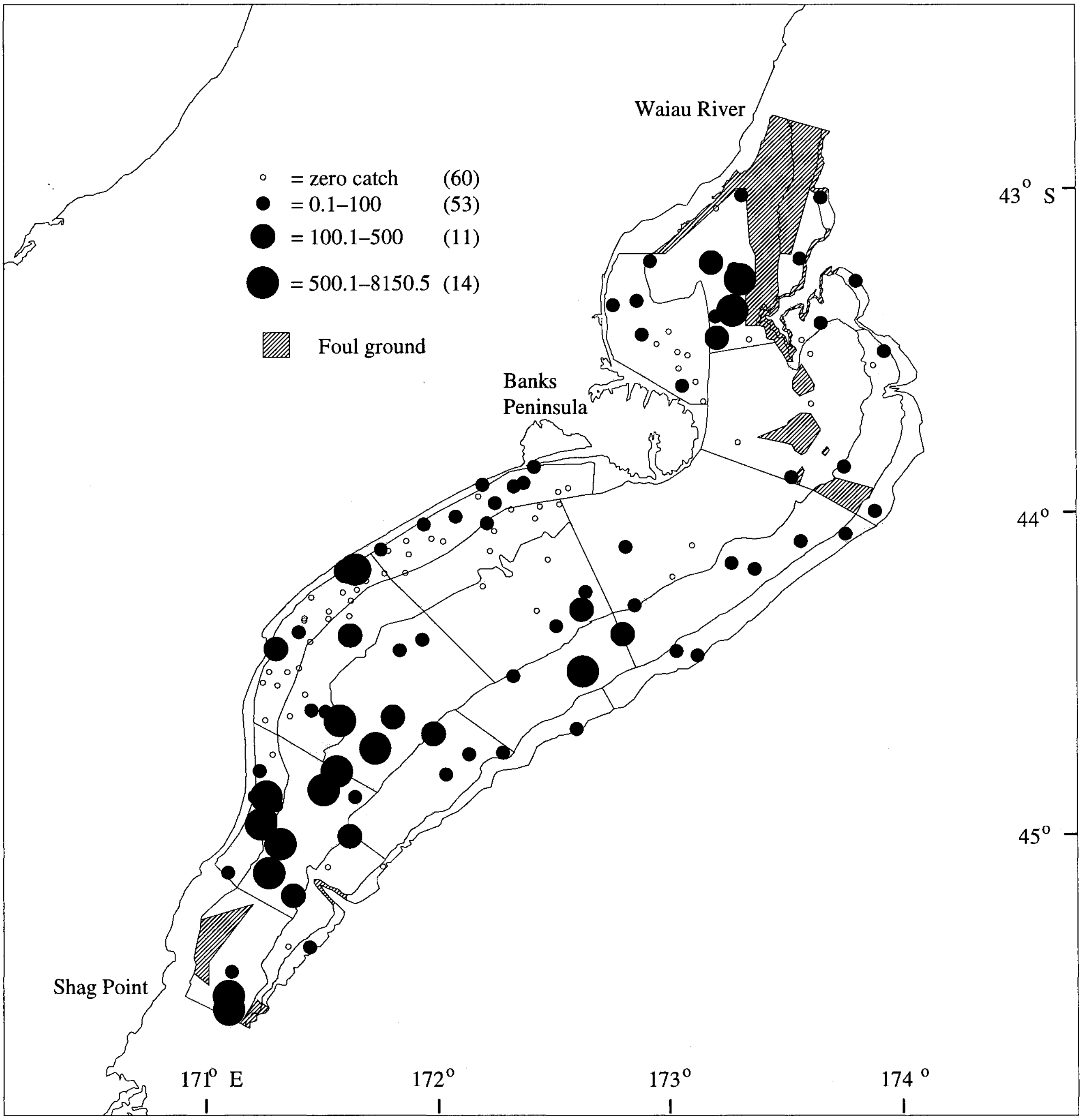

Figure 4— continued

Red gurnard

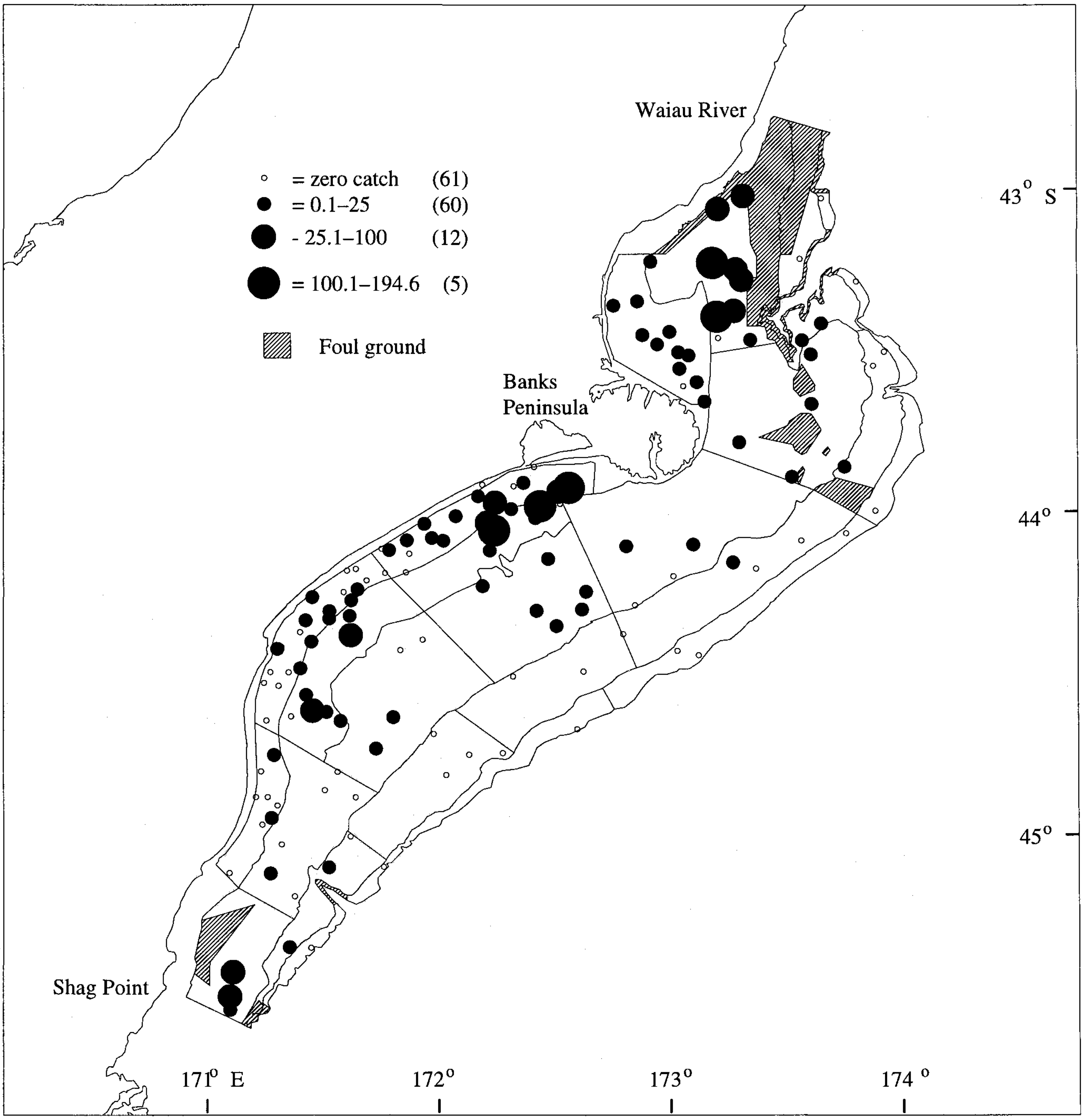

Figure 4— continued

Rig

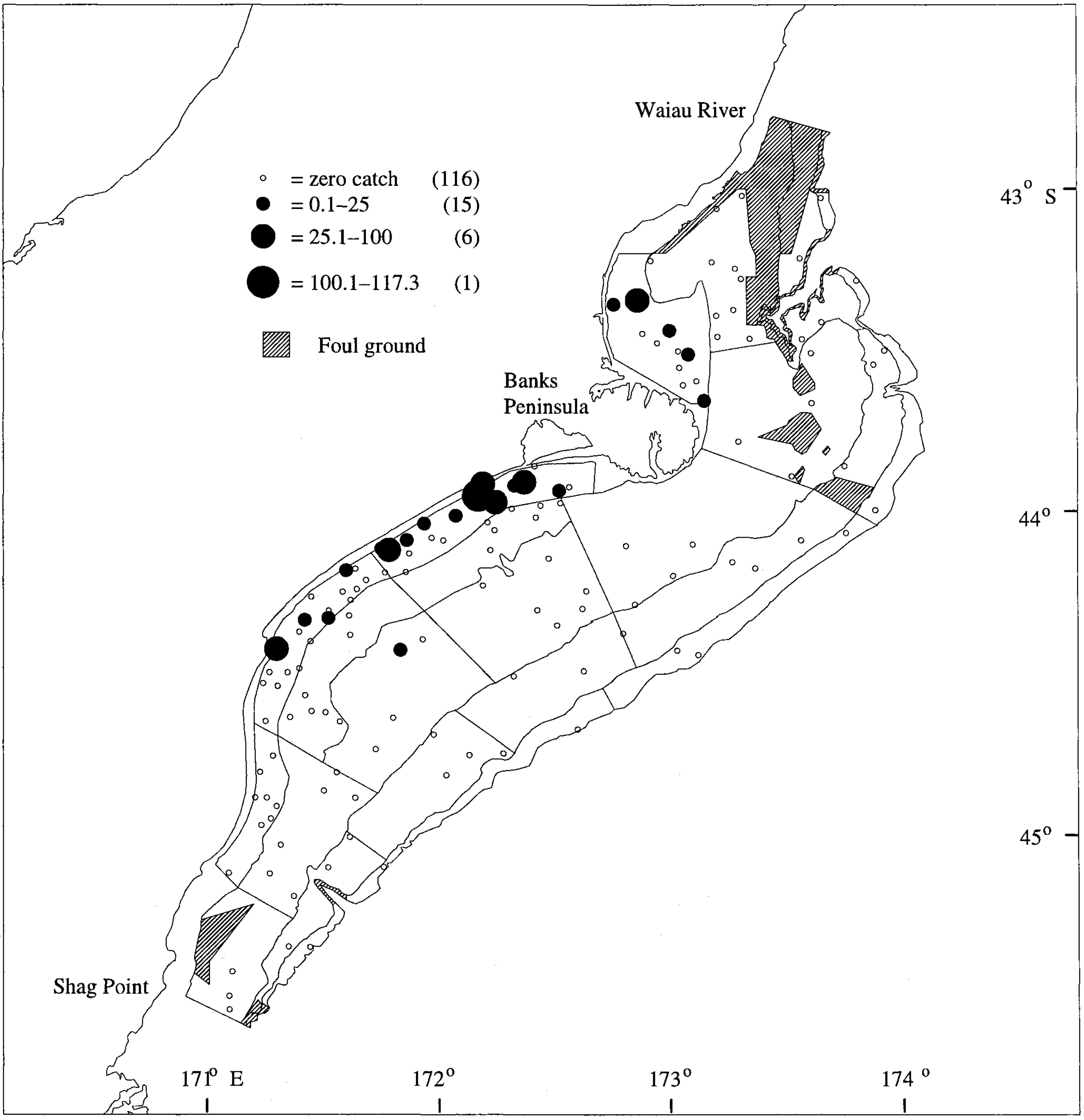

Figure 4— continued

Rough sakte

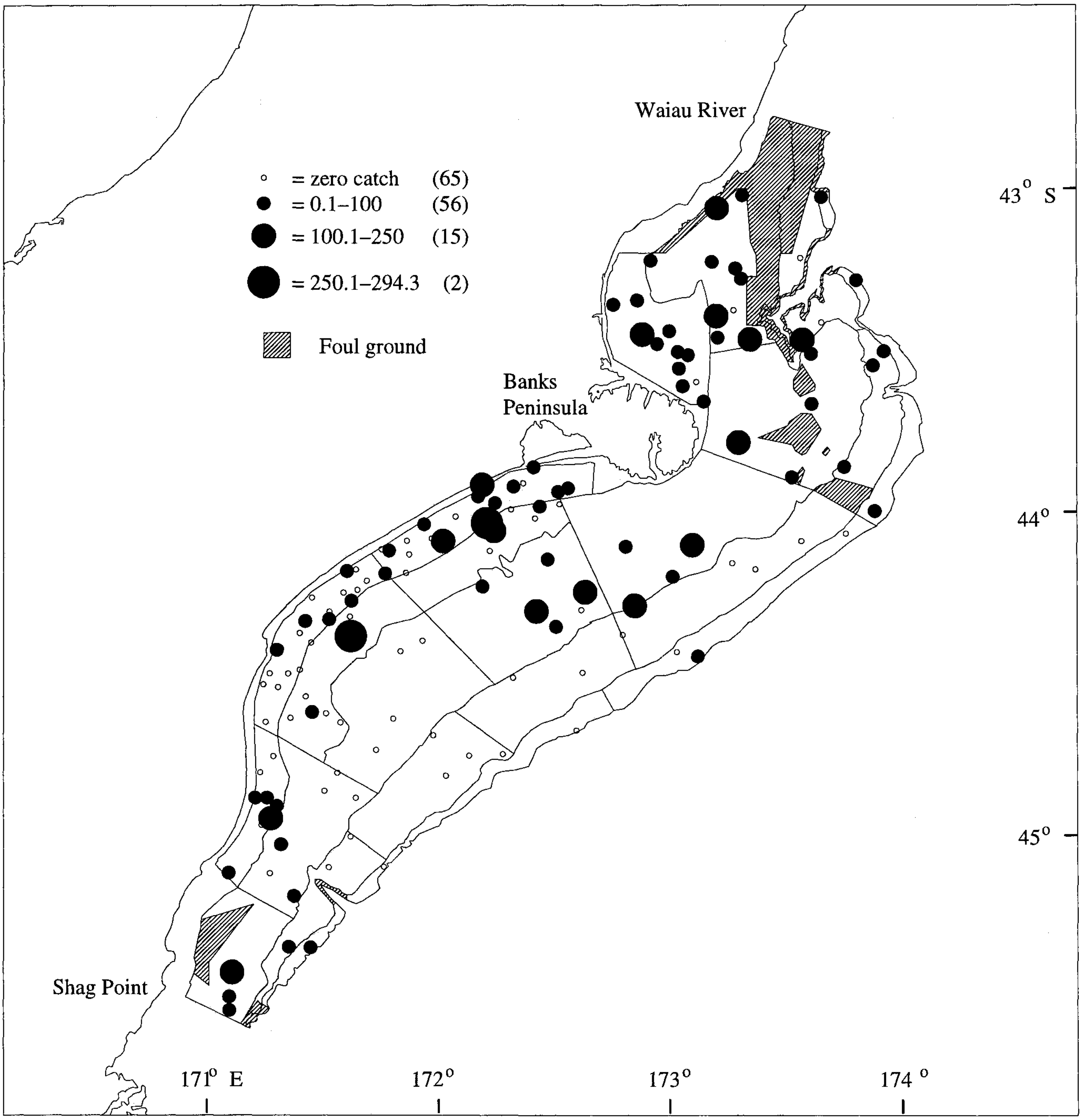

Figure 4— continued

Sand flounder

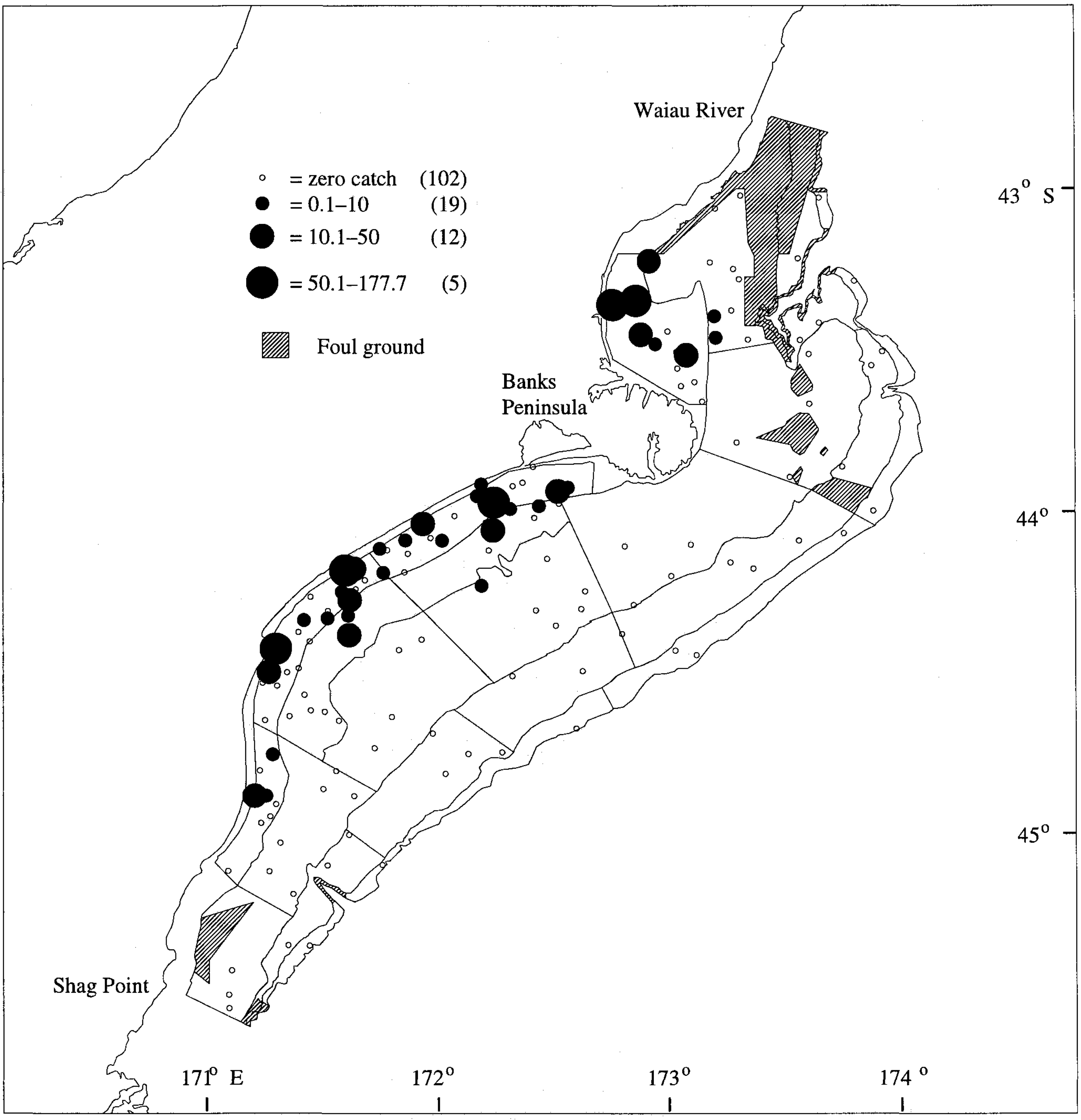

Figure 4— continued

School shark

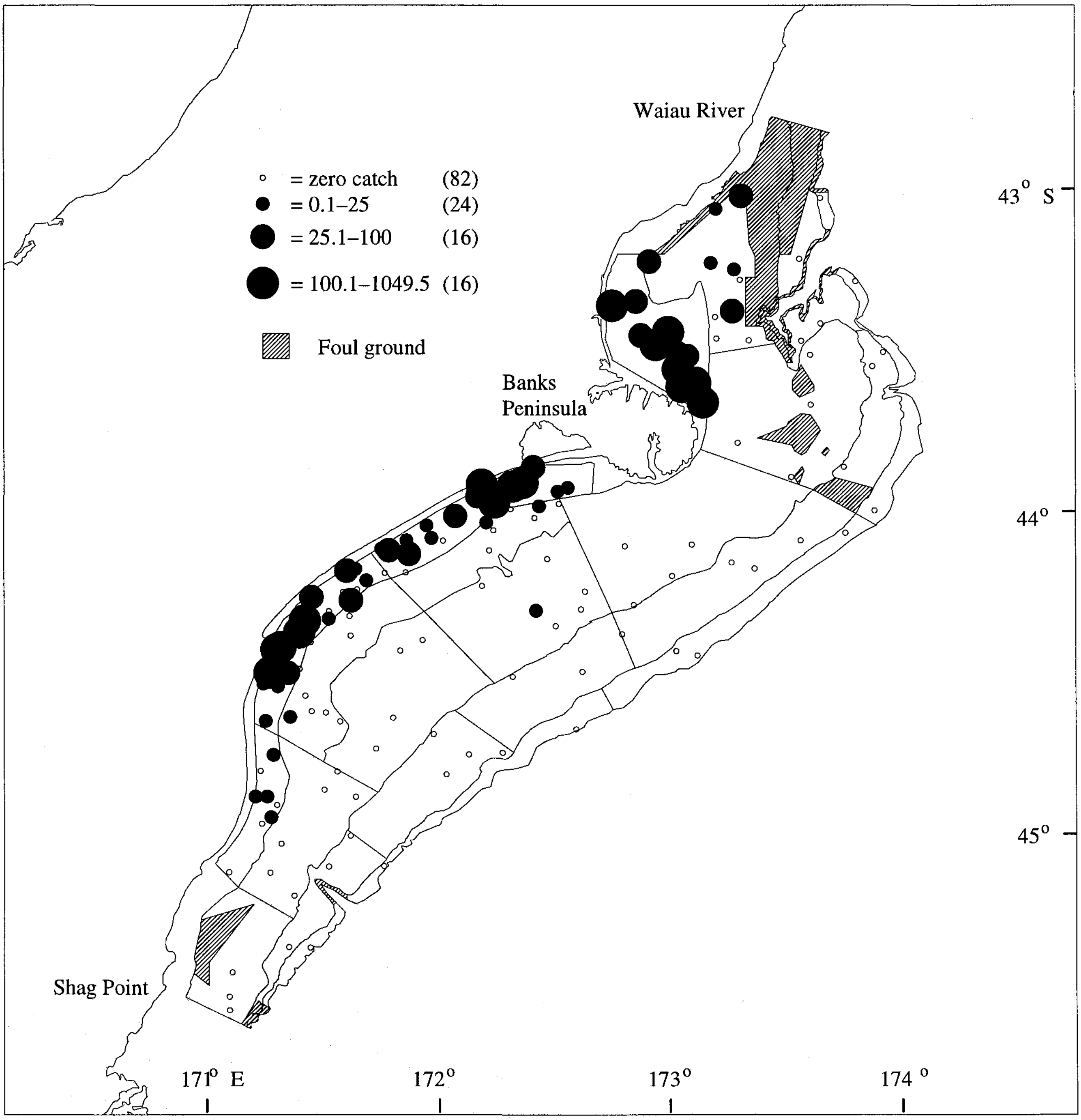

Figure 4— continued

Sea perch

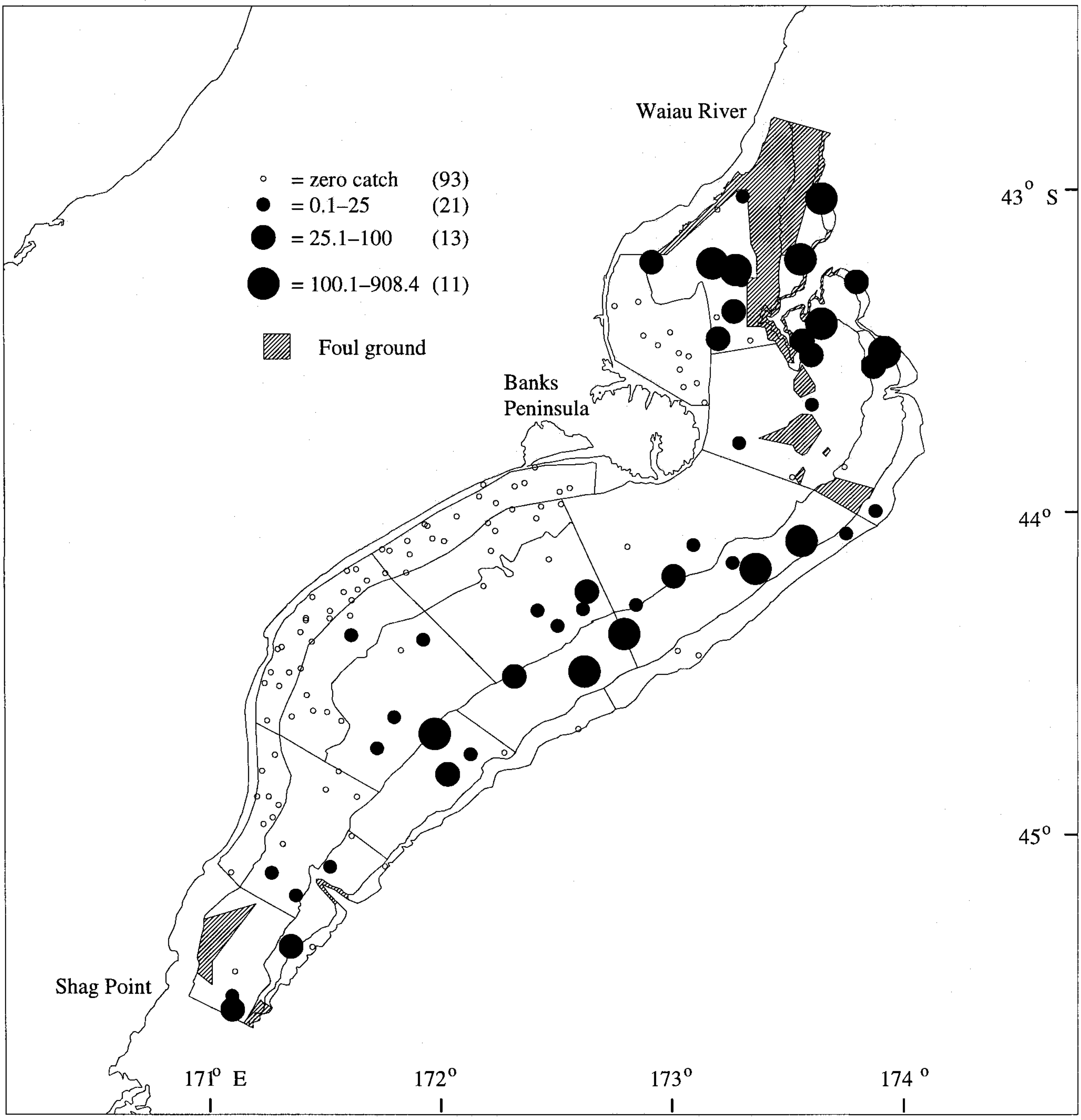

Figure 4— continued

Silver warehou

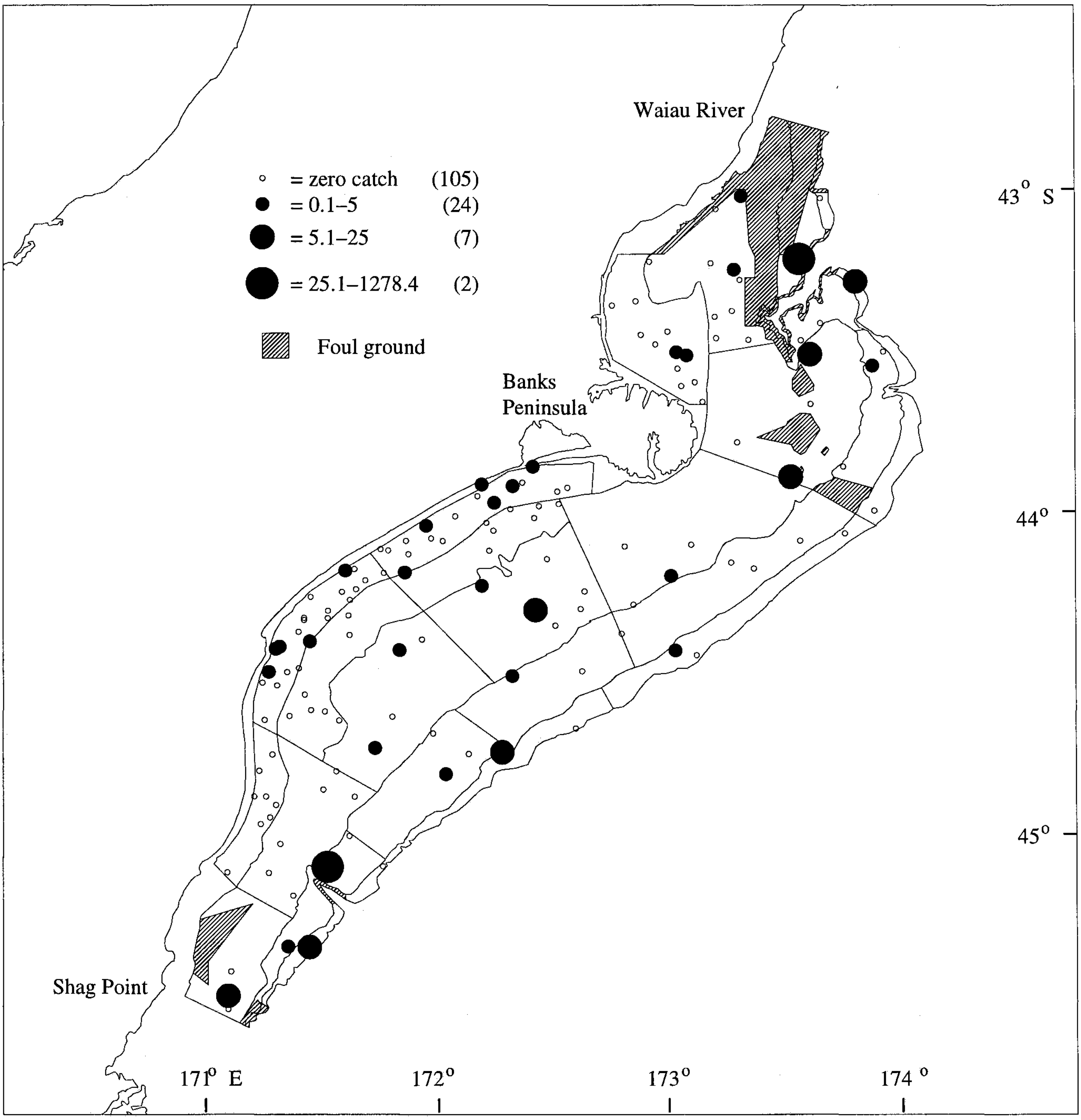

Figure 4— continued

Smooth skate

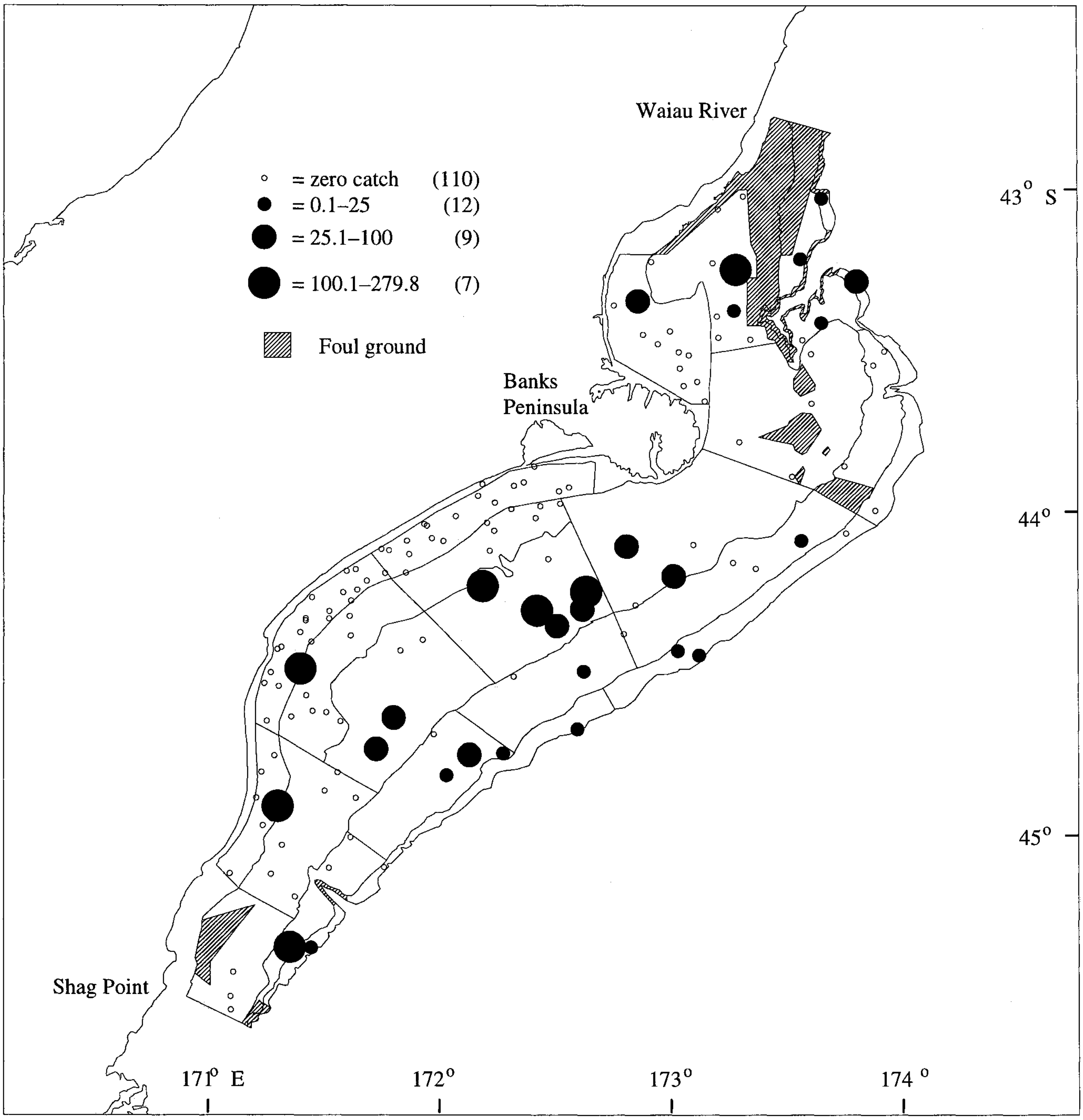

Figure 4— continued

Spiny dogfish

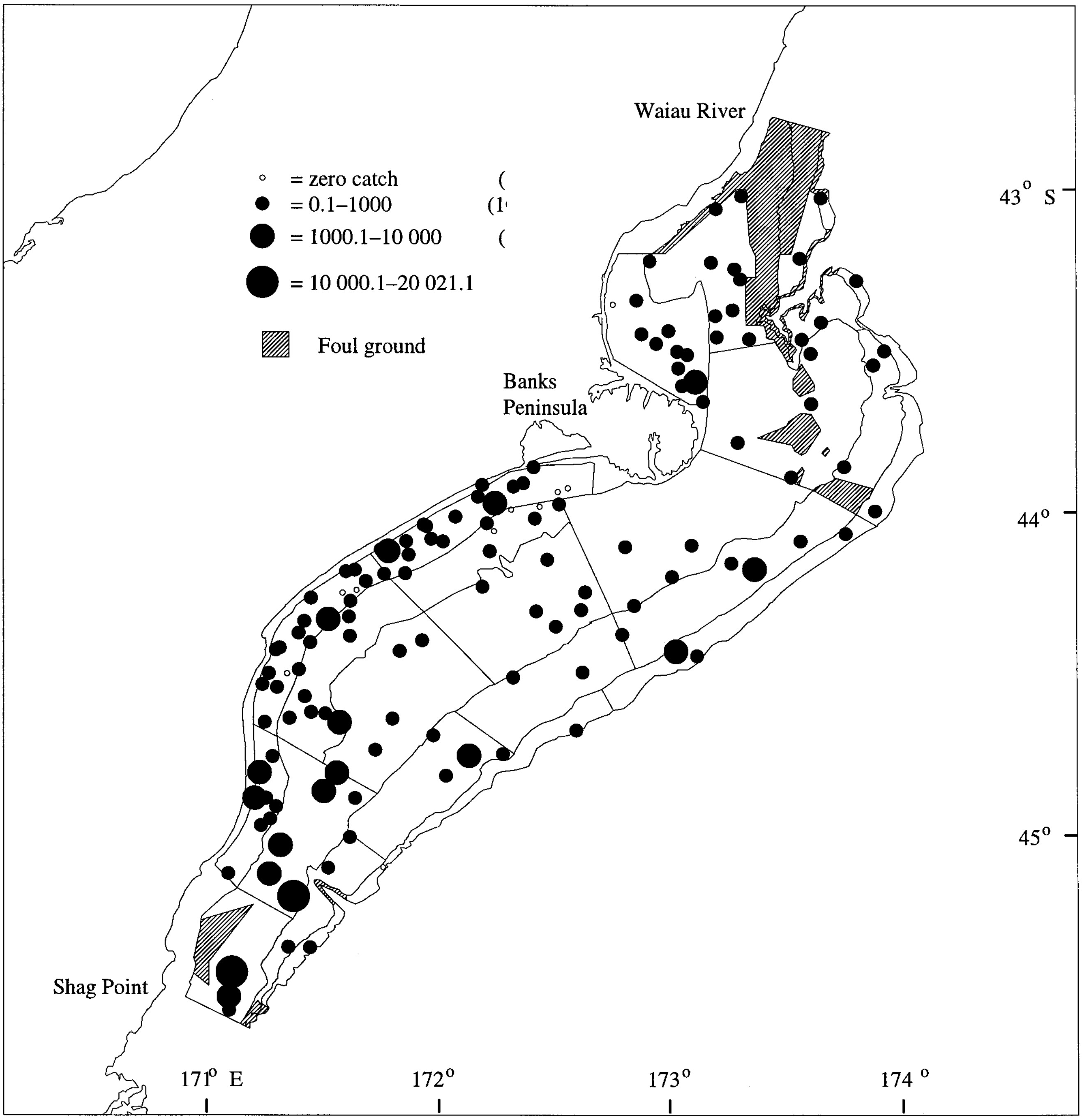

Figure 4— continued

Tarakihi

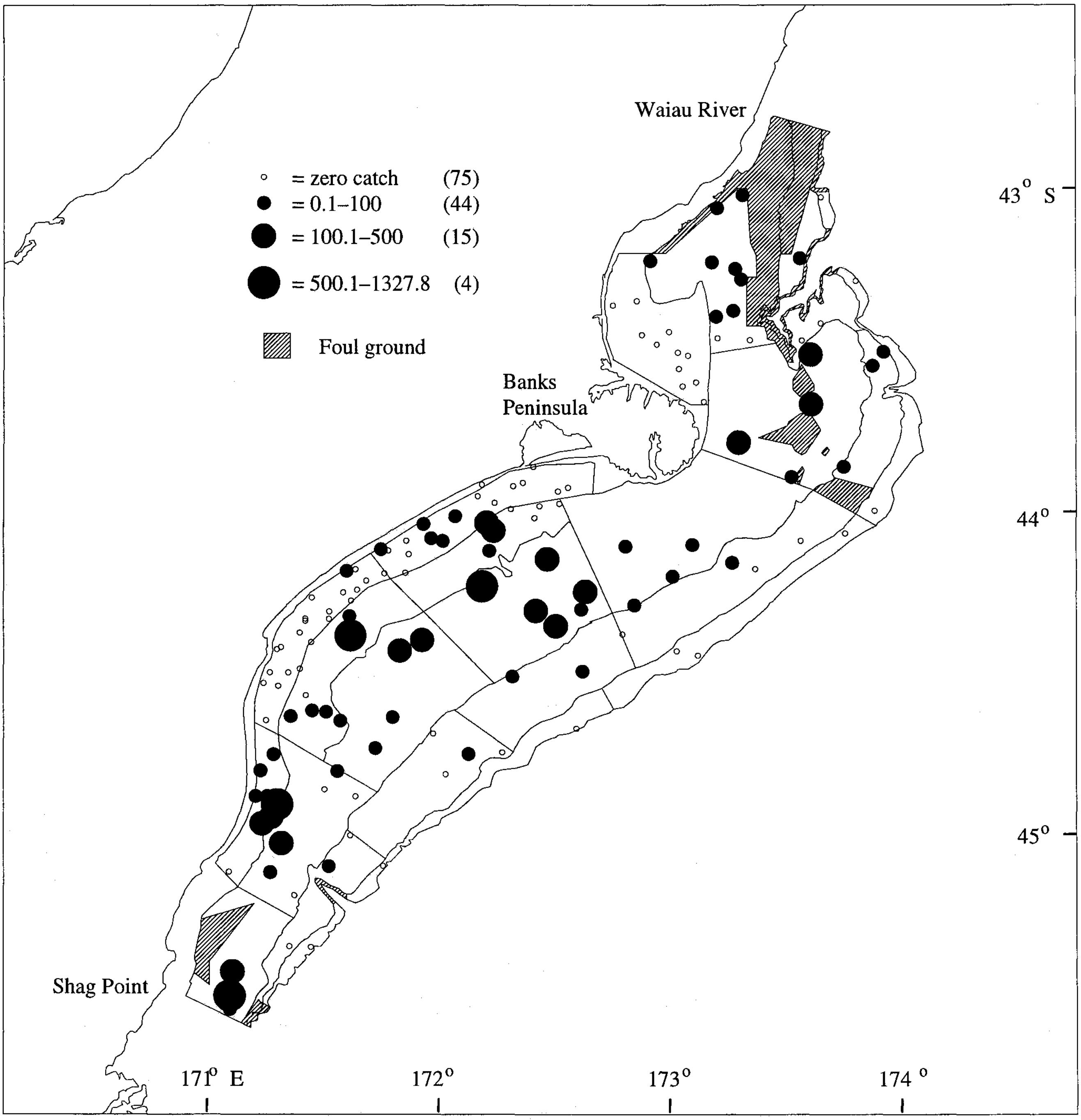

Figure 4— continued

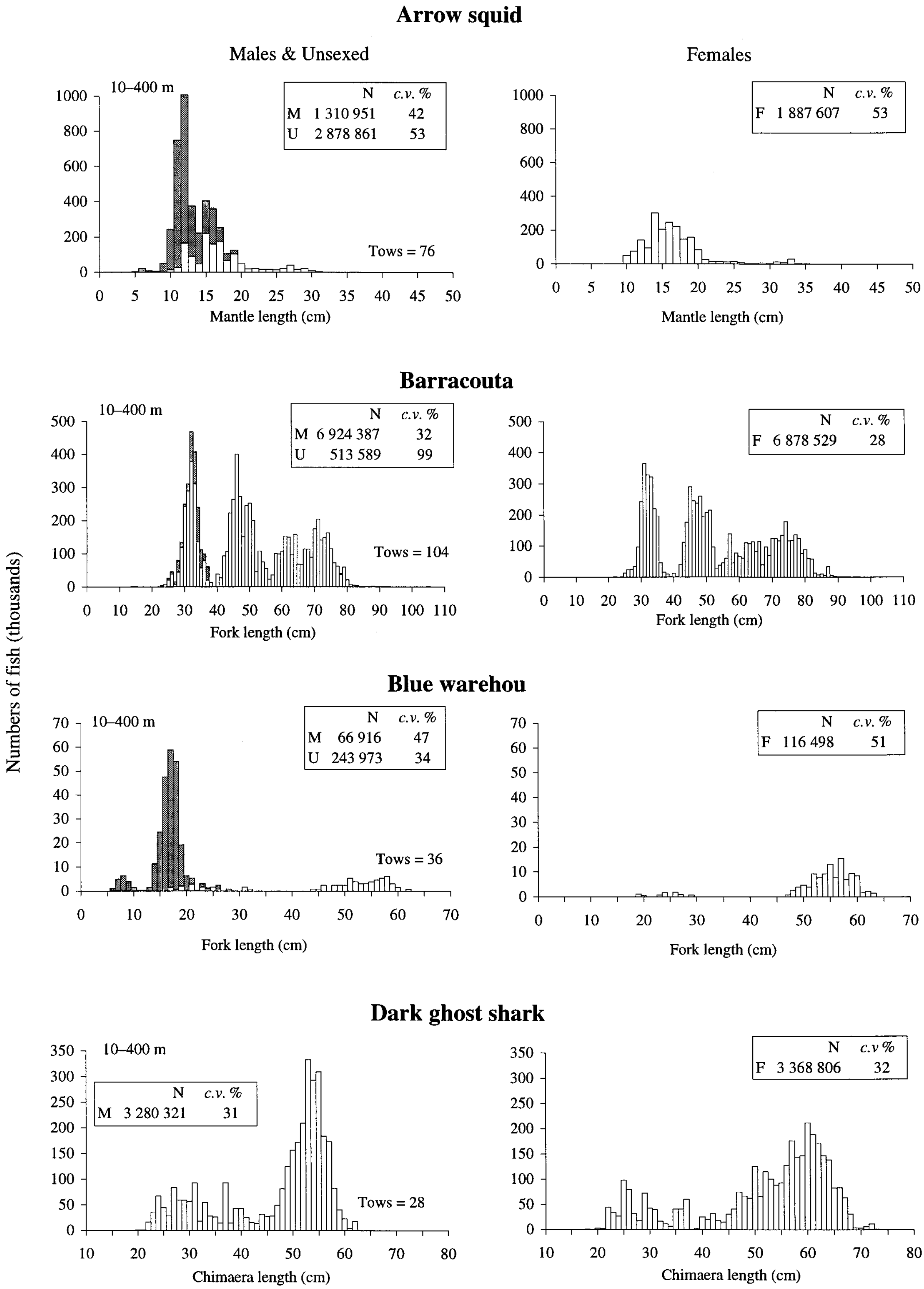

Figure 5 **: Length frequency distributions for the major commercial species, by depth where appropriate (N, estimated population (scaled); M, male; F, female; U, unsexed (shaded); Tows, number of stations at which species was caught).**

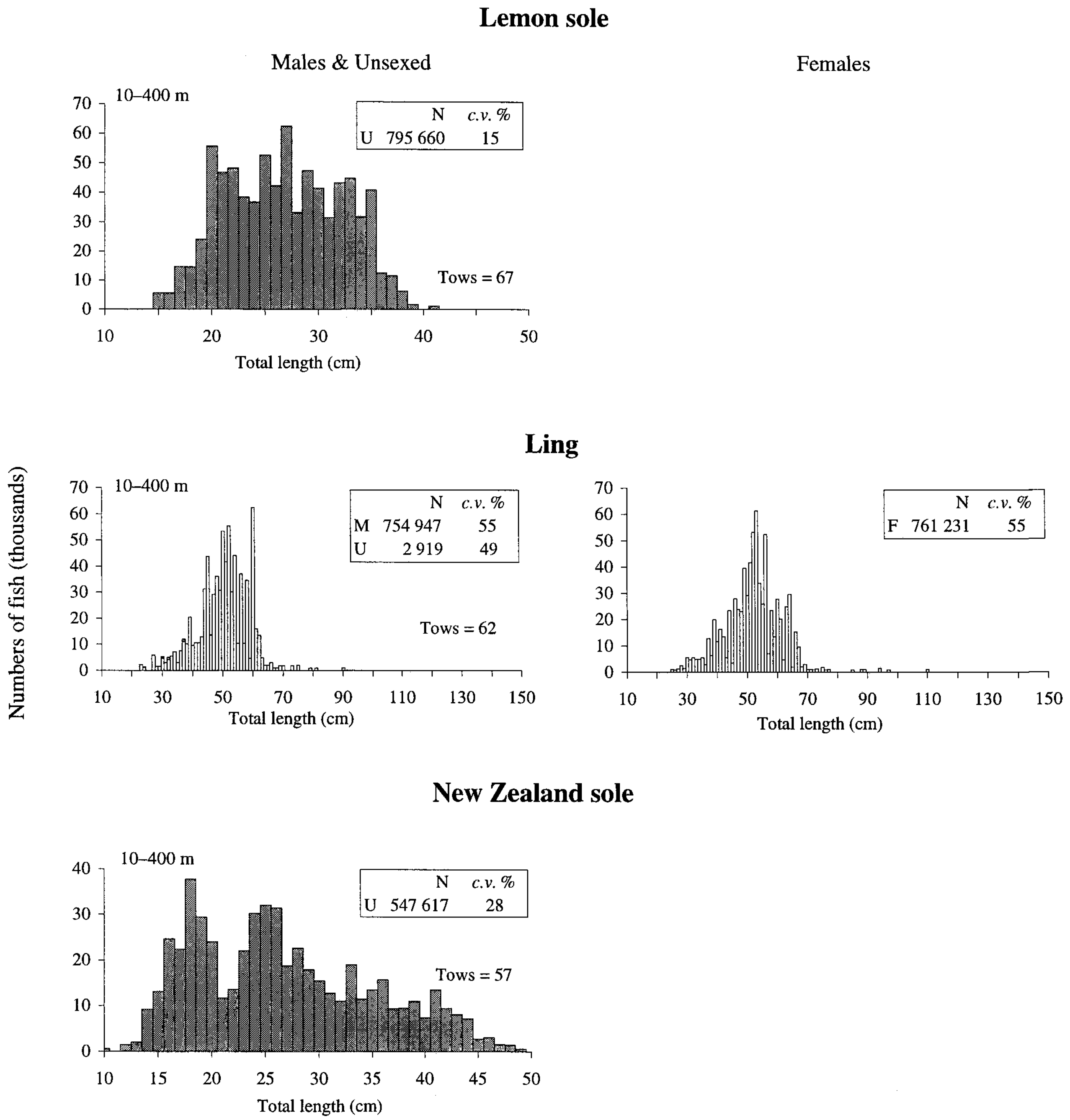

Figure 5 —continued

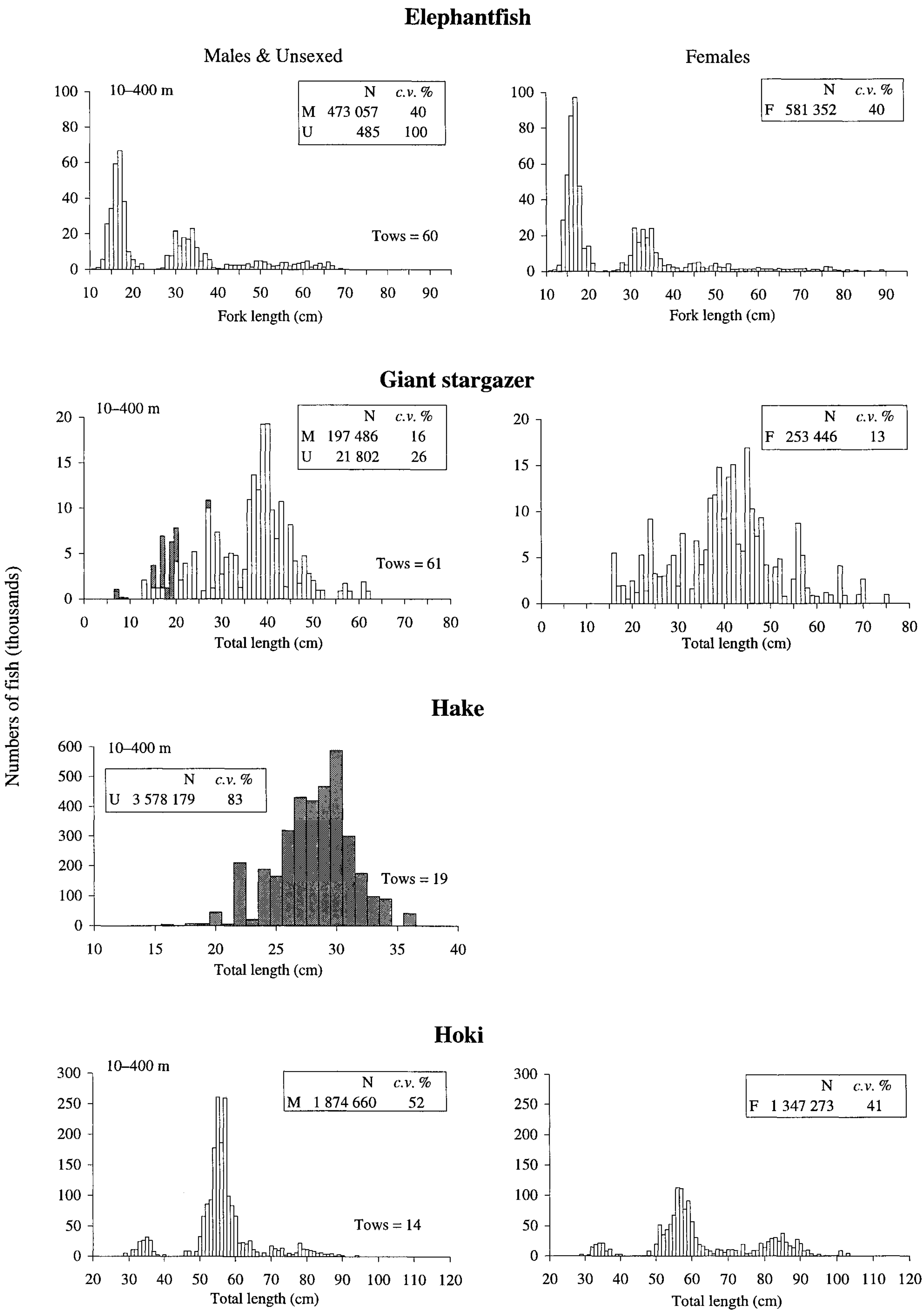

Figure 5 —continued

Red gurnard

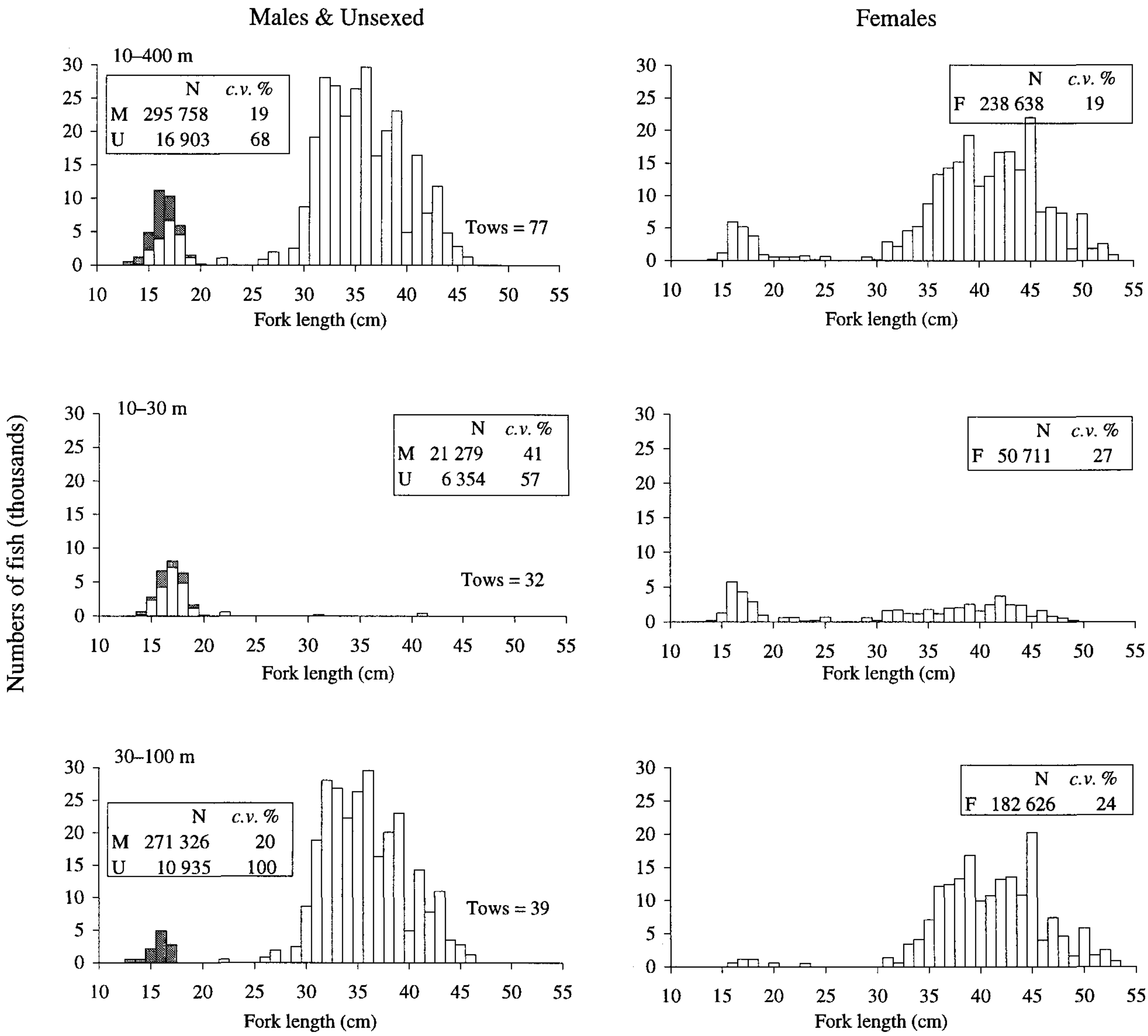

Figure 5 —continued

Red cod

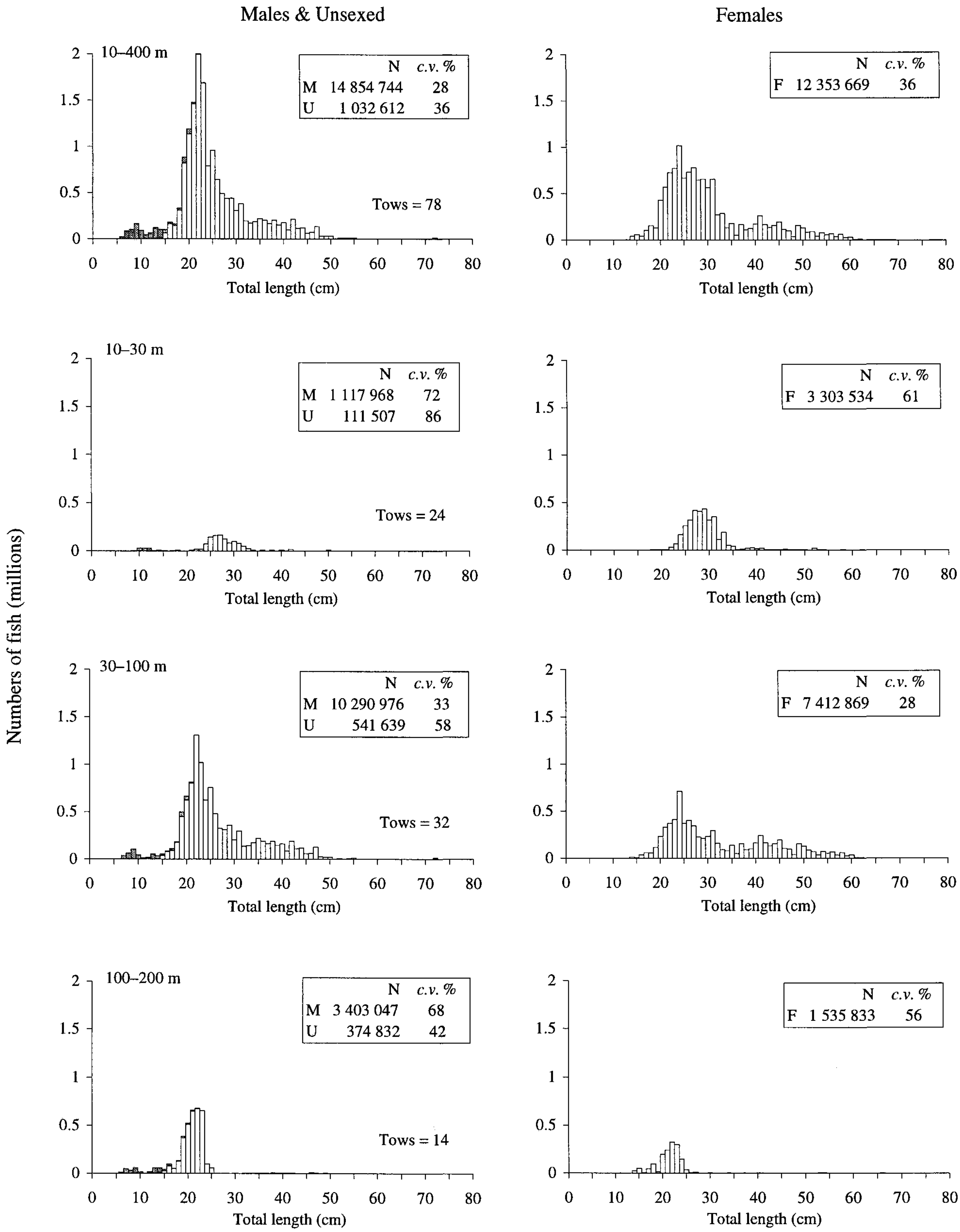

Figure 5 —continued

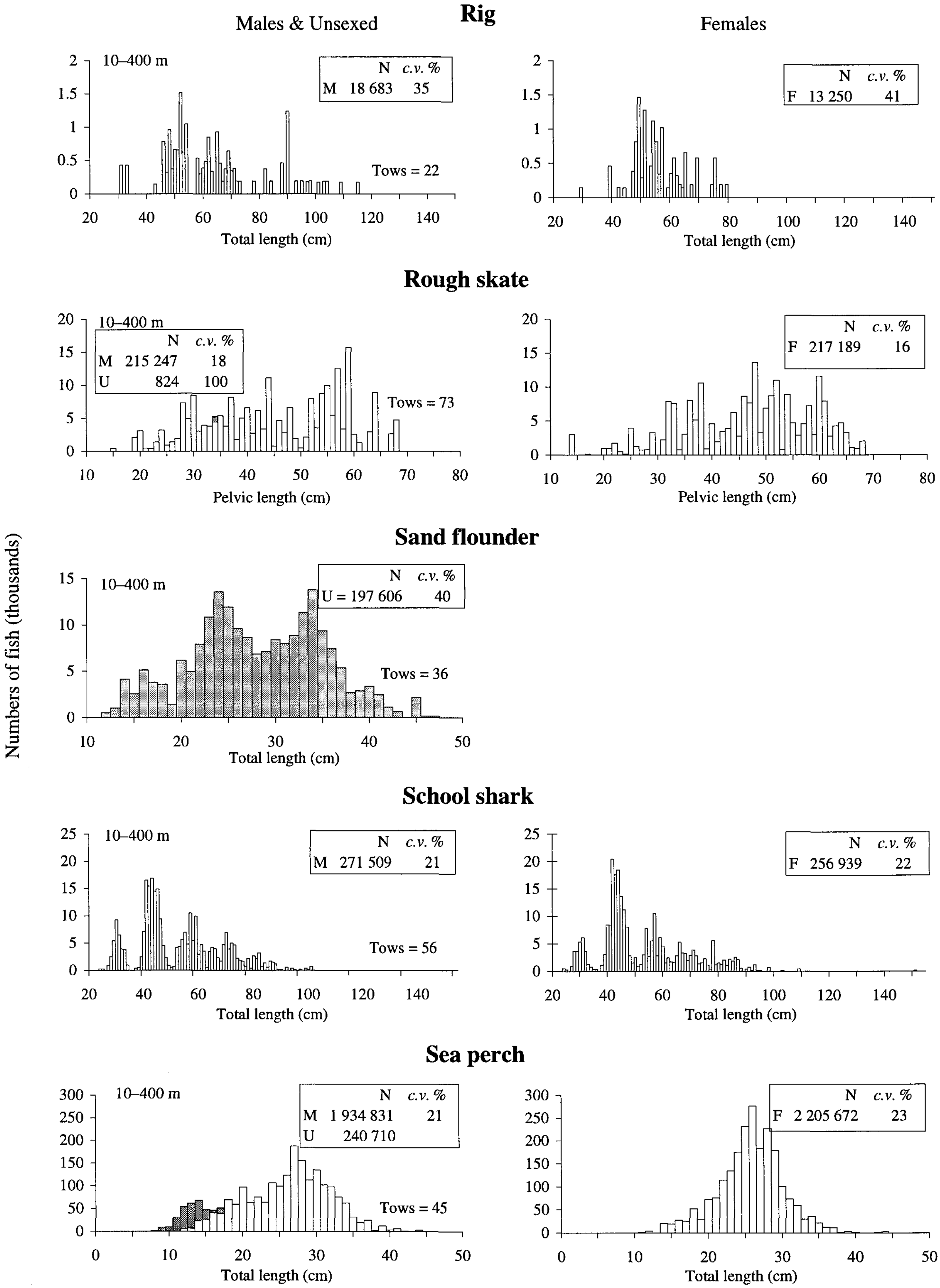

Figure 5 —continued

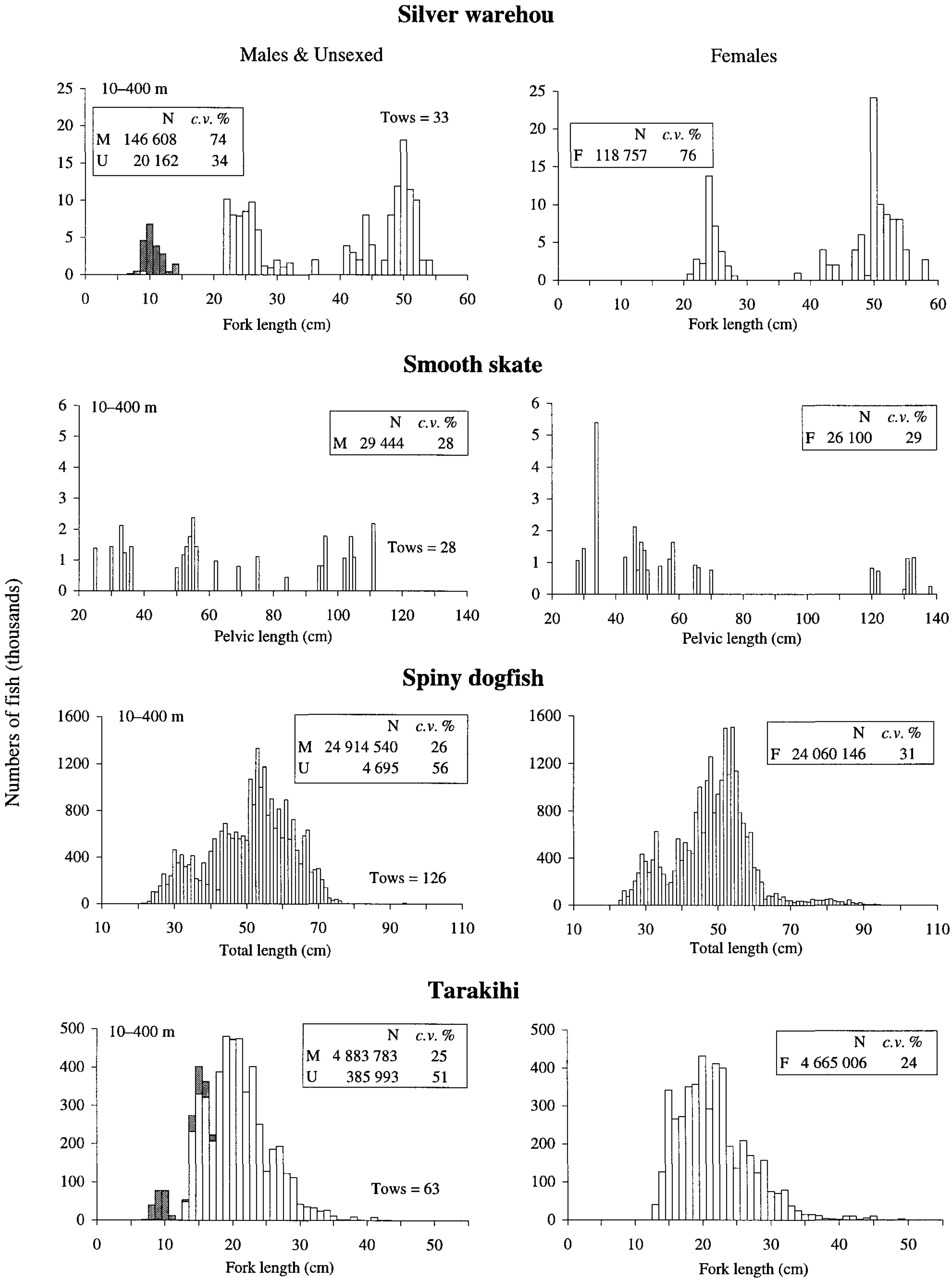

Figure 5 —continued

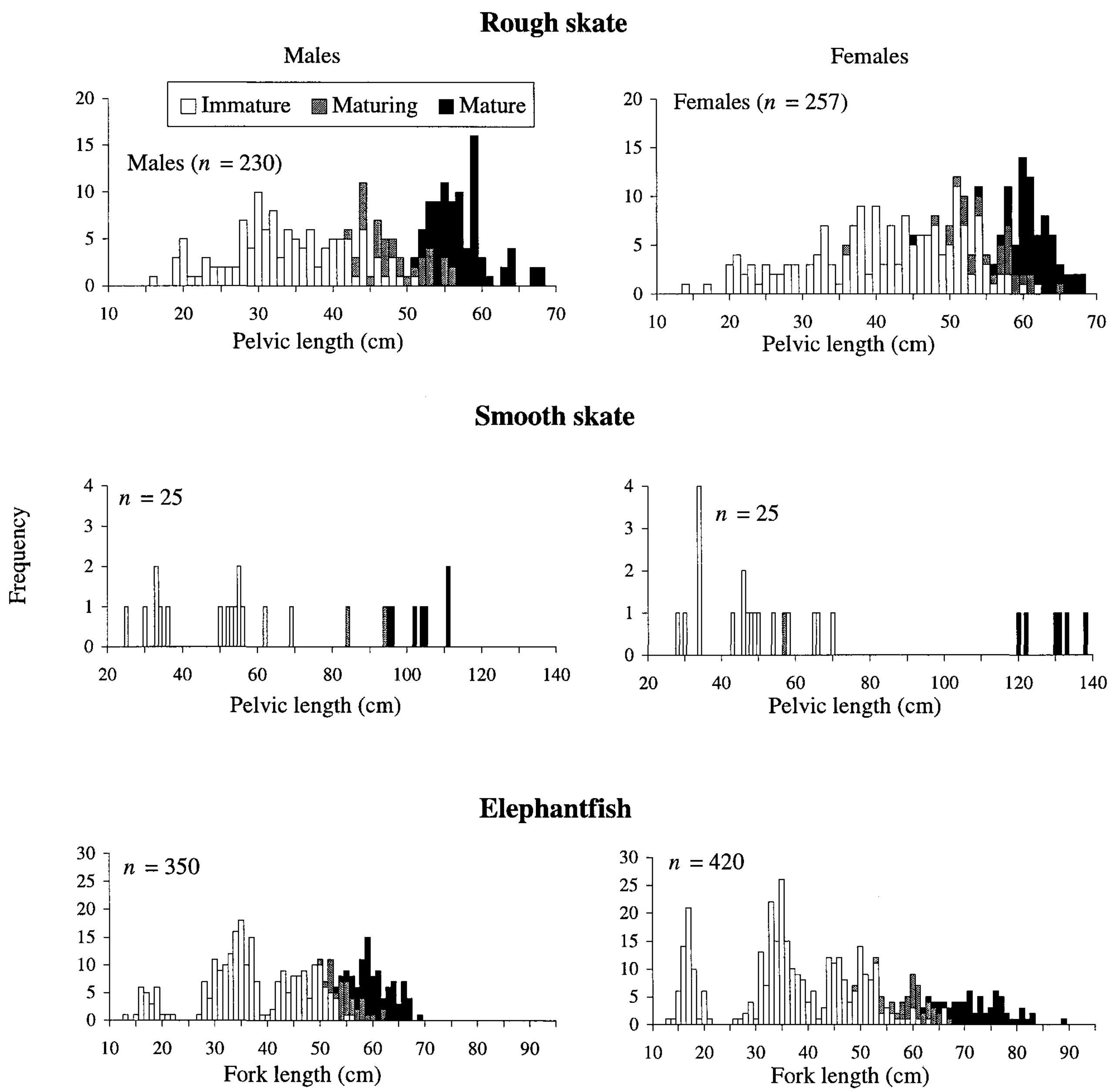

Figure 6 **: Length at maturity for rough and smooth skate and elephantfish.**

Appendix 1 : **Length-weight relationship parameters used to scale length frequencies and calculate length class biomass estimates**

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

Species	*a*	*b*	n	Range (cm) Min.	Range (cm) Max.	Data source
Barracouta	0.0055	2.9812	429	22.8	87.2	This survey
Blue cod	0.0052	3.3000	329	18.4	61.5	DB, TAN9502
Blue warehou	0.0144	3.1050	338	27.4	69.6	DB, TAN9604
Dark ghost shark	0.0015	3.3611	332	21.2	67.9	This survey
Elephantfish	0.0056	3.1284	774	13.7	87.6	This survey
Giant stargazer	0.0288	2.8561	353	7.6	75	This survey
Hake	0.0014	3.3770	333	33	123	DB, TAN9601
Hoki	0.0036	2.9490	1 511	34	102	DB, TAN9601
Lemon sole	0.0027	3.4669	107	15	42	DB, KAH9608
Ling	0.0011	3.3411	482	32	162	DB, TAN9501
New Zealand sole	0.0059	3.1310	60	8	50	DB, James (1969)
Red cod	0.0126	2.9236	987	7.5	71.9	This survey
Red gurnard	0.0054	3.1897	656	14.2	52.6	This survey
Rig	0.0031	3.0593	123	29.1	115.7	This survey
Rough skate	0.0277	2.9325	509	14.1	68	This survey
Sand flounder	0.0125	3.02	–	–	–	DB, IKA8003
School shark	0.0070	2.9100	804	30	166	DB, Seabrook-Davidson (Unpub.)
Sea perch	0.0262	2.9210	210	7	42	DB, KAH9618
Silver warehou	0.0048	3.3800	262	16.6	57.8	DB, TAN9502
Smooth skate	0.0220	2.9750	50	25	138	This survey
Spiny dogfish	0.0007	3.4500	1 052	43.4	104.4	DB, TAN9502
Tarakihi	0.0159	3.0484	1 396	11	50	DB, KAH9504

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

	a	*b*	*c*	n	Range (cm)	Source
Arrow squid	0.2777	1.41	0.2605	2 792	3–45	DB, *James Cook*, east coast South Island 1982–83

DB, NIWA (previously MAF Fisheries) trawl database
n, Sample size
– Data not available

Appendix 2 : **Summary of station data**

				Start of tow		End of tow		Gear depth (m)		Doorspread	Distance trawled	Headline height	Bottom temp
Station	Stratum	Date	Time	° ' S	° ' E	° ' S	° ' E	Min.	Max.	(m)	(n. miles)	(m)	(°C)
1	17	3-Dec-97	0547	43 01.65	173 39.24	43 03.60	173 39.84	219	223	72.2	2	4.6	9.8
2	18	3-Dec-97	1121	43 20.80	172 51.56	43 22.34	172 53.30	25	27	69	2	5	13.4
3	18	4-Dec-97	0500	43 27.09	172 52.85	43 25.48	172 51.23	24	26	70.8	2	5.2	13.6
4	18	4-Dec-97	0625	43 21.60	172 45.44	43 19.61	172 45.35	19	19	69.5	2	5.2	13.3
5	7	4-Dec-97	0808	43 13.42	172 55.06	43 13.58	172 57.78	34	39	71.3	2	5.1	12.0
6	7	4-Dec-97	0958	43 13.68	173 11.00	43 14.85	173 13.22	39	42	66.6	2	5.2	12.6
7	7	4-Dec-97	1120	43 16.85	173 18.55	43 18.87	173 18.51	62	66	69.1	2.01	4.8	12.0
8	7	4-Dec-97	1321	43 23.70	173 12.12	43 25.69	173 11.78	35	35	70.5	2	5.2	11.7
9	7	4-Dec-97	1437	43 27.69	173 12.47	43 29.48	173 13.69	37	43	72.1	2	5.2	12.4
10	13	5-Dec-97	0512	43 12.95	173 33.82	43 14.94	173 33.78	125	129	79.6	2	5	10.5
11	13	5-Dec-97	0719	43 24.92	173 39.19	43 26.41	173 37.37	104	109	73.4	2	4.9	10.5
12	13	5-Dec-97	0843	43 28.11	173 34.29	43 30.00	173 33.40	113	114	72.1	2	5	10.5
13	6	5-Dec-97	0956	43 30.70	173 36.57	43 32.68	173 36.88	88	90	65.7	2	4.9	10.9
14	6	5-Dec-97	1140	43 39.95	173 36.70	43 41.92	173 36.24	88	89	76	2	5	11.0
15	5	5-Dec-97	1334	43 53.54	173 31.63	43 55.47	173 30.93	91	91	78	2	5	11.0
16	6	5-Dec-97	1545	43 47.08	173 17.87	43 45.68	173 15.92	72	81	72.5	2	4.9	11.6
17	17	6-Dec-97	0515	43 17.12	173 48.26	43 18.92	173 49.44	335	351	85.1	2	4.9	9.0
18	12	6-Dec-97	0814	43 30.25	173 55.36	43 31.50	173 57.52	141	151	63	2	4.5	9.7
19	12	6-Dec-97	0944	43 32.83	173 52.56	43 34.82	173 52.60	106	107	63.2	2	4.4	10.8
20	12	6-Dec-97	1218	43 51.59	173 45.11	43 53.57	173 44.71	104	105	72.9	2	4.9	10.5
21	17	6-Dec-97	1440	43 59.81	173 53.01	44 01.09	173 50.88	396	399	75.6	2	4.8	8.7
22	11	7-Dec-97	0814	44 05.38	173 34.04	44 03.95	173 35.97	138	141	80.8	2	5.4	10.4
23	16	7-Dec-97	1000	44 04.00	173 45.53	44 02.73	173 47.48	382	384	89.3	2	5	8.7
24	11	6-Dec-97	1315	44 10.60	173 22.19	44 11.41	173 19.65	127	133	71.8	2	5.2	10.4
25	11	6-Dec-97	1447	44 09.46	173 16.24	44 10.65	173 14.01	105	107	71.1	2	5	10.7
26	16	8-Dec-97	0523	44 26.71	173 07.29	44 27.42	173 04.69	357	359	72.9	2	5.3	8.1
27	16	8-Dec-97	0653	44 25.89	173 01.86	44 26.83	172 59.40	235	246	68.4	2	5.1	9.9
28	10	8-Dec-97	0850	44 22.74	172 47.80	44 21.84	172 45.31	113	120	71.3	2	4.8	10.4
29	5	8-Dec-97	1026	44 17.33	172 50.89	44 15.89	172 52.82	87	89	74.9	2	5.1	10.9
30	5	8-Dec-97	1158	44 11.97	173 00.81	44 10.44	173 02.59	89	90	75.1	2	5	11.0
31	5	8-Dec-97	1327	44 06.12	173 05.94	44 06.30	173 03.17	80	81	74.6	2	5.1	11.2

Appendix 2 —continued

Station	Stratum	Date	Time	Start of tow ° ' S	Start of tow ° ' E	End of tow ° ' S	End of tow ° ' E	Gear depth (m) Min.	Gear depth (m) Max.	Doorspread (m)	Distance trawled (n. miles)	Headline height (m)	Bottom temp (°C)
32	5	8-Dec-97	1520	44 06.45	172 48.64	44 06.35	172 45.87	71	72	74.8	2	5.3	11.5
33	10	9-Dec-97	0538	44 29.69	172 37.49	44 27.98	172 36.01	119	129	75.9	2.02	5	10.4
34	4	9-Dec-97	0718	44 21.21	172 30.56	44 19.40	172 29.40	76	83	70.8	2	5.1	11.1
35	4	9-Dec-97	0834	44 18.36	172 25.43	44 18.22	172 28.21	74	76	73.7	2	5.1	11.2
36	4	9-Dec-97	1006	44 18.14	172 37.15	44 17.95	172 39.93	85	88	77.3	2	5.1	11.2
37	4	9-Dec-97	1121	44 14.84	172 38.14	44 13.61	172 35.95	73	80	73.3	2	5	10.8
38	4	9-Dec-97	1301	44 08.78	172 28.39	44 09.68	172 25.93	57	57	71.1	2	5	11.5
39	4	9-Dec-97	1453	44 13.82	172 11.36	44 14.57	172 08.79	54	56	71.6	2	5.1	12.1
40	10	10-Dec-97	0451	44 30.66	172 19.30	44 31.99	172 21.39	104	110	72.8	2	5	10.9
41	14	10-Dec-97	0714	44 40.41	172 35.80	44 41.25	172 33.26	388	393	80.1	2	5.1	7.9
42	9	10-Dec-97	0930	44 44.84	172 16.69	44 45.09	172 13.91	135	141	75.8	2	4.9	10.2
43	9	10-Dec-97	1049	44 45.12	172 07.93	44 45.22	172 05.13	132	134	71.9	2	5	9.7
44	9	10-Dec-97	1230	44 48.85	172 01.94	44 46.89	172 01.27	130	135	83.6	2.01	5	9.2
45	3	10-Dec-97	1357	44 41.37	171 58.64	44 39.42	171 58.02	102	106	78.4	2	5	10.3
46	3	10-Dec-97	1544	44 38.25	171 48.11	44 36.28	171 47.63	77	84	77.9	2	5	11.4
47	1	11-Dec-97	0509	45 32.57	171 05.89	45 30.81	171 07.22	82	83	74.7	2	5.2	11.4
48	1	11-Dec-97	0653	45 30.05	171 05.85	45 28.10	171 06.47	61	66	77.1	2	5.1	11.5
*49	1	11-Dec-97	0847	45 25.53	171 06.58	45 24.59	171 09.09	56	61	75.3	2	5.4	11.5
50	8	11-Dec-97	1059	45 20.90	171 21.14	45 19.45	171 23.09	115	118	68.8	2	5.4	11.0
51	14	11-Dec-97	1248	45 21.00	171 26.69	45 19.62	171 28.74	199	240	83.9	2	5.3	9.5
*52	2	11-Dec-97	1442	45 11.40	171 22.45	45 09.45	171 23.04	95	98	78.1	2	5.1	11.0
53	2	12-Dec-97	0453	45 01.80	171 19.12	45 00.54	171 16.93	35	46	71.3	2	5.2	11.9
54	21	12-Dec-97	0632	44 58.08	171 14.07	44 56.74	171 14.07	18	18	64.8	1.33	5.3	12.5
55	21	12-Dec-97	0818	44 48.21	171 13.77	44 46.45	171 15.08	14	19	69	2	5.1	13.2
56	21	12-Dec-97	0925	44 45.21	171 17.08	44 43.23	171 17.49	26	29	66.7	2	5.1	12.7
57	3A	12-Dec-97	1048	44 38.11	171 21.49	44 36.23	171 22.53	34	34	67.5	2.02	5.1	12.4
58	3A	12-Dec-97	1155	44 34.11	171 25.43	44 32.85	171 27.59	41	45	70.6	2	5.2	12.2
59	20	12-Dec-97	1308	44 29.16	171 23.91	44 27.51	171 22.33	25	30	70	2	5.3	12.8
60	20	13-Dec-97	0512	44 22.41	171 23.80	44 22.69	171 26.57	22	25	70.5	2	5.3	14.1
61	3A	13-Dec-97	0618	44 24.18	171 26.78	44 22.92	171 28.95	28	30	70.5	2	5.3	13.4
62	3A	13-Dec-97	0746	44 19.33	171 36.78	44 17.43	171 37.64	32	36	70.2	2	5.3	13.2

Appendix 2 —continued

Station	Stratum	Date	Time	Start of tow ° ' S	Start of tow ° ' E	End of tow ° ' S	End of tow ° ' E	Gear depth (m) Min.	Gear depth (m) Max.	Doorspread (m)	Distance trawled (n. miles)	Headline height (m)	Bottom temp (°C)
63	20	13-Dec-97	0852	44 14.45	171 38.76	44 12.91	171 40.51	24	27	69.3	2	5.3	13.4
64	19	13-Dec-97	1007	44 11.40	171 45.95	44 11.31	171 48.73	26	28	69.8	2	5.3	13.7
65	19	13-Dec-97	1112	44 11.31	171 51.40	44 09.31	171 51.38	26	31	72.9	2	5.2	
66	19	13-Dec-97	1244	44 02.55	171 56.85	44 01.06	171 58.69	16	16	70	2	5.6	14.3
67	3	13-Dec-97	1554	44 23.83	171 55.75	44 24.91	171 53.40	64	64	79.3	2	5.1	11.5
68	3	14-Dec-97	0508	44 25.79	171 49.96	44 27.78	171 49.59	61	65	71.2	2	5.4	11.8
69	3	14-Dec-97	0738	44 44.04	171 43.61	44 45.96	171 42.80	89	90	80.2	2	5.3	11.2
70	2	14-Dec-97	0946	44 53.03	171 38.34	44 51.55	171 36.44	83	92	89.6	2	4.5	11.2
71	3	14-Dec-97	1102	44 48.34	171 33.59	44 46.70	171 31.99	57	62	76.9	2	5.1	11.6
72	2	14-Dec-97	1245	44 51.72	171 30.24	44 53.68	171 30.80	59	64	75.5	2	5.3	11.6
73	14	14-Dec-97	1554	45 05.97	171 45.61	45 07.27	171 43.47	327	372	82.9	2	5.1	9.3
74	8	15-Dec-97	0505	45 00.29	171 36.94	45 01.93	171 35.33	110	110	68.6	2	5.1	11.0
75	8	15-Dec-97	0625	45 06.07	171 31.36	45 07.77	171 29.79	111	116	77.4	2.02	5.3	11.0
76	21	15-Dec-97	0904	45 07.06	171 05.58	45 05.08	171 05.97	15	18	70	2	5	12.3
77	2	15-Dec-97	1236	45 07.17	171 16.23	45 06.44	171 17.22	52	55	73.7	1.01	5.2	11.5
78	20	15-Dec-97	1600	44 38.86	171 15.14	44 37.26	171 16.82	25	27	72.9	2	5.4	12.6
79	20	16-Dec-97	0503	44 29.86	171 16.17	44 28.01	171 17.23	21	21	72.6	2	5.2	13.3
80	20	16-Dec-97	0610	44 25.14	171 18.96	44 23.19	171 19.54	18	21	72.3	2	5.5	14.0
81	20	16-Dec-97	0732	44 19.79	171 25.27	44 18.24	171 27.03	20	21	69.5	2	5.4	13.4
82	20	16-Dec-97	1245	44 18.48	171 31.45	44 16.69	171 32.71	25	26	70.6	2	5.5	14.0
83	19	16-Dec-97	1510	44 07.85	171 52.28	44 06.07	171 53.53	21	24	72	2	5.6	14.5
84	19	16-Dec-97	1616	44 05.36	171 51.66	44 03.38	171 51.31	14	18	70	2	5.5	14.4
85	19	17-Dec-97	0501	44 00.76	172 04.41	43 58.98	172 05.66	18	20	70	2	5.5	14.1
86	19	17-Dec-97	0615	43 57.05	172 10.21	43 55.56	172 12.05	16	19	70	2	5.4	13.7
87	19	17-Dec-97	0746	43 54.56	172 21.99	43 55.65	172 24.31	21	23	70	2	5.5	14.1
88	4A	17-Dec-97	0920	43 58.49	172 31.47	44 00.00	172 29.63	31	37	70	2	5.4	13.4
89	4A	17-Dec-97	1030	44 01.13	172 25.06	44 01.57	172 22.37	39	41	70	2	5.4	13.5
90	4A	17-Dec-97	1140	43 59.47	172 18.88	44 01.25	172 17.64	31	36	70	2	5.4	12.9
91	4A	17-Dec-97	1310	44 07.21	172 13.28	44 08.99	172 12.01	45	47	70	2	5.2	12.1
92	20	18-Dec-97	0509	44 12.78	171 41.14	44 10.93	171 42.19	23	26	73.4	2	5.5	13.3
93	20	18-Dec-97	0624	44 10.67	171 38.34	44 12.06	171 36.34	19	20	70.9	2	5	13.8

Appendix 2 —continued

Station	Stratum	Date	Time	Start of tow ° ' S	Start of tow ° ' E	End of tow ° ' S	End of tow ° ' E	Gear depth (m) Min.	Gear depth (m) Max.	Doorspread (m)	Distance trawled (n. miles)	Headline height (m)	Bottom temp (°C)
94	20	18-Dec-97	0753	44 14.93	171 35.08	44 16.09	171 32.82	25	26	71.9	2	5.3	13.0
95	20	18-Dec-97	0909	44 15.88	171 26.99	44 16.31	171 24.71	14	17	67.6	1.7	5.6	15.0
96	20	18-Dec-97	1053	44 25.51	171 17.95	44 27.28	171 16.64	16	18	75.1	2	5.5	14.2
97	20	18-Dec-97	1209	44 31.89	171 14.54	44 33.84	171 13.92	17	18	71	2	5.7	14.0
98	20	18-Dec-97	1319	44 32.41	171 18.29	44 31.90	171 20.99	24	26	73.1	2	5.4	13.2
99	20	18-Dec-97	1426	44 29.92	171 20.85	44 28.05	171 19.86	22	24	72.4	2	5.5	13.4
100	3A	19-Dec-97	0605	44 37.03	171 27.04	44 37.19	171 29.83	47	53	78	2	5.3	11.9
101	3A	19-Dec-97	0709	44 37.27	171 30.68	44 39.27	171 30.68	54	54	79	2	5	12.0
102	3A	19-Dec-97	0824	44 38.94	171 34.39	44 36.96	171 34.77	59	59	77.5	2	5	11.4
103	3A	19-Dec-97	1037	44 22.96	171 37.04	44 21.14	171 38.17	43	46	78.4	2	4.8	12.2
104	19	19-Dec-97	1307	44 06.93	171 45.06	44 05.42	171 46.89	13	14	70	2	5	14.7
105	19	19-Dec-97	1458	44 04.91	171 58.16	44 03.54	172 00.18	21	22	73.7	2	5	14.8
*106	19	20-Dec-97	0508	43 54.88	172 11.34	43 54.96	172 14.10	11	16	70	2	5.2	14.1
*107	19	20-Dec-97	0623	43 58.28	172 14.61	43 57.00	172 16.73	27	27	76.4	2	5.2	13.1
108	19	20-Dec-97	0736	43 55.19	172 19.49	43 53.86	172 21.56	20	22	70	2	5.2	13.4
109	19	20-Dec-97	0900	43 51.59	172 24.72	43 51.73	172 27.49	12	16	70	2	5.2	14.1
110	19	20-Dec-97	1026	43 55.48	172 33.67	43 56.84	172 35.69	24	29	74	2	5.5	13.4
111	19	20-Dec-97	1140	43 56.16	172 31.10	43 57.34	172 28.88	24	26	73.1	2	5.3	13.5
112	4A	20-Dec-97	1245	43 58.94	172 26.33	43 59.92	172 23.91	29	32	72.7	2	5.3	13.6
113	4A	20-Dec-97	1537	44 03.50	172 14.41	44 03.15	172 15.71	38	39	75.5	1	5.1	13.5
114	18	21-Dec-97	0505	43 39.51	173 08.90	43 37.73	173 07.66	19	21	77.4	2	5.1	14.0
115	18	21-Dec-97	0612	43 35.87	173 06.87	43 37.80	173 06.12	19	21	75.4	2	5.4	13.8
116	18	21-Dec-97	0719	43 36.62	173 03.43	43 34.70	173 02.64	23	25	75.5	2	5.3	13.6
117	18	21-Dec-97	0820	43 33.37	173 02.45	43 31.50	173 03.43	26	27	74.3	2	5.3	13.2
118	18	21-Dec-97	0921	43 30.90	173 04.80	43 28.90	173 04.57	26	27	74.6	2	5.5	13.8
119	18	21-Dec-97	1025	43 30.33	173 02.20	43 28.66	173 00.68	27	28	74.4	2	5.6	13.4
120	18	21-Dec-97	1130	43 26.50	172 59.90	43 28.05	172 58.17	28	29	75.8	2	5.4	13.2
121	18	21-Dec-97	1232	43 28.84	172 56.70	43 30.15	172 54.64	24	27	77	2	5.3	13.2
122	7	4-Jan-98	0532	43 01.24	173 18.88	43 02.85	173 17.26	55	55	77	2	5.2	13.0
123	7	4-Jan-98	0650	43 03.67	173 12.32	43 04.89	173 10.16	42	44	76.2	2	5.1	13.3
124	7	4-Jan-98	0856	43 14.89	173 17.06	43 16.87	173 17.33	53	56	76.1	2	4.6	11.8

Appendix 2 —continued

				Start of tow		End of tow		Gear depth (m)			Distance	Headline	Bottom
Station	Stratum	Date	Time	° ' S	° ' E	° ' S	° ' E	Min.	Max.	Doorspread (m)	trawled (n. miles)	height (m)	temp (°C)
125	7	4-Jan-98	1028	43 22.62	173 16.55	43 24.59	173 16.12	56	58	75.4	2	5	12.0
126	7	4-Jan-98	1317	43 28.01	173 20.79	43 30.00	173 20.98	72	73	77.2	2	5	12.1
127	19	5-Jan-98	0503	44 01.99	172 12.52	44 02.37	172 09.80	31	34	74.4	2	5	12.6
128	19	5-Jan-98	0632	44 05.42	172 01.18	44 06.38	171 58.73	27	28	76	2	5.1	13.3
129	19	5-Jan-98	0805	44 02.25	171 56.22	44 03.68	171 54.27	16	18	70	2	5	15.2
130	19	5-Jan-98	0931	44 07.18	171 47.04	44 08.24	171 44.69	17	18	70	2	5	15.5
131	20	5-Jan-98	1114	44 10.93	171 35.99	44 11.63	171 33.39	14	16	70	2	5.1	16.2
132	20	5-Jan-98	1244	44 16.47	171 37.16	44 17.38	171 34.68	28	29	70	2	5.1	13.8
133	20	5-Jan-98	1404	44 19.83	171 31.42	44 20.98	171 29.14	26	28	71	2	5.1	13.0
134	20	5-Jan-98	1511	44 20.20	171 25.25	44 21.29	171 22.92	19	20	69	2	5.1	14.7
135	21	6-Jan-98	0506	44 52.99	171 12.43	44 54.95	171 11.90	13	13	70	2	5.1	13.7
136	21	6-Jan-98	0706	44 56.86	171 16.48	44 54.87	017 11.66	23	26	68.5	2	4.9	13.5
137	21	6-Jan-98	0814	44 54.55	171 18.03	44 52.56	171 18.12	27	28	71.8	2	4.9	13.2
138	21	6-Jan-98	0925	44 52.99	171 15.44	44 52.00	171 15.35	19	19	62.3	1	4.9	13.4

* Blowout panel burst while trying to lift catch onto deck

Appendix 3 : **Common names, scientific names, total catch, number of stations at which caught (Occ.), and depth ranges of all species caught**

Species code	Common name	Scientific name	Catch (kg)	Occ.	Depth (m) Min	Max
API	Alert pigfish	*Alertichthys blacki*	0.3	1	382	384
BAR	Barracouta	*Thyrsites atun*	*22 029.5	104	11	399
BBE	Banded bellowsfish	*Centriscops humerosus*	1.9	4	104	399
BCO	Blue cod	*Parapercis colias*	42.1	12	18	151
BER	Numbfish	*Typhlonarke* spp.	6.7	3	88	114
BRI	Brill	*Colistium guntheri*	9.6	12	11	43
BTA	Smooth bluntnosed skate	*Pavoraja asperula*	0.4	1	382	384
BUT	Butterfish	*Odax pullus*	0.2	1	19	19
BWS	Blue shark	*Prionace glauca*	19.9	1	29	32
CAR	Carpet shark	*Cephaloscyllium isabella*	*836.4	72	13	246
CAS	Oblique banded rattail	*Caelorinchus aspercephalus*	231.8	14	111	399
CBE	Crested bellowsfish	*Notopogon lilliei*	*1 659.2	36	42	151
CBI	Two saddle rattail	*Caelorinchus biclinozonalis*	4 664.3	40	25	246
CBO	Bollons' rattail	*C. bollonsi*	526.2	6	104	399
CDO	Capro dory	*Capromimus abbreviatus*	0.2	2	219	359
CRB	Crab	Unspecified	*28.7	5	27	98
DCS	Dawson's catshark	*Halaelurus dawsoni*	12.4	5	335	399
DSP	Deepsea pigfish	*Congiopodus coriaceus*	4.0	5	82	141
ELE	Elephantfish	*Callorhinchus milii*	1 963.3	60	11	72
ERA	Electric ray	*Torpedo fairchildi*	121.8	10	16	73
ESO	N.Z. sole	*Peltorhamphus novaezeelandiae*	330.4	57	11	81
FHD	Deepsea flathead	*Hoplichthys haswelli*	71.2	10	110	399
GFL	Greenback flounder	*Rhombosolea tapirina*	22.8	15	13	83
GLB	Globefish	*Contusus richei*	166.6	21	11	27
GON	Sandfish	*Gonorynchus gonorynchus*	24.4	15	14	384
GSH	Dark ghost shark	*Hydrolagus novaezelandiae*	*5 560.4	28	73	399
GSP	Pale ghost shark	*Hydrolagus* sp.	64.3	3	327	399
GUR	Red gurnard	*Chelidonichthys kumu*	*476.8	77	14	118
HAG	Hagfish	*Eptatretus cirrhatus*	1.0	1	34	39
HAK	Hake	*Merluccius australis*	536.1	19	13	90
HAP	Hapuku	*Polyprion oxygeneios*	122.1	24	25	118
HOK	Hoki	*Macruronus novaezelandiae*	2 725.8	14	20	399
JAV	Javelinfish	*Lepidorhynchus denticulatus*	459.6	6	327	399
JDO	John dory	*Zeus faber*	1.0	1	27	28
JMD	N.Z. jack mackerel	*Trachurus declivis*	0.1	1	31	34
JMM	Chilean jack mackerel	*T. murphyi*	*26.0	10	31	223
JMN	N.Z. jack mackerel	*T. novaezelandiae*	0.1	1	27	28
KAH	Kahawai	*Arripis trutta*	131.1	23	11	43
LDO	Lookdown dory	*Cyttus traversi*	76.2	6	327	399
LEA	Leatherjacket	*Parika scaber*	466.0	31	13	46
LIN	Ling	*Genypterus blacodes*	892.3	62	13	399
LSO	Lemon sole	*Pelotretis flavilatus*	*183.8	67	13	246
MOK	Moki	*Latridopsis ciliaris*	3.8	3	15	19
MOL	Molluscs	Unspecified	0.7	1	34	39
OCT	Octopus	*Octopus maorum*	*26	17	14	134
OPA	Opalfish	*Hemerocoetes* spp.	2.0	11	43	223
OPE	Orange perch	*Lepidoperca aurantia*	0.1	1	327	372
PAD	Paddle crab	*Ovalipes catharus*	73.9	8	11	29
PCO	Ahuru	*Auchenoceros punctatus*	7.6	5	11	27
PDG	Prickly dogfish	*Oxynotus bruniensis*	2.0	1	327	372
PIG	Southern pigfish	*Congiopodus leucopaecilus*	*212.7	57	13	393
RBM	Ray's bream	*Brama brama*	10.1	2	219	393
RBT	Redbait	*Emmelichthys nitidus*	0.6	4	88	351
RCO	Red cod	*Pseudophycis bachus*	*9 508.7	78	11	399
RSK	Rough skate	*Raja nasuta*	*1 319.2	73	11	399

Appendix 3 —continued

Species code	Common name	Scientific name	Catch (kg)	Occ.	Depth (m) Min	Max
SAM	Quinnat salmon	*Oncorhynchus tshawytscha*	31.7	11	11	39
SAR	Mantis shrimp	*Squilla armata*	0.3	3	74	84
SAZ	Sand stargazer	*Crapatalus novaezelandiae*	2.2	7	11	27
SBW	Southern blue whiting	*Micromesistius australis*	0.2	1	388	393
SCG	Scaly gurnard	*Lepidotrigla brachyoptera*	*248.4	50	31	135
SCH	School shark	*Galeorhinus galeus*	1 743.0	56	11	76
SCI	Scampi	*Metanephrops challengeri*	3.9	5	335	399
SCO	Swollenhead conger	*Bassanago bulbiceps*	6.6	3	327	393
SDF	Spotted flounder	*Azygopus pinnifasciatus*	0.4	4	335	399
SDO	Silver dory	*Cyttus novaezelandiae*	8.0	21	61	240
SDR	Spiny seadragon	*Solegnathus spinosissimus*	0.1	1	87	89
SFI	Starfish	Unspecified	6.8	6	24	399
SFL	Sand flounder	*Rhombosolea plebeia*	230.3	36	11	56
SHO	Seahorse	*Hippocampus abdominalis*	0.1	1	13	14
SLS	Slender sole	*Peltorhamphus tenuis*	21.7	15	12	39
SPA	Slender sprat	*Sprattus antipodum*	13.4	6	16	28
SPD	Spiny dogfish	*Squalus acanthias*	*30 655.7	126	11	399
SPE	Sea perch	*Helicolenus* spp.	*1 279.0	45	34	399
SPF	Scarlet wrasse	*Pseudolabrus miles*	0.7	1	82	83
SPM	Stout sprat	*Sprattus muelleri*	19.3	7	13	65
SPO	Rig	*Mustelus lenticulatus*	150.2	22	11	65
SPR	Sprats#	*Sprattus antipodum* , *S. muelleri*	102.9	16	11	84
SPS	Speckled sole	*Peltorhamphus latus*	5.9	12	14	29
SPZ	Spotted stargazer	*Genyagnus monopterygius*	17.2	14	18	39
SQU	Arrow squid	*Nototodarus sloanii, N. gouldi*	*880.6	77	13	399
SSI	Silverside	*Argentina elongata*	*456.2	46	45	399
SSK	Smooth skate	*Raja innominata*	529.1	28	25	393
STA	Giant stargazer	*Kathetostoma giganteum*	*470.0	61	12	399
STY	Spotty	*Notolabrus celidotus*	66.5	13	13	46
SUR	Kina	*Evechinus chloroticus*	0.8	1	23	26
SWA	Silver warehou	*Seriolella punctata*	416.5	33	11	351
TAR	Tarakihi	*Nemadactylus macropterus*	*2 165.7	63	13	151
THR	Thresher shark	*Alopias vulpinus*	145.0	2	17	32
TOD	Dark toadfish	*Neophrynichthys latus*	8.5	18	12	91
TOP	Pale toadfish	*N. angustus*	10.0	5	89	399
TRP	Triplefin	Tripterygiidae	0.2	1	14	16
TRU	Trumpeter	*Latris lineata*	0.1	1	15	18
UNI	Unidentified teleost		0.1	1	104	105
WAR	Common warehou	*Seriolella brama*	898.9	36	11	66
WIT	Witch	*Arnoglossus scapha*	*613.7	77	15	399
WSQ	Warty squid	*Moroteuthis* spp.	7.7	3	219	399
WWA	White warehou	*Seriolella caerulea*	29.0	3	327	384
XBP	Black petrel	*Procellaria parkinsoni*	1.7	1	102	106
YBF	Yellowbelly flounder	*Rhombosolea leporina*	62.4	11	12	29
YCO	Yellow cod	*Parapercis gilliesi*	1.0	3	88	151
YEM	Yelloweyed mullet	*Aldrichetta forsteri*	0.7	2	28	39

* Includes estimated catch from tows 49 & 52

Not identified to species for these catches

Appendix 4 : **Catch (kg) by station for the 18 most abundant commercially important species and all species combined***

Station	BAR	ELE	GSH	GUR	HAK	HOK	LIN	RCO	RSK	SCH	SPD	SPE	SQU	SSK	STA	SWA	TAR	WAR	All species
1	176.2	0	29.6	0	0	15.2	5.1	9.3	7.1	0	42.9	82.9	26.6	3.7	18.6	0	0	0	506.8
2	136.3	27.2	0	0.5	0.5	0	0	13.8	20.4	11.5	48.6	0	1.1	14.5	0	0	0	3.1	447.0
3	946.4	0.5	0	0.3	0.4	0	0	5.7	28.7	9.3	96.7	0	0	0	0	0	0	0.6	1 114.1
4	436.2	0.5	0	0.1	0	0	0	0.1	8.6	53.3	0	0	0	0	0	0	0	0	615.4
5	134.7	0	0	3	2.5	0	1.4	20.8	19.1	13.5	7	11.5	0	0	0	0	0.5	16	807.8
6	741.3	0	0	48	0.1	0	1.5	84.8	6.4	3.5	29.9	28.6	0	0	4.2	0	5.4	9.2	1 001.3
7	349.5	0	0	12.5	50.5	498.7	1.3	247.6	13.8	0	172.4	2.7	0.9	0	29.8	0	5.8	66.6	2 442.8
8	187.1	0	0	30	0	0	0	2.8	36.1	0	177.2	0	0	0	0	0	0.1	0	497.7
9	179.1	0	0	0	0	0	0.4	74.7	22.9	0	87.2	9.4	0	0	0	0	0	0	462.5
10	1 051.8	0	0	0	0	0	3.9	19.3	0	0	42.2	97.4	1.8	2.8	27.5	376.9	20.3	0	2 110.7
11	15.6	0	0	1.2	0	0	1.8	5.1	0	0	42.6	173.7	0.1	3.3	10.9	0	0	0	666.8
12	0	0	0	2.3	0	0	1.1	0	36.5	0	75.0	19.0	0	0	15.6	0	0	0	260.4
13	0	0	0	1.3	0	0	0.1	0	9.8	0	107.5	11.3	0.5	0	3.1	5.6	33.2	0	249.3
14	19.1	0	0	2.2	0	0	1.0	0	14.0	0	96.4	0.1	1.3	0	2.8	0	35.3	0	218.2
15	22.8	0	0	0.6	0	0	0	0.1	22.1	0	22.4	0	0	0	0.5	2.1	21.3	0	147.4
16	209.9	0	0	2.5	0	0	0	0	33.0	0	109.2	0.2	1.1	0	9.3	0	38.7	0	452.2
17	3.0	0	32.7	0	0	44.5	57.5	17.5	9.3	0	40.2	18.7	6.0	19.5	3.1	4.8	0	0	522.4
18	2.6	0	4.5	0	0	0	2.1	1.9	7.0	0	94.5	111.4	0.9	0	0.6	0	1.5	0	333.5
19	0	0	0	0	0	0	0	0	5.3	0	88.7	6.6	0.5	0	3.1	0.3	4.9	0	195.1
20	21.3	0	0	1.6	0	0	0	0.1	3.6	0	53.9	0	15.1	0	0	0	8.6	0	191.4
21	1.8	0	10.8	0	0	566.6	26.4	5.8	3.7	0	176.8	4.8	1.8	0	13.9	0	0	0	1 346.9
22	11.2	0	245.6	0	0	0	0	0.3	0	0	108.7	30.8	0.1	6.5	2.8	0	0	0	629.2
23	0	0	35.8	0	0	943.5	19.0	3.9	0	0	75.7	4.5	8.6	0	0	0	0	0	1 307.9
24	0	0	38.1	0	0	0	0.2	1.0	0	0	977.2	97.2	0	0	0.7	0	0	0	1 169.8
25	0	0	1.6	1.1	0	0	0.9	7.7	0	0	186.5	0.5	21.6	0	0.2	0	18.3	0	272.2
26	0	0	27.8	0	0	160.3	1.7	3.2	6	0	17.7	0	5.4	5.7	2	0	0	0	275.7
27	0	0	289.1	0	0	0	2.1	4.3	0	0	402.1	0	4.3	5.0	0	0.9	0	0	970.5
28	38.9	0	87.5	0	0	1.8	3.3	72.4	0	0	83.0	239.9	0	0	11.0	0	0	0	632.3
29	46.9	0	0	0	0	0	0.1	1.1	44.0	0	111.0	0.5	1.5	0	19.3	0	4.4	0	276.4
30	0	0	0	0	0	0	0	0	4.3	0	217.1	27.3	0.9	23.5	7.1	0.2	16.9	0	383.6
31	1.3	0	0	0.8	0	0	0	0	38.0	0	32.1	0.7	0.8	0	14.0	0	6.0	0	133.1
32	69.8	1.3	0	3.1	0	0	0	1.2	17.6	0	29.3	0	0.6	17.8	3.8	0	2.1	0	219.1
33	11.1	0	213.3	0	0	0	5.4	256.0	0	0	44.0	115.9	4.3	3.4	8.9	0	0.3	0	806.8
34	0	0	53.7	0.7	0	0	1.2	3.3	22.1	0	41.5	2.2	1.1	7.9	16.0	0	47.3	0	288.3
35	0	0	34.4	1.7	0	0	0.5	0	30	3.4	15.4	2.8	2.3	35.0	8.8	1.4	68.5	0	240.1
36	0	0	81.9	0.9	0	0	0.6	44.0	0	0	75.9	0.8	2.0	24.8	8.6	0	12.1	0	340.7

Appendix 4—continued

Station	BAR	ELE	GSH	GUR	HAK	HOK	LIN	RCO	RSK	SCH	SPD	SPE	SQU	SSK	STA	SWA	TAR	WAR	All species
37	0	0	10.5	0.4	0	0	1.8	1.8	45.1	0	23.2	8.1	0.1	46.8	9.2	0	55.8	0	244.1
38	1.1	0	0	1.7	0	0	0	0	5.3	0	4.7	0	3.7	0	10.9	0	60.8	0	104.0
39	36.1	0	0	3.5	14.4	0	0.1	0	15.5	0	6.6	0	1.9	33.2	16.1	0.5	265.9	0	436.7
40	0.1	0	106.3	0	0	7.7	9.1	3.5	0	0	45.3	16.3	2.2	0	0.8	0.3	1.1	0	211.6
41	0	0	17.7	0	0	58.6	25.9	0.9	0	0	96.2	0	9.8	5.5	0	0	0	0	293.2
42	0	0	479.1	0	0	0	0.8	0.1	0	0	244.6	0	1.6	2.0	0	2.5	0	0	813.0
43	53.3	0	282.8	0	0	0	0	8.3	0	0	366.6	4.6	0.7	11.7	5.9	0	0.7	0	791.7
44	0	0	393.6	0	0	0	1.2	10.7	0	0	181.3	9.1	3.4	0.8	4.0	0.5	0	0	639.3
45	0	0	79.3	0	0	0	1.7	30.4	0	0	166.3	31.2	0	0	0.4	0	0	0	326.8
46	209.6	0	0	3.3	0.2	0	95.2	106.1	0	0	251.3	4.4	2.3	24.5	21.6	0	13.5	0	782.5
47	295.6	0	0	1.8	0	0	9.1	374.2	4.4	0	189.1	8.4	4.3	0	1.8	0	3.2	0	997.0
48	204.2	0	0	12.3	0	0	0.2	447.9	12.0	0	1 855.9	0.1	0.6	0	3.3	4.7	255.7	0	2 892.9
49	20.4	0	0	9	0	0	0	18.6	33.9	0	5 584.1	0	1.5	0	17.4	0	36.6	0	5 840.9
50	23.2	0	63.7	2.9	0	0	1.0	0	13.6	0	70.4	7.5	0.8	71.3	6.7	0.3	0	0	1 882.9
51	45.5	0	570.9	0	0	0	6.1	1.6	5.7	0	7.4	0	0	6.1	2.0	1.6	0	0	705.6
52	0.4	0	2 118.0	0	0	0	0	29.6	3.5	0	5 409.1	4.0	1.2	0	0	0	0	0	7 588.2
53	0.9	14.6	0	0	0	0	1.1	577.6	10.9	0	2 023.4	0	0	0	0	0	73.1	0	2 778.4
54	155.2	0	0	0	0	0	0	1 170.1	0	0	20.0	0	0.3	0	0	0	41.7	0	1 458.7
55	2.4	0	0	0	0	0	0	1.9	0	0	1 026.5	0	0.1	0	0	0	0.1	0.5	1 032.7
56	159.5	7.2	0	1.2	0	0	0	0	0	2.5	147.2	0	0	0	0	0	0.9	0	361.3
57	0	11.9	0	0	0	0	0	0	0	2.9	13.0	0	0	0	0	0	0.1	0	38.7
58	0	5.3	0	0.2	0	0	0	0	0	0	7.8	0	0	0	0	0	0	0	17.1
59	0	0	0	2.3	0	0	0	0	0	0	1.3	0	0	40.4	0	0	0	0	52.0
60	217.7	16.7	0	0	0	0	0	14.5	0	28.0	60.5	0	0.3	0	0	0	0	0	339.7
61	174.0	0	0	0.7	0	0	0	0	0	0	30.2	0	0.1	0	0	0.1	0	0	211.3
62	0	11.0	0	5.0	0	0	0	0	0	0	2.4	0	2.3	0	0	0	0.1	0	33.9
63	0	12.5	0	1.5	0	0	0	0	0	0	0	0	2.2	0	0	0	0	0	27.7
64	2.1	4.7	0	0	0	0	0	0	3.2	0	2.3	0	45.3	0	0	0	0	0	74.2
65	117.9	0	0	0	0	0	0	0	0	0	6.2	0	0.4	0	0	0.1	0	0	145.3
66	19.8	54.8	0	0	0	0	0	0	0	1.4	19.1	0	0	0	0	0.5	0	0	108.1
67	0.5	0	0	0	0	0	0	6.7	0	0	113.1	0.3	105.5	0	7.4	0	96.2	0	331.4
68	100.4	0	0	0	0	0	1.8	23.8	0	0	16.9	0	20.4	0	10.8	0.3	40.2	0	222.9
69	0	0	0	1.6	1.2	4.3	555.2	890.7	0	0	107.8	1.5	176.2	17.7	1.5	0.1	2.5	0	1 808.9
70	0	0	0	0	0	0	3.4	15.6	0	0	40.7	0	1.3	0	0	0	0	0	61.4
71	0	0	0	0	0	0	0.2	739.4	0	0	1 828.7	0	0.5	0	0	0	0.3	0	2 570.6
72	25.2	0	0	0	0	0	0	1 053.9	0	0	1 605.8	0	0.6	0	0	0	0	0	2 690.7

Appendix 4—continued

Station	BAR	ELE	GSH	GUR	HAK	HOK	LIN	RCO	RSK	SCH	SPD	SPE	SQU	SSK	STA	SWA	TAR	WAR	All species
73	0	0	44.3	0	0	9	15.5	0	0	0	0	0	0	0	4.0	0	0	0	416.0
74	1.6	0	115.9	0	0	0	0.8	58.8	0	0	7.3	0	63.3	0	21.0	0	0	0	300.4
75	512.7	0	91.9	1.6	0	0	3.9	0	0	0	20.7	5.0	4.3	0	15.2	10.0	0.6	0	734.8
76	0	0	0	0	0	0	0	1.6	3.4	0.0	2.7	0	0	0	0	0	0	0	33.8
77	74.4	0	0	1.4	0	0	1.7	121.4	0	0	624.1	1.1	0	0	2.9	0	11.6	0	839.8
78	3.7	7.9	0	0	0	0	0.4	0	0	0.8	7.3	0	0	0	0	0	0	0	24.4
79	43.7	51.0	0	0	0	0	0	0	0	36.0	29.3	0	0	0	0	0.1	0	1.8	180.0
80	8.5	321.4	0	0	0.1	0	0	0	0	28.9	19.2	0	0	0	0	0.4	0	4.9	409.6
81	0	31.3	0	0	0	0	0	0	0	4.8	0	0	0	0	0	0	0	0	42.3
82	25.4	0	0	4.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54.2
83	302.9	3.6	0	0	0	0	0	0	0	19.9	88.4	0	0.1	0	0	0	0	0	433.2
84	49.6	77.1	0	0.5	0	0	0	0	0	5.3	84.6	0	0	0	0	0	0	0.2	224.8
85	253.0	14.7	0	4.3	0	0	0	0.4	0	10.3	174.9	0	0.7	0	0	0	0.2	0.5	485.5
86	74.1	46.6	0	3.9	0	0	0	0	4.6	24.0	56.3	0	0	0	0	0	0	0.2	249.4
87	63.5	11.5	0	1.4	0	0	0	2.6	0	272.1	16.0	0	0	0	0	0	0	0	393.6
88	42.0	4.3	0	0	0	0	0	0	0	0	3.5	0	0	0	0	0	0	0	54.3
89	0	2.0	0	4.7	0	0	0	0	0	0	0.4	0	0.1	0	0	0	0	0	18.8
90	0	0	0	4.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17.4
91	0.1	2.4	0	0.4	0	0	0	0	0	0	28.3	0	0	0	2.2	0	16.2	0	50.0
92	1 980.2	6.8	0	0	0	0	0	0	0	4.2	31.0	0	0.2	0	0	0	0	0.1	2 025.3
93	235.2	22.2	0	0	0	0	2.3	475.9	0	1.3	3.2	0	0	0	0	0	0	32.9	803.7
94	46.2	8.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	59.8
95	0	15.7	0	0.1	0	0	0	0	0	6.4	3.7	0	0	0	0	0	0	0.2	58.5
96	0	161.5	0	0.1	0	0	0	47.6	0.4	90.4	49.3	0	0	0	0	0.5	0	24.2	434.2
97	5.4	13.4	0	0	0	0	0	0	0	6.1	12.9	0	0	0	0	0	0	0	38.9
98	2.9	0.4	0	0	0	0	0	0	0	0.7	3.3	0	2.3	0	0.3	0	0	0	12.8
99	21.1	1.0	0	0	0	0	0	0	0	8.1	0	0	0.2	0	0	0	0	0	39.7
100	0	31.3	0	8.0	0	0	0.2	0.2	20.2	0	16.5	0	0	0	2.6	0	0.2	0	113.2
101	0.1	47.6	0	1.0	0	0	0.3	2.2	0	0	89.9	0	0	0	4.1	0	0.1	0	167.3
102	11.7	4.2	0	4.8	0.3	0	1.7	1 080.6	0	0	457.9	0	0	0	5.8	0	2.3	0	1 633.5
103	29.4	5.1	0	12.7	3.9	0	6.3	70.3	82.8	0	98.1	1.9	0.4	0	1.1	0	281.5	0.6	675.4
104	91.9	129.8	0	0	0	0	0	0.8	0	5.1	25.8	0	0	0	0	0	0.2	0.3	272.9
105	772.0	0	0	3.1	0	0	0	0	0	4.4	236.1	0	0	0	0	0	0.1	0	1 071.8
106	2.6	45.1	0	0	0	0	0	5.0	28.9	128.1	209.3	0	0	0	0	0.1	0	0.4	523.7
107	31.8	92.0	0	20.7	0.1	0	0.1	0.8	17.5	290.9	288.4	0	0	0	0	0.4	0	9.0	882.1
108	6.7	48.7	0	0	0.5	0.1	0	11.3	7.8	43.2	75.1	0	0	0	0.1	0.4	0	1.5	229.7

Appendix 4—continued

Station	BAR	ELE	GSH	GUR	HAK	HOK	LIN	RCO	RSK	SCH	SPD	SPE	SQU	SSK	STA	SWA	TAR	WAR	All species
109	0	3.5	0	0	0	0	0	3.9	0.1	21.7	60.5	0	0	0	0.1	0.2	0	0.3	143.5
110	2.5	12.8	0	32.0	0	0	0	0	16.7	2.7	0	0	0	0	0	0	0	0	92.8
111	22.6	46.0	0	22.1	0	0	0	0	6.7	2.5	0	0	0	0	0	0	0	0	114.4
112	177.3	18.1	0	39.1	0	0	0	0	18.4	2.9	0	0	0	0	0	0	0	0	339.7
113	2 365.0	0	0	26.6	0	0	0	0	21.9	0	0	0	0.7	0	0.4	0	47.3	0.7	2 494.1
114	272.4	3.9	0	2.4	0	0	0	0	17.2	233.4	190.0	0	0	0	0	0	0	0	751.8
115	124.5	2.9	0	1.6	0	0	0	0	0	48.3	287.0	0	0	0	0	0	0	0	472.2
116	59.6	2.7	0	0	0	0	0	0.3	0.2	76.7	36.7	0	0	0	0	0	0	0	181.2
117	101.4	0	0	0.3	0	0	0	0	2.3	34.9	3.3	0	0	0	0	0	0	0	145.7
118	50.0	7.2	0	0.7	0	0	0	0	4.9	14.5	2.2	0	0	0	0	0.1	0	0	102.6
119	69.3	3.6	0	0.3	0	0	0	0	5.5	21.9	1.2	0	0	0	0	0.1	0	0	114.0
120	65.4	2.3	0	0.4	0	0	0	0	6.1	35.5	0.1	0	0.1	0	0.1	0	0	0.1	122.4
121	113.8	0	0	1.5	0	0	0.6	0	1.8	31.6	5.3	0	0	0	0	0	0	0.1	185.6
122	108.8	0	0	26.4	0	0	0	8.2	20.9	8.8	29.1	3.5	1.9	0	0	0.2	6.3	58.1	297.6
123	0.1	0	0	23.9	0	0	0.1	0	55.9	3.3	72.3	0	0	0	0	0	0.7	0	194.0
124	122.3	0	0	15.2	0.1	229.5	0.9	7.2	4.2	2.7	4.6	57.9	1.4	40.8	16.9	0.2	25.6	274.6	1 130.8
125	326.3	7.9	0	19.7	459.7	186.0	1.3	160.1	0	12.2	16.6	12.7	4.9	0.8	22.2	0	0.1	375.2	2 744.2
126	422.9	0	0	1.9	0.3	0	0.1	0	60.5	0	64.4	0	0	0	4.9	0	0	0	615.3
127	361.7	0	0	8.2	0	0	0.3	0.2	81.1	3.5	2.5	0	3.7	0	0	0	42.3	1.9	573.9
128	1 133.8	1.8	0	1.9	0	0	0	0	61.6	0	135.1	0	257.2	0	0	0	19.7	0.1	1 709.6
129	456.9	11.1	0	5.2	0	0	0	9.4	20.7	0	87.9	0	1.6	0	0	0	17.3	0.3	641.1
130	2 611.5	51.3	0	1.3	0	0	0	0	8.1	8.5	266.4	0	2.3	0	0	0	0	0.2	3 069.7
131	27.7	108.1	0	0	0.1	0	1.4	52.6	15.9	9.4	136.2	0	0	0	0	0.1	0.1	12.2	480.6
132	119.6	41.4	0	1.3	0.6	0	0	0	15.0	11.1	23.8	0	24.5	0	0.1	0	0	0.2	326.8
133	65.6	12.3	0	3.6	0	0	0	0	15.1	1.5	271.2	0	0	0	0	0	0	0	425.0
134	281.6	247.5	0	0.9	0	0	0	0	0.6	27.9	66.4	0	0	0	0	0	0	0	638.6
135	273.3	3.4	0	0	0.6	0	0.6	10.6	16.9	1.7	339.6	0	5.1	0	0	0	1.8	0.5	693.3
136	762.0	0	0	1.0	0	0	0	0.2	31.0	5.0	66.1	0	3.8	0	0	0	30.7	0	943.4
137	8.7	0	0	0	0	0	0.9	0.4	10.3	0	75.7	0	0.5	54.1	0	0	353.1	1.5	597.1
138	151.5	0	0	0	0	0	0.4	940.4	11.5	0.5	44.5	0	0.5	0	0	0	7.7	0	1 195.2
Total	22 029.5	1 963.3	5 560.4	476.8	536.1	2 725.8	892.3	9 508.7	1 319.2	1 743.0	30 655.7	1 279.0	880.6	529.1	470.0	416.5	2 165.7	898.9	96 991.8

* Species codes are given in Appendix 3

Appendix 5: **Species of invertebrates collected during the survey and identified by Steve O'Shea and Don McKnight, NIWA, Wellington**

Porifera
- *Callyspongia ?ramosa*
- *Ircinia* sp.
- Unidentified porifera

Mollusca
- Polyplacophora
  - *Acanthochitona zelandica*
- Gastropoda
  - *Aeneator comptus*
  - *Argobuccinum tumidum*
  - *Austrofusus glans*
  - *Calliostoma blacki*
  - *Calliostoma selecta*
  - *Calliostoma waikanae*
  - *Cominella nassoides*
  - *Crepidula monoxyla*
  - *Fusitriton laudandus*
  - *Iredalina mirabilis*
  - *Malluvium calcareus*
  - *Maoricolpus roseus*
  - *Penion fairfeldi*
- Bivalvia
  - *Atrina pectinata zelandica*
  - *Chlammys delicatula*
  - *Hiatella arctica*
  - *Modiolarca impacta*
  - *Monia zelandica*
  - *Ostrea lutaria*
- Cephalopoda
  - *Octopus maorum*
  - *Pinnoctopus cordiformis*

Crustacea
- Amphipoda
  - Unidentified amphipod
- Anomura
  - *Diacanthurus rubricatus*
  - *Diacanthurus spinulimanus*
  - *Lophopagurus* sp.
  - *Paguristes barbatus*
  - *Paguristes pilosus*
  - *Parapagurus dimorphus*
- Pycnogonida
  - Unidentified pycniginid
- Decapoda
  - *Cancer novaezelandiae*
  - *Leptomithrax australis*
  - *Leptomithrax longipes*
  - *Nectocarcinus antarcticus*
  - *Paromola petterdi*
  - *Thacanophrys filholi*

? Identification uncertain

Crustacea (continued)
- Cirripedia
  - *Balanus* spp. (large)
  - *Balanus* spp. (other)
  - *Balanus vestitus*
  - *Lepas antifera*

Echinodermata
- Ophiuridea
  - *Amphiura correcta*
  - *Astrothorax waitei*
  - *Ophionereis fasciata*
- Asteroidea
  - *Asterodon millaris*
  - *Bollonaster primigenius*
  - *Cosmasterias dyscrita*
  - *Dipsacaster magnificus*
  - *Henricia* sp.
  - *Odontaster benhami*
  - *Proserpinaster neozelanicus*
  - *Psilaster accuminatus*
  - *Pteraster* sp.
  - *Sclerasterias mollis*
- Holothurodea
  - *Bathyplotes* sp.
  - *Parastichopus mollis*
- Echinodea
  - *Echinocardium cordatum*
  - *Goniocidaris* sp.
  - *Pseudechinus albocinctus*
  - *Pseudechinus huttoni*

Coelenterata
- Actinaria
  - Unidentified actinaria
- Alcyonacea
  - *Rhodalinda gardineri*
- Zoantharia
  - *Bathyzoanthis* sp.
- Hydroida
  - Unidentified hydroid

Urochordata
- Unidentified ascidiand

Polychaeta
- *Euphione squamosa*