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Contents

Introduction

This report describes the fourth in a series of trawl surveys of deepwater fish from the south Chatham Rise carried out using RV *Tangaroa* between 4 October and 13 November 1995. McMillan & Hart (1994b, 1994c, 1995) described the first (1991), second (1992), and third (1993) surveys.

The principal aim of this time series of trawl surveys is to estimate the relative biomass of black oreo (*Allocyttus niger*), smooth oreo (*Pseudocyttus maculatus*), and orange roughy (*Hoplostethus atlanticus*) on the south Chatham Rise. Relative biomass is required for stock assessment of these species from the area.

Three different surveys were carried out during this voyage. The principal survey was a repeat of the "standard" survey carried out in 1991, 1992, and 1993 and aimed to estimate relative biomass on flat and undulating ground between the depths of 600 and 1500 m.

The second was a new survey, termed the "OEO 3A echosounder survey", which aimed to measure the occurrence of fish schools in a part of area OEO 3A where the main oreo commercial catches have been taken from 1979 to 1994 (Ralph Coburn, NIWA, Wellington, pers. comm.). The *Tangaroa*'s hull-mounted Simrad transducer was used to measure the occurrence of fish schools along a series of north–south transects. Trawling was also carried out to estimate the species composition of schools observed during the echosounder survey. Length and sex were recorded from samples of black oreo and smooth oreo to estimate the proportion of pre-recruit and recruited fish, and standard biological data were also collected. This survey was designed to answer questions about the high variability of abundance estimates from the standard trawl survey, particularly of smooth oreo. It follows on from the 1993 "high catch rate area" trawl survey which aimed to determine if there was a problem with the standard trawl survey by carrying out another trawl survey using a different (random) design in a part of OEO 3A known to have produced high commercial catch rates of black oreo and smooth oreo in the past. The 1993 survey suggested that there was no problem with the standard trawl survey, but also suggested that the schooling behaviour of the adult oreos and the relative scarcity of schools was reducing the effectiveness of the standard trawl survey in OEO3A.

The third survey, termed the "hill echosounder survey", aimed to estimate the occurrence and distribution of fish schools of black oreo, smooth oreo and orange roughy around a known fishing hill over a 24 h period. It was designed to answer questions about depth and spatial distribution of fish around a hill, and more particularly, how these changed over time. Trawling on fish marks was carried out to establish species composition and biological data including length (for pre-recruit and recruit composition) and sex ,weight, and other data were collected. The 1995 hill echosounder survey was not aimed at estimating relative abundance, in contrast to the "hill" trawl surveys carried out under this project in 1992 and 1993. The latter aimed to establish the relative abundance of black oreo, smooth oreo and orange roughy on six known hills. The hill trawl survey was not continued in 1995 because abundance estimates from 1992 and 1993 had unacceptably high *c.v.*s.

Objectives

Standard trawl survey

1. To estimate the relative biomass and determine the distribution of deepwater species, principally black oreo, smooth oreo, and orange roughy.
2. To determine the size structure of the populations of black oreo, smooth oreo, orange roughy, and other commercial or potentially commercial species.

3. To determine the reproductive status of the populations of black oreo, smooth oreo, and orange roughy.
4. To retain rare or unusual species of fish for the Museum of New Zealand, Te Papa Tongarewa, Wellington and invertebrates for NIWA, Wellington.

OEO 3A echosounder survey

1. To measure the occurrence and distribution of fish marks within the area using the Simrad echosounder.
2. To measure the species composition by trawling on observed marks.
3. To measure lengths of smooth oreo and black oreo samples taken from fish marks to compare the length distribution with samples from random trawl stations.

Hill echosounder survey

1. To measure the occurrence and distribution of fish marks over a 24 h period on each of up to six fishing hills using the Simrad echosounder.
2. To measure the species composition over time by trawling on observed marks using bottom and midwater trawls.
3. To measure lengths of smooth oreo and black oreos taken from fish marks to compare the length distribution with samples from random trawl stations.

Methods

Survey area and stratification

Standard survey (Figure 1, Table 1). The 1995 survey area was the same as the 1992 and 1993 survey area, and totalled 60 503 km^2. It was divided into 7 subareas and 26 strata (1–26).

OEO 3A echosounder survey (Figure 2). A catch per unit effort (CPUE) analysis for oreos in OEO 3A identified three areas that had produced high catches from 1978 to 1992, two of which were sampled as strata 100 and 101 in 1993 (McMillan & Hart 1994c). In 1995 an area covering the two western high catch areas was surveyed by echosounder with 23 north–south transects 2 n. miles apart. This area was defined as stratum 103. The first nine transects covered depths of 600 to 1200 m, but transect numbers 10 to 23 covered 800 to 1200 m because of time constraints and sufficient samples from 600 to 800 m.

Hill echosounder survey (Figure 1, Table 3). As many known south Chatham Rise fishing hills as possible were visited during the survey period to assess whether they showed fish marks. Trawls were made on six hills for fish mark identification. Each hill was defined as a stratum, two of the six hills (strata 30 and 31) were also sampled in the 1992 and 1993 "hill survey". Hegerville was chosen for the temporal survey because it had the best fish marks of the hills visited.

Survey design

Standard survey. A two-phase stratified random bottom trawl survey design (*after* Francis 1981, 1984) was used with 105 stations planned for phase 1 and about 45 for phase 2. Areas and depths were chosen to sample black oreo, smooth oreo, and orange roughy.

OEO 3A echosounder survey. The area was surveyed by echosounder (Simrad EK500 with "standard" setting) along 23 north–south transects 2 n. miles apart. Trawls to identify fish mark composition were undertaken on any substantial marks seen during the transect.

Hill echosounder survey. A total of 19 hills was examined for marks using the Simrad echosounder. Target identification trawls were carried out on six hills. Hegerville had the densest marks and was selected for two 24 h echosounder surveys. Nine north–south transects covering the hill base were used in five snapshots over two separate 24 hour periods, 27–28 October and 9–10 November. Target identification trawls were undertaken after each 24 h survey.

Station allocation

Standard survey, phase 1. The number of stations planned (105) was the same as in the 1993 survey. Half the phase 1 stations were randomly selected from the 1993 phase 1 and 2 stations, the remainder were new by random longitude and depth. This was a compromise between using all new positions, and spending time searching for trawlable ground, and repeating previous random stations.

Standard survey, phase 2. The strata and numbers of stations required to reduce the variability of the recruited (to the fishery) biomass estimates were calculated. Emphasis was placed on reducing the coefficient of variation (*c.v.*) of the largest recruited biomass estimate (smooth oreo) to less than 30%. Phase 2 stations were new random longitude and depth positions.

OEO 3A echosounder survey. Short trawls were undertaken on substantial fish marks.

Hill echosounder survey. Short trawls were undertaken on fish marks where practical.

Station execution

Half the phase 1 stations used the actual start and finish positions of the 1993 stations, and the remainder passed through a new randomly selected position. For all phase 2 positions, the station was carried out by towing through a new (1995) randomly selected position. Where this was not possible because of foul trawl ground, an area within 2 n. miles of the position was searched for trawlable ground. If a station was still not possible, the position was abandoned and replaced with the next one on the list.

Phase 1 and phase 2 stations for the standard survey aimed to be 2 n. miles long, but ranged from 0.52 to 2.04 n. miles (n = 177, mean = 1.87 n. miles). Tows less than 2 n. miles were because of insufficient trawlable ground or the gear being hauled early because of large quantities of fish entering the net during the tow.

OEO 3A echosounder survey stations were between 0.09 and 1.02 n. miles long (n = 8, mean = 0.57 n. mile).

Hill echosounder survey stations were between 0.13 and 0.70 n. miles long (n = 18, mean = 0.22 n. miles).

Survey timing

The survey was carried out between 4 October and 13 November 1995.

Vessel and gear

Vessel specifications were given by McMillan & Hart (1994a). Trawl gear specifications, where they differ from the 1993 survey, are given in Appendix 1.

Biomass estimation

Biomass estimation was carried out for the standard survey only using the area-swept method (Francis 1981).

The effective fishing width of the net was monitored using Scanmar wingspread and doorspread sensors (Appendix 1). The distance between the wings of the net (26 m) was assumed to be the effective fishing width. The mean distance between the doors for the standard survey was 114.7 m, and consequently the vulnerability (V) was assigned a value of 0.226.

Biomass was calculated with the NIWA Trawlsurvey Analysis Program (Vignaux 1994). The combined biomass and length frequency analysis was used and biomass stations were selected from the required strata where gear performance was 1 or 2. Run parameters for the analysis included: recorded distance towed; constant doorspread of 114.7 m; catch data weight as recorded in catch table; length-weight relationship calculated for each species from data collected during the 1995 survey; fish vulnerability, 0.226; vertical availability, 1.0; areal availability, 1.0. Catch rates were expressed as kilograms per kilometre.

Biomass estimates for black oreo, smooth oreo, and orange roughy were made for fish of all lengths ("all fish") and also for fish that were considered to have recruited to the fishery ("recruited"). The length at recruitment is defined as the 50% level on the left-hand side of the total length frequency relationship for the commercial catch (McMillan & Hart 1994a). Recruited lengths were 27 cm total length (TL) for black oreo, 34 cm TL for smooth oreo, and 33 cm standard length (SL) for orange roughy.

Data recording and handling

All station data were recorded by hand on 030 forms and were then entered on to the on board computer. All the catch and biological data were entered directly on to computer in the wetlab using the digitisers. All weights including catch, individual fish, and gonad weights were measured and entered directly on to computer. Data were checked on board by scientific staff and were checked and edited at Greta Point by Alan Hart before being loaded on to the database.

Catch sampling

All catches were sorted by species and all bycatch species were weighed and recorded. Small catches totalling less than about 2 t were weighed in full on the Seaway weighers and the data recorded.

For catches over about 2 t, the weight of the smooth oreo, black oreo, or orange roughy was back-calculated from the amount of fish processed on board. This required a) the conversion factor (from unprocessed to headed and gutted state), estimated for most of the large catches from about 200 kg of unprocessed fish and, b) the weight of the processed fish, from the Scanvaegt data capture system. The weight from the Scanvaegt system was accepted only after comparison with an estimate of processed weight calculated by multiplying the hand tallies of block counts by the mean block weight. The total catch of each species was then calculated from the product of the processed weight and the conversion factor. Small specimens of the three main species that could not be processed were sorted out of large catches, weighed, recorded, and then discarded.

Rare or unusual fish were frozen for the Museum of New Zealand, Wellington, and molluscs and crustaceans were kept for NIWA collections.

Biological sampling

A sample of up to about 200 individuals each of black oreo, smooth oreo, and orange roughy (and other quota species when they were caught) was taken at each station to determine the length frequency distribution in different areas and depths. Lengths and gonad stage were recorded for most of the smooth oreo and black oreo. Length (to the nearest millimetre), weight (nearest 10 g), sex, gonad stage, gonad weight (nearest 1 g), and otoliths were collected for up to 20 individual specimens of the above three species at each station (termed "biologicals" below). Larger biological sample sizes were taken when the catch was large. These data were collected for studies of size and age structure (not described in this report), length-weight relationship, and reproductive state of the populations sampled. Reproductive state was assessed by macroscopic gonad staging using the definitions for black oreo, smooth oreo, and orange roughy given in McMillan & Hart (1994a, appendix 3). The stomachs of smooth oreo sometimes contained a large amount of water, probably taken in during capture, and the stomach was drained of excess water before weighing. Black oreo and orange roughy were weighed intact.

Scaling length data

Length frequency data were scaled or adjusted to represent the population in the survey area using the NIWA Trawlsurvey Analysis Program. Options selected for running the program were: combined biomass and length frequency; scaled to percent sampled and distance towed; stations were selected from the required strata where gear performance was 1 or 2; length-weight parameters used were obtained from data collected during the 1995 survey. The calculations within the program were described by Vignaux (1994).

Water temperatures

Surface and bottom water temperatures were recorded during the survey. The usefulness of these data is uncertain as temperature sensors are uncalibrated.

Results

Trawl stations

All station data are summarised in Appendix 2.

Standard survey. A total of 177 stations (105 in phase 1 and 72 in phase 2) was completed and used for biomass estimation (Table 1).

OEO 3A echosounder survey. A total of eight trawl stations was completed.

Hill echosounder survey. A total of 18 trawl stations was completed for all hills examined with 9 trawls carried out for the echosounder survey (Table 2).

Catch and catch rates

A summary of the catch of the 10 most abundant species from all stations from all three surveys is given in Table 3. Catches of the three main species from all stations are listed in Appendix 3. The species caught during the survey are in Appendix 4.

Standard survey. Catch and catch rates of black oreo, smooth oreo, and orange roughy by stratum and catch by subarea are presented in Table 4. Catch rates of the three main species are plotted by station in Figures 3–5.

OEO 3A echosounder survey. Catch and catch rate data are presented in Table 5.

Hill echosounder survey. Catch and catch rate data are presented in Table 6.

Biomass estimates

Biomass estimates for all quota species and commercially important non-quota species caught during the standard survey are given in Table 7. Catch and biomass estimates of hoki from the depth intervals 600–800, 800–1000, and 1000–1200 m for all catches made during daylight (0451–1813 hours New Zealand Standard Time), are in Table 8. The survey covered only a small part of the depth range of species such as hoki, hake, ling, ribaldo, and pale ghost shark and was not designed to measure their biomass.

Estimates of biomass were not made for the OEO 3A echosounder or the hill echosounder surveys because they were not designed to measure biomass.

Standard survey. Biomass estimates for all strata, individual strata, and for recruited and fish of all lengths for each of the three main species are presented in Table 9. Biomass estimates for the three main species for fish of all lengths are summarised by subarea in Table 10 and by depth for the standard survey only in Table 11.

Biological data

The numbers of length and other biological samples taken are given in Table 12.

The scaled length distributions of black oreo, smooth oreo, and orange roughy measured are given in Figure 6.

Scaled length data for black oreo, smooth oreo, and orange roughy from the depth intervals 600–800, 800–1000, and 1000–1200 m are given in Figure 7. Figure 8 presents scaled length data for the same species by three defined areas, i.e., 1, 172° 30′–176° E; 2, 176°–179° 30′ E; 3, 179° 30′ E–174° W. These areas are the same as those used by McMillan & Hart (1994b).

Length-weight relationships for the fish sampled are given in Table 13.

The results of macroscopic staging of gonads for the three species sampled throughout the survey are summarised in Table 14. A large proportion of black oreo and smooth oreo were either immature or developing (stages 1–3). Most of the orange roughy were immature or resting (stages 1–2).

Tables 15 and 16 give the observations (not scaled) of each gonad stage for the three main species by depth interval and subarea, respectively.

Water temperatures

Surface water temperatures were recorded for 201 stations and bottom water temperatures for 193 stations. Results are not reported because the data may be inaccurate.

Discussion

Catch rates from the standard survey showed a similar pattern to those from previous surveys. Highest catch rates for smooth oreo were from subarea 6, which continues to contribute the largest percentage of smooth oreo biomass. Black oreo catch rates were relatively homogenous at the western end of the survey area from subareas 1–5 at depths of 600–1000 m. The standard random trawl survey provided a satisfactory index of relative biomass for these species in those areas. In this survey and in the 1993 survey we tried to address problems with low catch rates for smooth oreo in subareas 1 and 2. In early random trawl surveys in this area (1986 and 1987) one or two fish schools were encountered during random trawling, but this has declined in recent surveys leaving uniformly low catch rates for smooth oreo. Stratifying areas of high catch in this area in 1993 and undertaking 20 additional random trawls, the "high catch rate area survey", failed to sample any smooth oreo schools and produced a lower catch rate than in the standard survey. In 1995 we carried out an echosounder transect survey to measure the frequency and distribution of fish schools in an area of subarea 1. Few substantial marks were seen during the 3.5 days of the survey. The results of this experiment (the full results will be presented elsewhere) suggest that the smooth oreo population is too small and scattered to be measured by random trawling techniques in OEO 3A.

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Table 1: **Subareas, strata, and numbers of stations for the standard survey**

Stratum	Depth (m)	Area (km^2)	No. of stations		
			Phase 1	Phase 2	Total
Subarea 1					
1	600–800	3 630	3	0	3
2	800–1000	3 167	6	0	6
3	1000–1200	3 351	6	0	6
	Subtotal	10 148	15	0	15
Subarea 2					
4	600–800	4 180	3	0	3
5	800–1000	3 248	3	0	3
6	1000–1200	3 474	3	0	3
	Subtotal	10 902	9	0	9
Subarea 3					
7	600–1200	4 875	3	0	3
Subarea 4					
8	600–800	2 909	3	0	3
10	900–1000	1 361	6	6	12
11	1000–1100	1 580	6	0	6
12	1100–1200	2 242	6	0	6
	Subtotal	9 468	24	6	30
Subarea 5					
13	600–800	1 922	3	0	3
14	800–1000	2 366	3	0	3
15	1000–1200	2 380	3	0	3
16	1200–1500	3 990	3	0	3
	Subtotal	10 658	12	0	12
Subarea 6					
17	600–800	2 106	3	0	3
18	800–900	1 295	6	25	31
19	900–1000	1 039	6	38	44
20	1000–1100	1 159	6	0	6
21	1100–1200	1 094	6	0	6
22	1200–1500	4 085	3	3	6
	Subtotal	10 778	30	66	96
Subarea 7					
23	600–800	930	3	0	3
24	800–1000	547	3	0	3
25	1000–1200	846	3	0	3
26	1200–1500	1 351	3	0	3
	Subtotal	3 674	12	0	12
Total		60 503	105	72	177

Table 2: **Hill (including echosounder survey) strata and numbers of trawl stations**

Hill	Stratum	Area (km^2)	No. of stations
Trevs Pinnacle	30	1	2
Condoms	31	3	2
Hegerville	36	9	9
Neils Pinni	37	10	2
Mt Sally	38	3	2
Mt Nelson	39	1	1
Total		28	18

Table 3: **Total catch, percentage catch composition by weight, and number of stations at which the species was caught for the 10 most abundant species from all valid trawl stations combined (standard, OEO 3A echosounder, and hill echosounder surveys)**

	Total catch (kg)	Percentage composition	No. of stations
Smooth oreo	127 581	71.9	186
Black oreo	16 489	9.3	171
Orange roughy	4 503	2.5	118
Shovelnosed dogfish	4 508	2.5	93
Baxter's lantern dogfish	4 173	2.3	193
Hoki	2 557	1.4	116
Fourrayed rattail	1 824	1.0	137
Smallscaled brown slickhead	1 706	1.0	130
Johnson's cod	1 394	0.8	149
Bigscaled brown slickhead	1 243	0.7	59
All other species	11 445	6.5	
All species	177 423		

Table 4: **Catch, percentage of total catch, and mean catch rate of black oreo (BOE), smooth oreo (SSO), and orange roughy (ORH) by stratum and subarea from the standard survey**

	Catch (kg)				% of total catch			Mean catch rate (kg.km^{-1})		
Stratum	BOE	SSO	ORH	All species	BOE	SSO	ORH	BOE	SSO	ORH
Subarea 1										
1	1 067	1	0	1 421	75.1	0.1	0.0	99	0	0
2	378	46	0	1 036	36.5	4.4	0.0	17	2	0
3	43	28	0	672	6.4	4.2	0.0	2	1	0
Subtotal	1 489	75	0	3 129	47.6	2.4	0.0			
Subarea 2										
4	453	2	0	1 111	40.8	0.2	0.0	46	0	0
5	341	17	0	541	63.0	3.1	0.0	32	2	0
6	1	3	0	295	0.3	1.0	0.0	0	0	0
Subtotal	796	22	0	1 947	40.9	1.1	0.0			
Subarea 3										
7	629	5	0	1 023	61.5	0.5	0.0	56	0	0
Subtotal	629	5	0	1 023	61.5	0.5	0.0			
Subarea 4										
8	1 148	6	0	1 528	75.2	0.4	0.0	103	1	0
9	946	31	3	1 284	73.7	2.4	0.2	85	3	0
10	1 780	3 804	13	6 935	25.7	54.9	0.2	40	86	0
11	27	27	7	656	4.1	4.1	1.1	1	1	0
12	34	50	0	533	6.4	9.4	0.0	2	2	0
Subtotal	3 936	3 918	22	10 936	36.0	35.8	0.2			
Subarea 5										
13	532	6	0	1 114	47.8	0.5	0.0	49	1	0
14	92	5	4	661	13.9	0.8	0.7	8	0	0
15	4	15	15	373	1.1	4.0	4.0	0	1	1
16	0	1	0	216	0.0	0.6	0.0	0	0	0
Subtotal	628	27	20	2 363	26.6	1.2	0.8			
Subarea 6										
17	114	48	0	727	15.7	6.6	0.0	12	4	0
18	982	33 393	156	39 838	2.5	83.8	0.4	11	365	2
19	1 177	59 077	1 920	69 648	1.7	84.8	2.8	12	620	15
20	35	1 981	104	3 240	1.1	61.1	3.2	2	90	5
21	6	2 292	18	3 321	0.2	69.0	0.5	0	194	1
22	1	189	9	1 388	0.1	13.6	0.6	0	9	0
Subtotal	2 315	96 980	2 207	118 161	2.0	82.0	1.8			
Subarea 7										
23	1	2	11	702	0.1	0.3	1.6	0	0	1
24	2	3	115	977	0.2	0.3	11.8	0	0	12
25	25	18	398	1 023	2.4	1.8	38.9	2	2	36
26	0	7	43	296	0.0	2.4	14.5	0	1	4
Subtotal	28	31	566	2 998	0.9	1.0	18.9			
Total	9 820	101 058	2 815	140 557	7.0	71.9	2.0			

Table 5: **Catch, percentage of total catch, and mean catch rate of black oreo (BOE), smooth oreo (SSO), and orange roughy (ORH) from the OEO 3A echosounder survey trawl stations**

	Catch (kg)				% of total catch			Mean catch rate (kg.km^{-1})		
Stratum	BOE	SSO	ORH	All species	BOE	SSO	ORH	BOE	SSO	ORH
0103	5 168	10 622	0	16 669	31.0	63.7	0	824	6 920	0

Table 6: **Catch, percentage of total catch, and mean catch rate of black oreo (BOE), smooth oreo (SSO), and orange roughy (ORH) from the hill target identification trawl stations**

		Catch (kg)				% of total catch			Mean catch rate (kg.km^{-1})*		
Hill	Stratum	BOE	SSO	ORH	All species	BOE	SSO	ORH	BOE	SSO	ORH
Trevs Pinnacle	30	103	2 120	11	2 300	4.5	92.1	0.5	106	4 062	11
Condoms	31	50	490	145	713	7.0	68.7	20.4	84	839	272
Hegerville	36	551	12 100	1 196	14 477	3.8	83.6	8.3	103	2 806	111
Neils Pinni	37	606	336		1 190	50.9	28.2	0.0	625	349	0
Mt Sally	38	69	281		432	15.9	65.0	0.0	117	530	0
Mt Nelson	39	1 21	574	336	1 079	11.2	53.2	31.2	272	1 290	756
Total		1 498	15 900	1 688	20 191	7.4	78.7	8.4			

* Mean catch rate (kg.km^{-1}) was taken from the biomass mean catch rate calculation which is scaled by a fish vulnerability of 0.226.

Table 7: **Biomass estimates (for fish of all lengths) for all quota species and commercially important non quota species and all other species caught during the standard survey***

	Biomass (t)	*c.v.* (%)
Black oreo	63 249	18.9
Smooth oreo	63 078	22.9
Hoki	16 399	37.7
Pale ghost shark	7 065	12.7
Shovelnosed dogfish	4 803	10.1
Orange roughy	2 861	37.6
Hake	1 490	60.3
Ribaldo	574	38.2
Ling	232	47.1
All other species	50 261	
Total	210 307	9.5

* The total biomass was calculated using the "Biopc" program held on the main computer at Greta Point. The vulnerability value used in that calculation was restricted to two decimal points i.e., 0.23 was used rather than the 0.226 which was used for the rest of the biomass calculations.

Table 8: **Catch and biomass of hoki (all lengths) from catches taken during the standard survey between 0451 and 1813 hours NZST**

Depth (m)	Catch (kg)	Biomass (t)	*c.v.* (%)	No. of stations at which caught
600–800	872.2	17 180	49.4	14
800–1000	514.7	819	23.0	45
1000–1200	30.0	179	55.4	5

Table 9 : **Biomass estimates (t) for fish of all lengths (all fish) and for recruited fish for black oreo, smooth oreo, and orange roughy***

Stratum	Area (km^2)	No. of stations	Black oreo			Smooth oreo			Orange roughy					
			All fish	*c.v.* (%)	Recruited	*c.v.* (%)	All fish	*c.v.* (%)	Recruited	*c.v.* (%)	All fish	*c.v.* (%)	Recruited	*c.v.* (%)
Subarea 1														
1	3 630	3	13 867	38	12 282	55	14	100	0	0	0	0	0	0
2	3 167	6	2 089	44	1 884	44	256	86	104	60	0	0	0	0
3	3 351	6	247	45	221	45	163	44	90	52	0	0	0	0
Subarea 2														
4	4 180	3	7 383	11	5 924	7	25	100	25	0	0	0	0	0
5	3 248	3	4 072	31	3 350	31	209	50	107	57	0	0	0	0
6	3 474	3	10	100	10	100	41	21	14	100	0	0	0	0
Subarea 3														
7	4 875	3	10 619	53	8 604	51	80	56	0	0	0	0	0	0
Subarea 4														
8	2 909	3	11 596	73	10 948	74	63	98	13	100	0	0	0	0
9	1 376	3	4 508	62	4 435	63	147	41	57	13	12	53	7	100
10	1 361	12	2 106	31	2 068	32	4 504	59	3 265	61	15	32	8	54
11	1 580	6	75	47	64	53	74	45	42	49	19	48	12	68
12	2 242	6	136	50	128	51	197	59	158	58	0	0	0	0
Subarea 5														
13	1 922	3	3 622	16	3 051	27	40	58	17	100	0	0	0	0
14	2 366	3	752	50	715	50	44	69	8	100	35	51	29	50
15	2 380	3	29	57	21	50	125	35	79	72	126	77	96	70
16	3 990	3	0	0	0	0	17	100	17	100	0	0	0	0
Subarea 6														
17	2 106	3	969	54	492	59	359	75	0	0	0	0	0	0
18	1 295	31	528	31	461	34	18 235	25	6 770	39	85	25	20	40
19	1 039	44	460	48	429	51	24 864	42	16 233	59	596	25	169	40
20	1 159	6	76	37	60	37	4 002	78	103	76	215	43	124	31
21	1 094	6	17	71	16	73	8 178	93	291	59	45	36	32	50
22	4 085	6	8	100	5	100	1 341	43	882	46	66	63	50	66
Subarea 7														
23	930	3	5	100	5	100	5	100	0	0	34	82	4	100
24	547	3	4	100	2	100	7	30	0	0	243	78	118	93
25	846	3	74	84	70	85	54	54	25	50	1 170	89	231	67
26	1 351	3	0	0	0	0	35	70	32	68	200	43	166	50
Total	60 503	177	63 249		55 245		63 078		28 313		2 861		1 066	
Lower bound			39 246		33 873		34 248		7 912		694		594	
Upper bound			87 251		76 616		91 909		48 714		5 028		1 538	
c.v. (%)			19.0		19.3		22.9		36.0		37.9		22.1	

* Recruited size for black oreo is ≥ 27 cm TL, for smooth oreo ≥ 34 cm TL and for orange roughy ≥ 33 cm SL (McMillan & Hart 1994a).

† ± 2 standard deviations.

Table 10: **Biomass estimates for fish of all lengths by subarea for black oreo (BOE), smooth oreo (SSO), and orange roughy for the standard survey subareas**

Subarea	Area (km²)	% of area	Biomass (t) BOE	SSO	ORH	% of biomass BOE	SSO	ORH
1	10 148	16.8	16 203	433	0	25.6	0.7	0.0
2	10 902	18.0	11 464	275	0	18.1	0.4	0.0
3	4 875	8.1	10 619	80	0	16.8	0.1	0.0
4	9 468	15.6	18 420	4 984	46	29.1	7.7	0.9
5	10 658	17.6	4 403	225	162	6.9	0.3	3.2
6	10 778	17.8	2 057	56 980	1 007	3.3	87.6	35.2
7	3 674	6.1	83	101	1 647	0.1	0.2	57.6
Total	60 503		63 249	63 078	2 861			

Table 11: **Biomass estimates for fish of all lengths by depth for black oreo (BOE), smooth oreo (SSO), and orange roughy for the standard survey**

Depth interval	Area (km²)	Biomass (t) BOE	SSO	ORH	% of biomass BOE	SSO	ORH
600-800	15 677	37 441	506	34	71.1	0.8	1.2
800-1000	14 399	14 517	48 266	985	27.6	76.6	34.4
1000-1200	16 126	664	12 835	1 576	1.3	20.4	55.1
1200-1500	9 426	8	1 392	266	0.0	2.2	9.3
All depths	55 628	52 630	62 999	2 861			

NB: excludes subarea 3 (600–1200 m).

Table 12: **Number of length and sex and "biological" samples taken during TAN9511**

	Length & sex	Staged	"Biological"	Otoliths
Smooth oreo	19 393	16 210	2 733	yes
Black oreo	12 560	8 923	1 799	yes
Orange roughy	4 608	1 743	1 192	yes
Hoki	1 584	2	124	
Pale ghost shark	441			
Hake	62	5	4	
Ribaldo	56	3		
Bigscaled brown slickhead	46	46		
Smallscaled brown slickhead	40	39	23	
Warty oreo	20	20		
Lookdown dory	16			
Violet cod	8	8		
Robust cardinalfish	8	7		
Ling	7	1		
Serrulate rattail	7	7		
Sea perch	5			
Kaiyomaru rattail	5	5		
Tubbia tasmanica	3	3		
Ray's bream	3			
Black javelinfish	2	2		
Squaretail	1	1		
Oxeye oreo	1	1		
Alfonsino	1			

Table 13: **Length-weight relationships for oreos and orange roughy**

	Weight range (g)	Length range (cm)	*a*	*b*	r^2	*n*
Black oreo	225–1 575	21.6–40.0	0.010	3.20	99.9	1 770
Smooth oreo	55–2 735	15.9–47.0	0.027	2.93	97.1	2 650
Orange roughy	36–2 305	9.5–42.0	0.077	2.75	99.7	1 099

* $W = a.L^b$. Lengths are total length for oreos, and standard length for orange roughy. n = number of observations. Length - weight relationships used in calculating biomass for species other than black oreo, smooth oreo and orange roughy are taken from Schofield & Livingston (1995).

Table 14: **Relative proportions of gonad stages sampled during TAN9511 (data are unscaled)**

	Black oreo				Smooth oreo				Orange roughy			
Gonad stage	Male	%	Female	%	Male	%	Female	%	Male	%	Female	%
1	2 592	54.3	1 670	40.2	3 244	36.6	4 239	57.7	546	68.9	398	41.9
2	1 255	26.3	1 697	40.9	1 456	16.4	1 883	25.6	245	30.9	547	57.5
3	750	15.7	519	12.5	2 151	24.3	517	7.0	1	0.1	5	0.5
4	136	2.8	218	5.3	1 949	22.0	560	7.6				
5	42	0.9	19	0.5	66	0.7	93	1.3				
6			25	0.6			52	0.7			1	0.1
7	1	0.1	2	0.1	2	0.1						
Total *n*	4 776		4 150		8 868		7 344		791		951	

Table 15: **Percentage of unscaled gonads at stage by species by depth range from the standard survey only *(data are unscaled)**

Black oreo

	Males						Females						
Depth range (m)	1	2	3	4	5	*n*	1	2	3	4	5	6	*n*
600–800	61.2	27.1	9.8	1.6	0.3	774	44.6	39.7	13.2	1.7	0.3	0.5	756
800–1000	53.1	25.1	16.8	3.6	1.4	2 355	36.2	43.3	11.5	7.4	0.7	0.9	1 991
1000–1200	67.2	27.9	4.9			122	44.8	41.0	11.9	1.5		0.7	134
1200–1500		100.0				1	100.0						1
Total *n*	1 806	835	478	97	35	3 252	1 126	1 214	345	159	15	23	2 882

Smooth oreo

	Males						Females						
Depth range (m)	1	2	3	4	5	*n*	1	2	3	4	5	6	*n*
600–800	77.5	10.0	10.0	2.5		40	96.0	4.0					25
800–1000	42.7	17.2	17.5	21.8	0.8	6 198	61.6	22.4	6.3	7.4	1.3	0.9	5 231
1000–1200	51.5	13.1	28.4	6.8		471	82.4	16.3	0.8	0.5			398
1200–1500	15.9	21.7	39.9	22.5		138	48.9	44.6	4.3	2.2			92
Total *n*	2 943	1 160	1 277	1 417	50	6 847	3 653	1 276	327	380	67	43	5 746

Orange roughy

	Males			Females				
Depth range (m)	1	2	*n*	1	2	3	6	*n*
600–800	100.0		14	88.2	11.8			17
800–1000	78.1	21.9	494	59.1	40.5	0.4		548
1000–1200	67.4	32.6	89	36.0	63.2		0.9	114
1200–1500	27.8	72.2	18		100.0			21
Total *n*	464	150	615	380	317	2	1	700

* Excludes subarea 3.

Table 16: **Percentage of gonads at stage by species by subarea from the standard and OEO 3A echosounder and hill target identification stations**

Black oreo

	Males						Females						
Subarea	1	2	3	4	5	*n*	1	2	3	4	5	6	*n*
1	58.0	36.7	5.0	0.0	0.3	343	30.0	57.1	12.5	0.3	0.0	0.0	343
2	88.0	7.1	4.6	0.0	0.3	308	65.3	28.9	5.5	0.0	0.3	0.0	291
3	63.6	27.7	8.3	0.5	0.0	206	57.7	32.1	8.3	1.8	0.0	0.0	168
4	41.5	40.4	16.9	0.9	0.4	1 138	20.5	54.3	16.9	6.1	0.8	1.4	1 134
5	62.3	27.3	7.4	2.8	0.3	326	49.1	36.8	11.2	3.0	0.0	0.0	269
6	58.2	12.1	20.3	6.9	2.5	1 136	55.4	25.9	7.6	9.6	0.6	0.8	844
7	0.0	0.0	0.0	0.0	0.0	0	100.0	0.0	0.0	0.0	0.0	0.0	1
Hills	56.0	19.2	21.9	2.3	0.6	688	58.3	28.4	6.1	6.3	0.4	0.4	521
103	42.9	36.7	16.5	3.5	0.5	630	24.8	48.7	22.2	4.0	0.3	0.0	577
Total *n*	2 592	1 255	750	136	42	4 775	1 670	1 697	519	218	19	25	4 148

Smooth oreo

	Males						Females						
Subarea	1	2	3	4	5	*n*	1	2	3	4	5	6	*n*
1	44.9	21.7	21.7	11.6	0.0	69	61.0	33.9	5.1				59
2	61.5	7.7	15.4	15.4	0.0	13	60.0	20.0	20.0				15
3	100.0	0.0	0.0	0.0	0.0	4	100.0						7
4	11.2	13.6	39.8	35.4	0.0	573	40.2	28.7	17.9	12.3	0.9		341
5	24.0	12.0	60.0	4.0	0.0	25	69.2	30.8					13
6	45.9	17.3	16.5	19.6	0.8	6 132	65.0	21.7	4.9	6.4	1.2	0.8	5 291
7	57.1	11.4	20.0	11.4	0.0	35	92.6	3.7		3.7			27
Hills	16.8	15.2	35.0	32.0	1.0	1 516	42.6	37.9	5.7	11.3	1.7	0.8	1 173
103	8.6	13.0	68.6	9.4	0.2	499	19.4	40.1	29.5	11.6	1.5		418
Total *n*	3 244	1 456	2 151	1 949	66	8 866	4 239	1 883	517	560	93	52	7 344

Orange roughy

	Males			Females			
Subarea	1	2	*n*	1	2	3	*n*
1			0				0
2			0				0
3			0				0
4	44.4	55.6	9	20.0	70.0	10.0	10
5	62.5	37.5	8	11.1	88.9		9
6	76.7	23.1	510	55.9	43.7	0.2	581
7	72.4	27.6	87	52.0	48.0		100
Hills	46.3	53.7	177	7.2	91.6	1.2	251
Total *n*	546	245	791	398	547	5	951

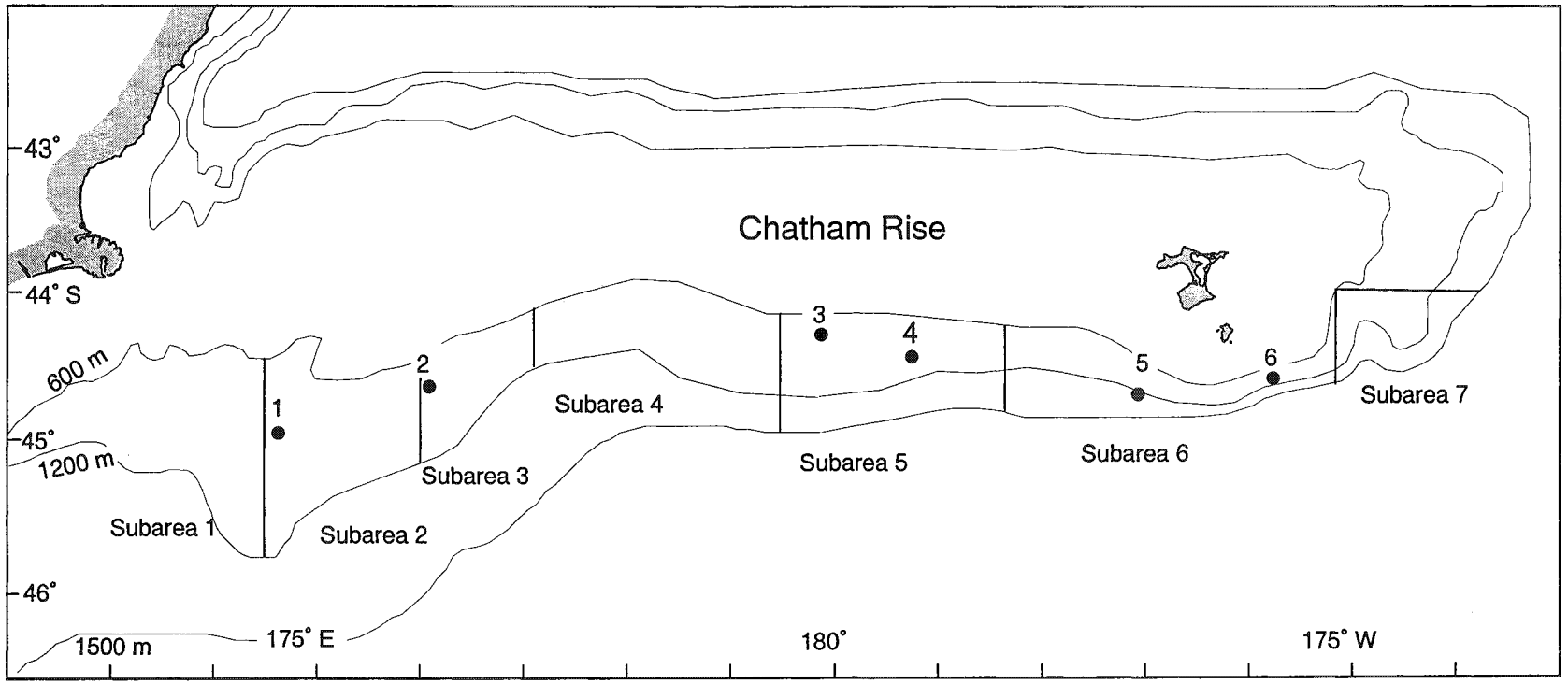

Figure 1: Survey area showing subareas and locations of hills sampled: 1, Neil's Pinni; 2, Mt Sally; 3, Mt Nelson; 4, Trev's Pinnacle; 5, Hegerville; 6, Condom's.

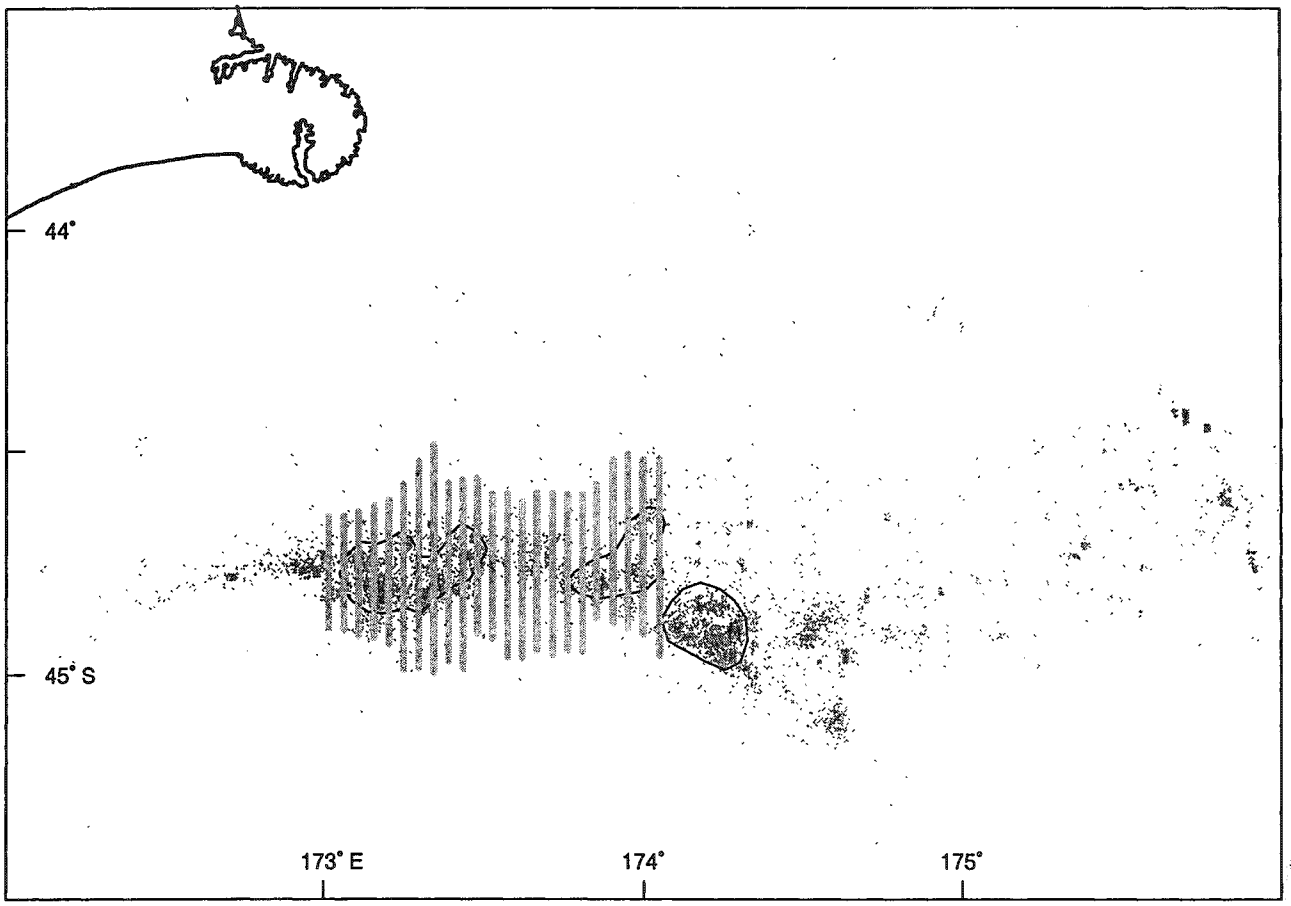

Figure 2: OEO 3A echosounder survey transects (shaded lines), dots show targeted shots which caught smooth oreo from 1979 to 1994. The three polygons indicate where the majority of the smooth oreo was caught in that period.

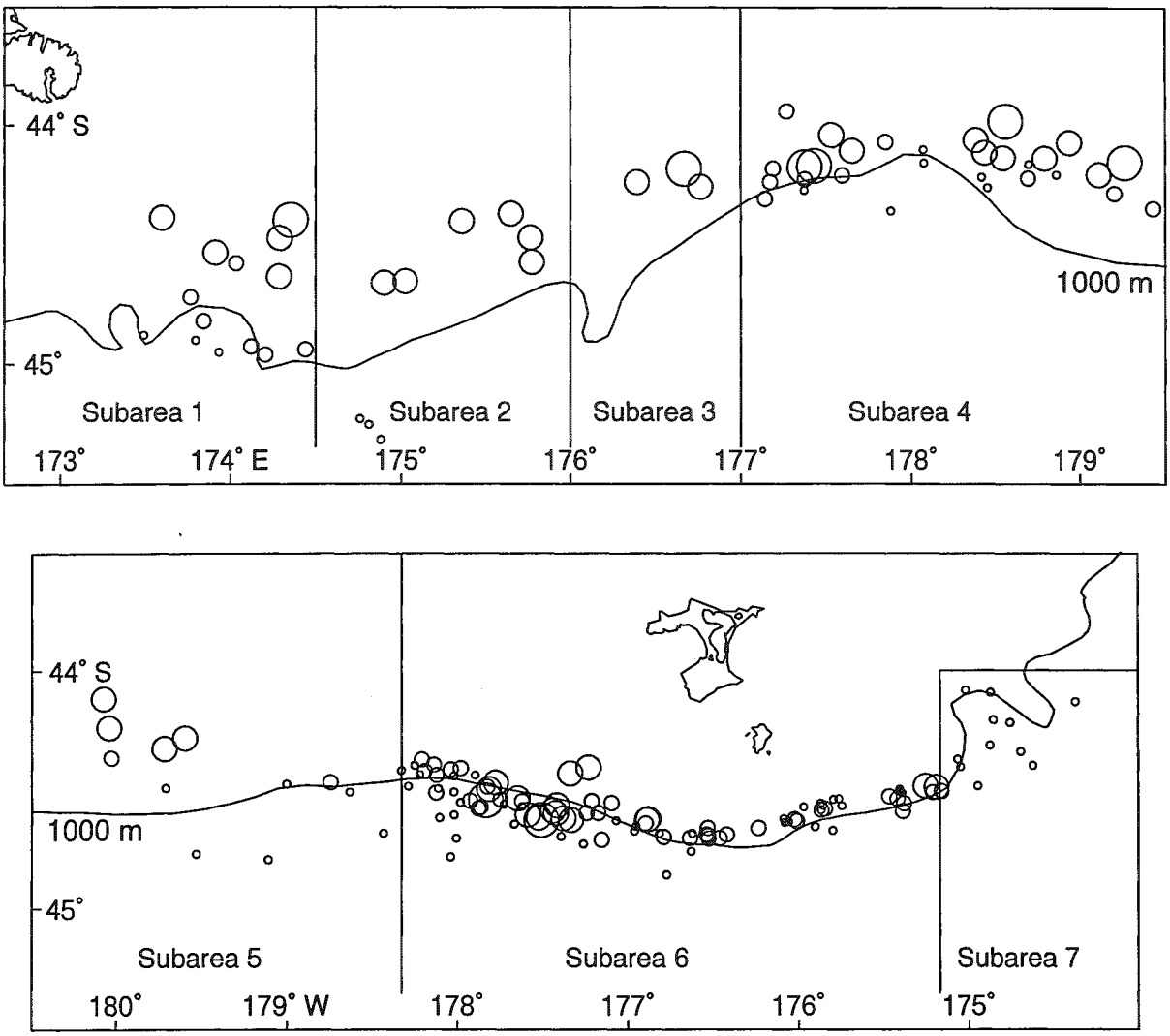

Figure 3: Catch rates (kg.km^{-1}) of black oreo.

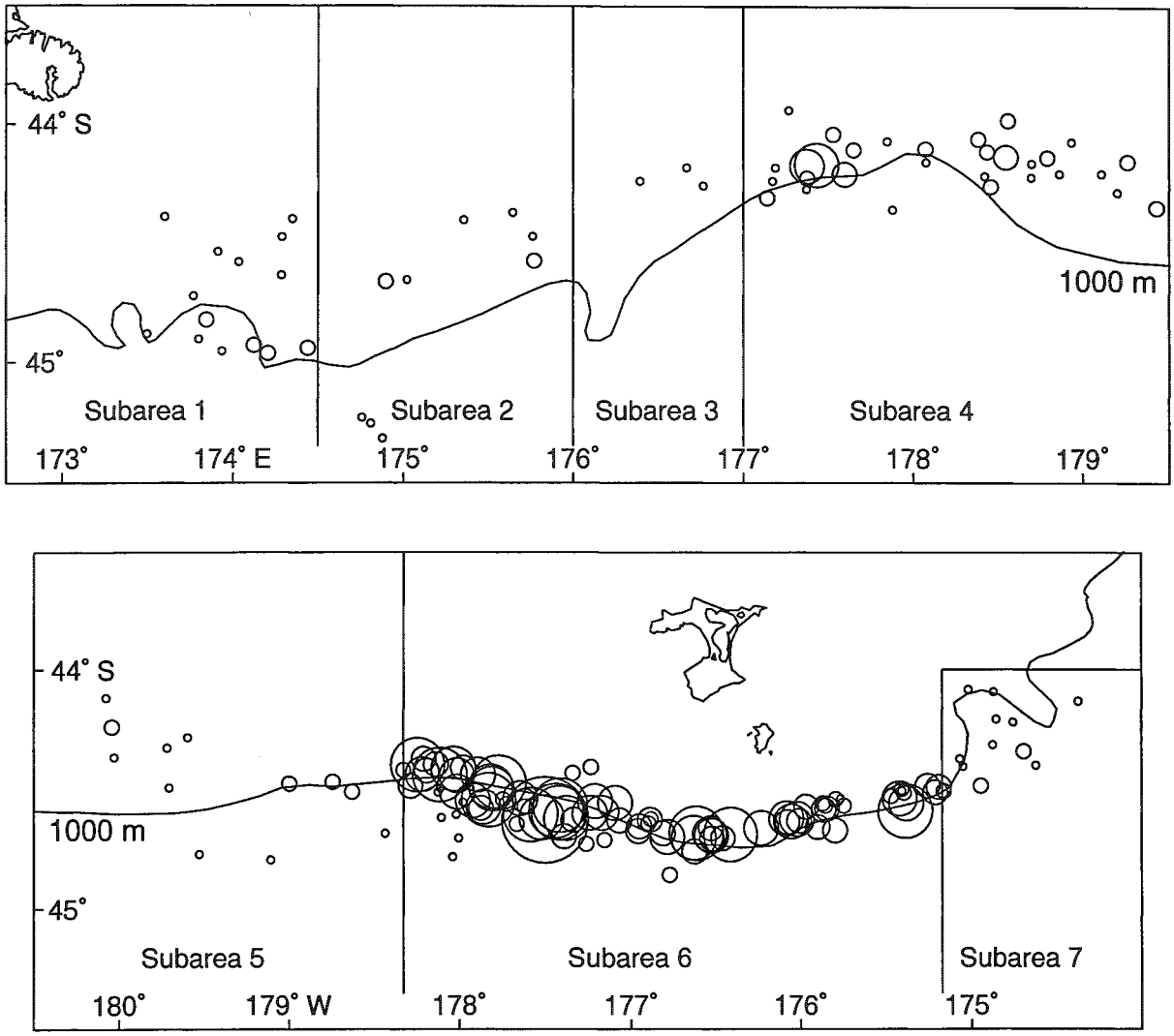

Figure 4: Catch rates (kg.km^{-1}) of smooth oreo.

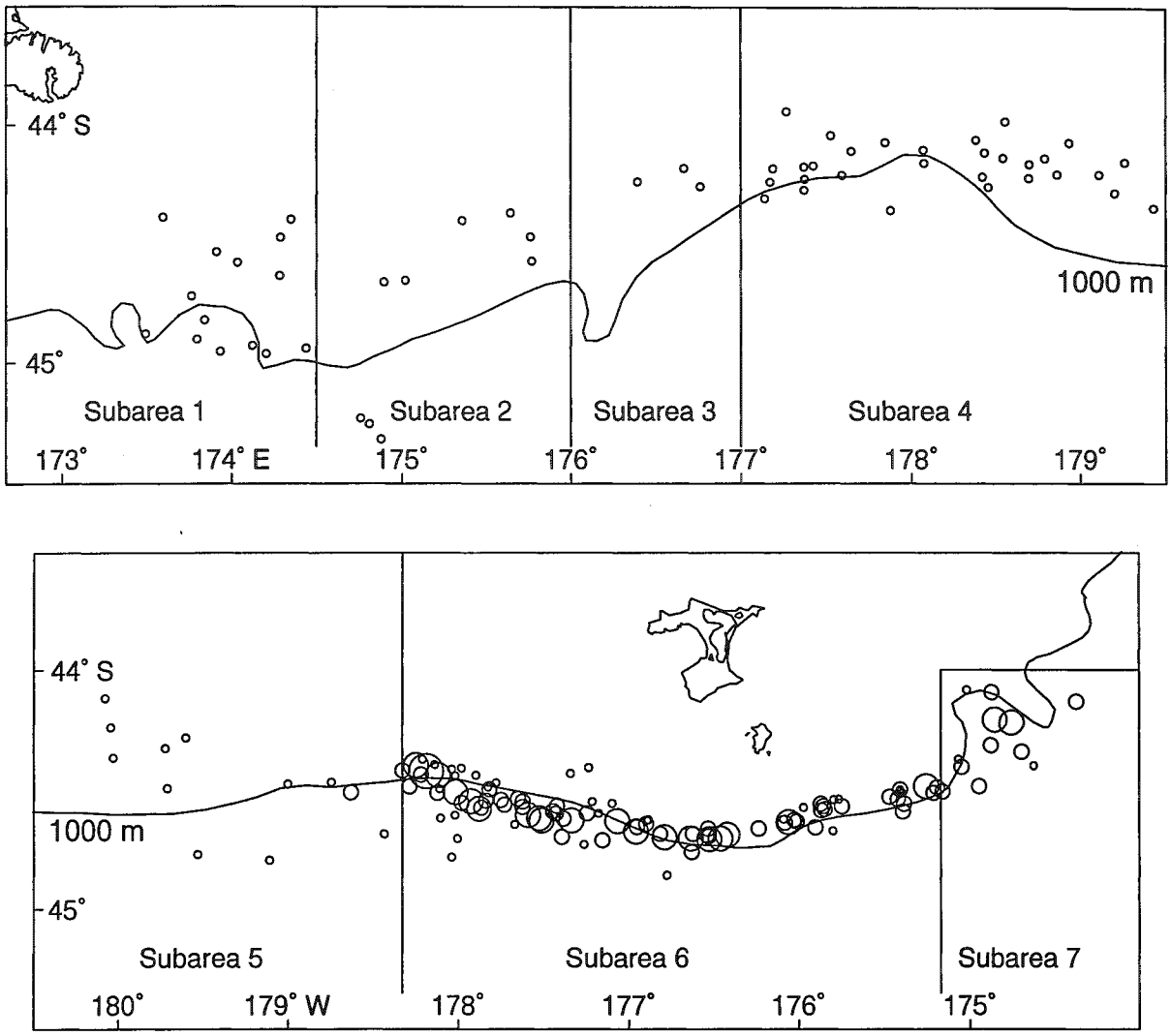

Figure 5: Catch rates (kg.km^{-1}) of orange roughy.

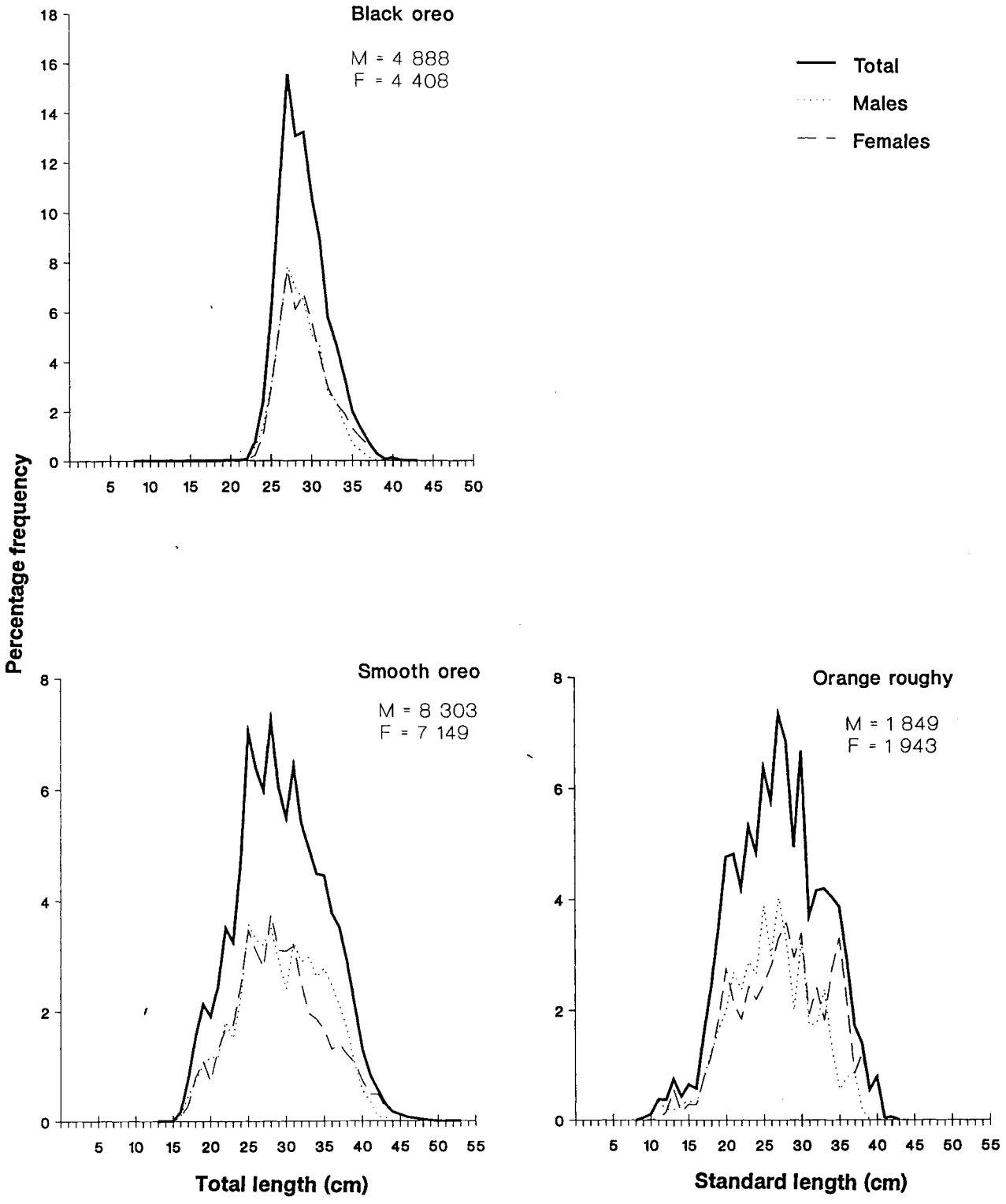

Figure 6: Scaled distribution of black oreo, smooth oreo, and orange roughy length samples for the entire survey area.

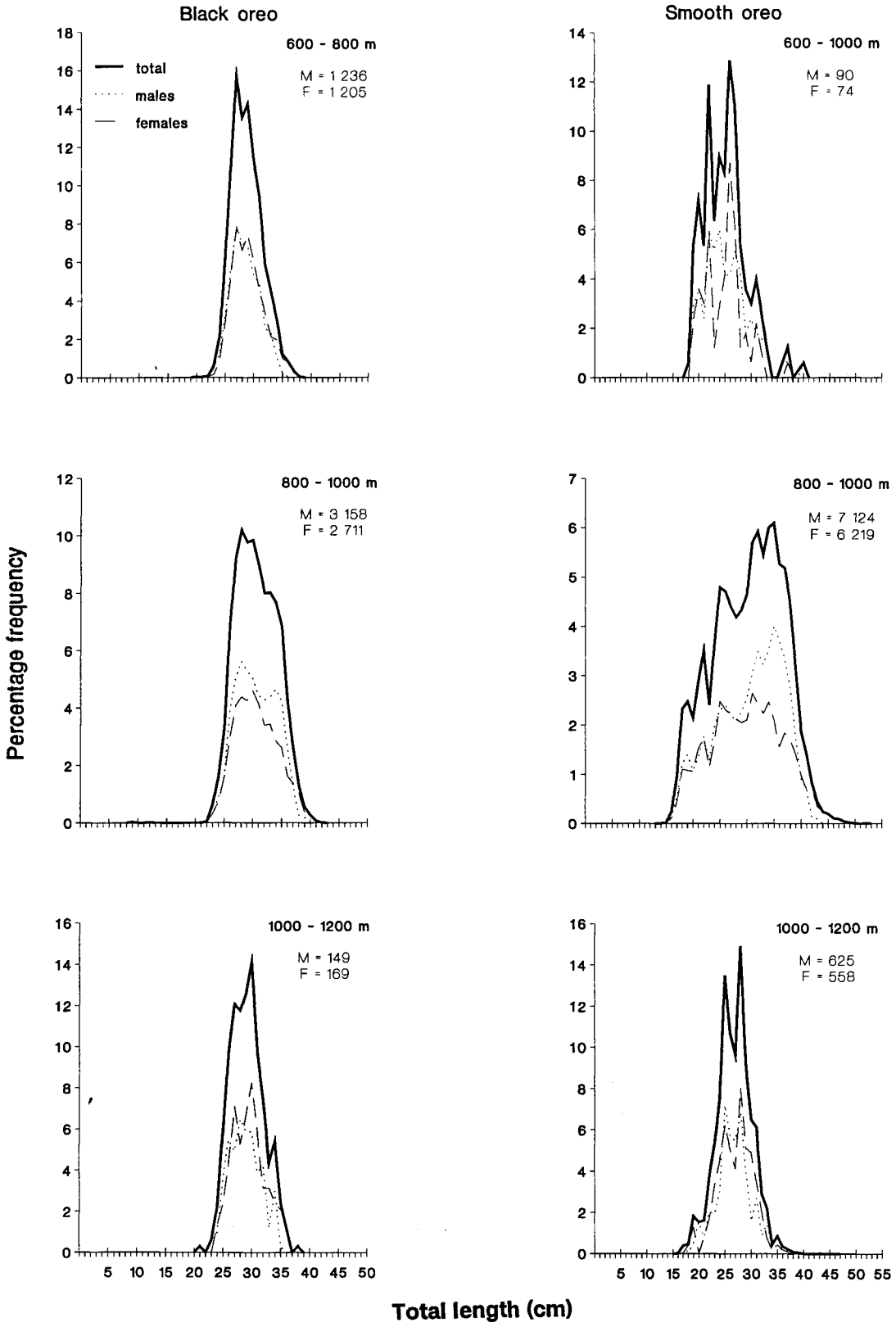

Figure 7: Scaled distribution of length data for black oreo, smooth oreo, and orange roughy by depth interval.

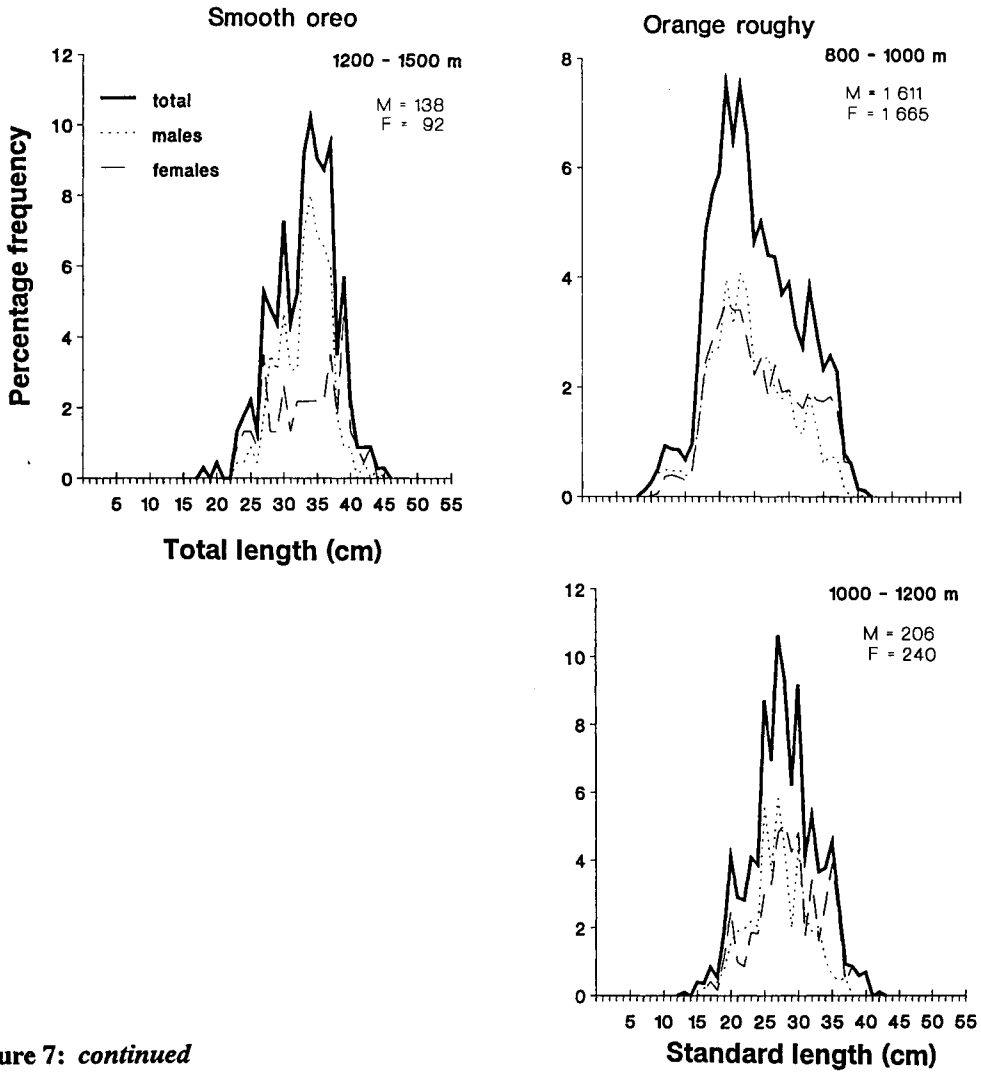

Figure 7: ***continued***

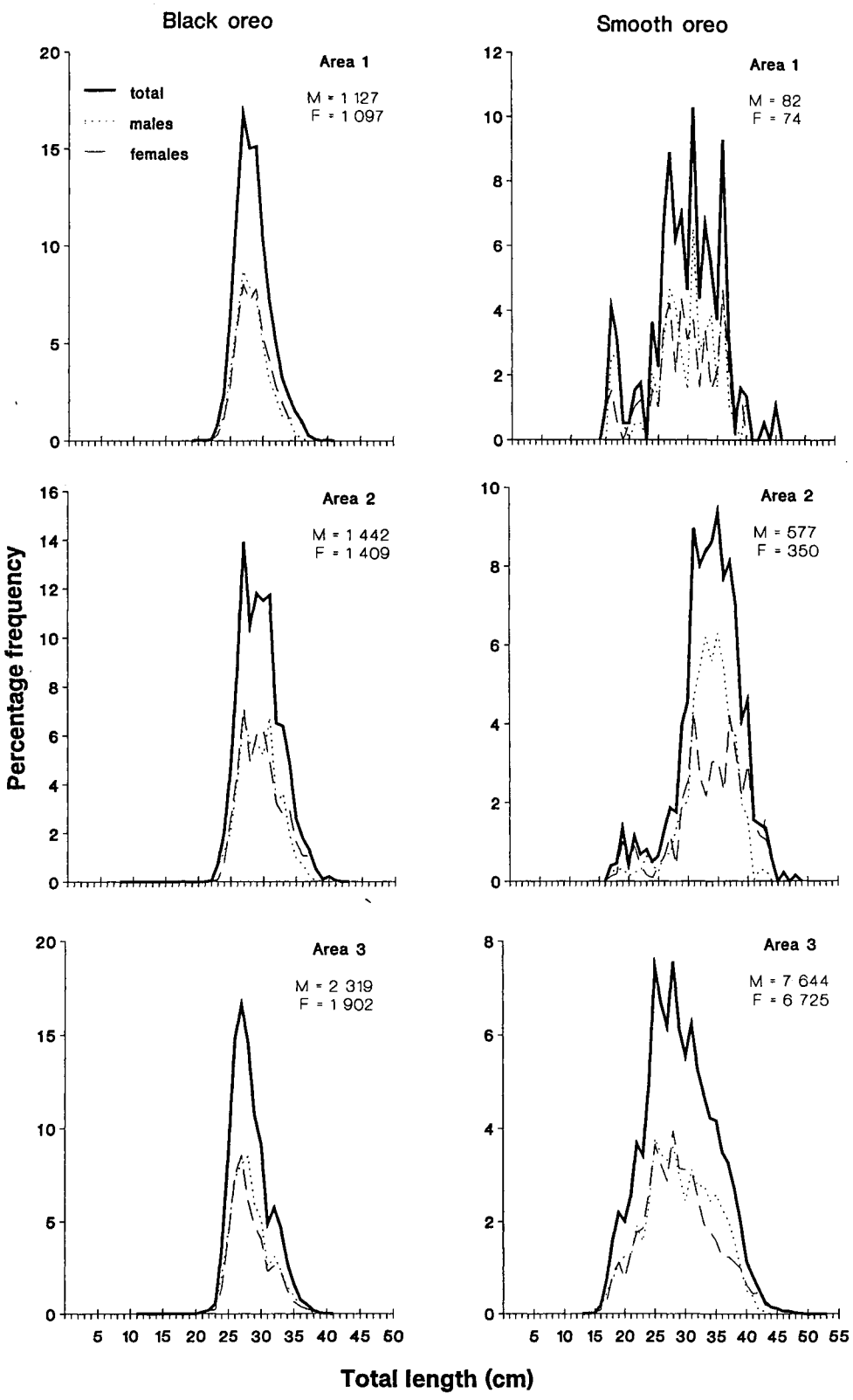

Figure 8: Scaled distribution of length data for black oreo, smooth oreo, and orange roughy by area. Area 1, 172° 30' – 176°E; area 2, 176° – 179° 30' E; area 3, 179° 30' E – 174°

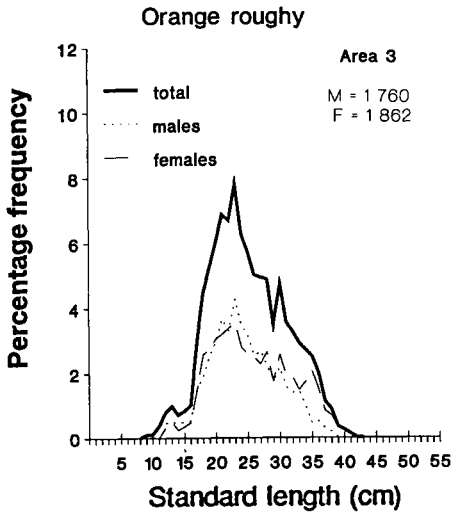

Figure 8—*continued*

Appendix 1: Gear specifications and performance for TAN9511, see McMillan & Hart (1994a, 1994b) for details of the gear

Summary of gear performance measurements from net monitor (†) and Scanmar net telemetry gear (‡):

	Range (m)	Mean (m)	Median (m)	No. of tows
Standard survey				
Headline height †	5.1–10.0	6.7	6.7	176
Distance between doors ‡	95.0–128.0	114.7	115.0	133
Distance between wings ‡	25.5–26.3	25.8	25.9	5

Note: At each station a range of values was noted, where possible, for headline height and the distance between the doors. The value recorded for that station was the one considered to have been in effect for most of the distance towed.

Appendix 2: **Summary of station data for TAN9511**

Station	Stratum	Date 1995	Start Latitude ° 'S	Start Longitude ° 'E/W	Finish Latitude ° 'S	Finish Longitude ° 'E/W	Depth (m) Min.	Depth (m) Max.	Distance towed (n. mile)	Warp length (m)
1	2	5 Oct	44 48.75	172 32.22 E	44 48.49	172 35.02 E	921	934	2.00	1680
2	3	5 Oct	44 52.94	173 29.59 E	44 52.63	173 26.79 E	1 127	1 162	2.00	2070
3	3	6 Oct	44 54.19	173 47.75 E	44 55.91	173 49.22 E	1 150	1 167	2.01	2000
4	3	6 Oct	44 49.41	173 50.38 E	44 51.03	173 48.72 E	995	1 020	2.00	1890
5	1	6 Oct	44 23.53	173 35.90 E	44 22.68	173 37.64 E	656	666	1.51	1160
6	2	6 Oct	44 32.21	173 54.50 E	44 31.58	173 57.16 E	801	820	2.00	1440
7	2	6 Oct	44 34.91	174 01.86 E	44 35.49	173 59.16 E	877	894	2.01	1590
8	1	6 Oct	44 24.05	174 20.80 E	44 22.85	174 23.02 E	689	697	1.99	1260
9	1	6 Oct	44 28.66	174 17.17 E	44 30.66	174 16.58 E	738	756	2.04	1380
10	2	6 Oct	44 38.26	174 16.93 E	44 38.21	174 14.09 E	882	924	2.00	1620
11	3	7 Oct	44 55.88	174 07.34 E	44 55.80	174 04.53 E	1 009	1 067	1.99	2000
12	3	7 Oct	44 57.23	173 55.89 E	44 57.30	173 58.72 E	1 174	1 184	2.00	2050
13	3	7 Oct	44 57.94	174 12.31 E	44 59.01	174 14.72 E	1 031	1 042	2.01	2000
14	2	7 Oct	44 56.51	174 26.35 E	44 58.26	174 25.63 E	942	991	1.82	1750
15	6	7 Oct	45 15.31	174 48.39 E	45 13.75	174 50.16 E	1 068	1 085	2.00	1930
16	6	7 Oct	45 19.05	174 52.61 E	45 18.82	174 49.76 E	1 090	1 110	2.00	1980
17	6	7 Oct	45 13.86	174 45.31 E	45 11.90	174 44.74 E	1 051	1 053	2.00	1890
18	5	8 Oct	44 39.88	174 53.57 E	44 39.94	174 51.20 E	800	825	1.69	1460
19	5	8 Oct	44 39.43	175 01.29 E	44 39.39	175 04.10 E	824	855	2.00	1450
20	4	8 Oct	44 22.46	175 38.81 E	44 23.70	175 40.99 E	690	728	1.99	1320
21	4	8 Oct	44 28.52	175 45.71 E	44 29.44	175 46.87 E	755	769	1.24	1350
22	5	8 Oct	44 34.69	175 46.18 E	44 33.68	175 48.60 E	834	863	2.00	1530
23	7	8 Oct	44 14.54	176 23.49 E	44 15.57	176 21.10 E	619	673	2.00	1210
24	7	9 Oct	44 11.08	176 39.83 E	44 10.71	176 42.59 E	655	658	2.01	1170
25	7	9 Oct	44 15.63	176 45.58 E	44 15.21	176 48.30 E	810	846	1.99	1470
26	12	9 Oct	44 18.73	177 08.53 E	44 18.87	177 11.35 E	1 085	1 118	2.02	1990
27	9	9 Oct	44 11.09	177 11.32 E	44 12.97	177 10.32 E	841	887	2.01	1580
28	8	9 Oct	43 56.49	177 16.09 E	43 56.24	177 18.85 E	603	613	2.00	1100
29	10	9 Oct	44 10.30	177 25.63 E	44 10.35	177 22.85 E	915	930	2.00	1710
30	11	9 Oct	44 13.70	177 22.57 E	44 13.32	177 25.31 E	1 002	1 044	2.00	1800
31	11	9 Oct	44 16.54	177 22.26 E	44 16.08	177 19.53 E	1 074	1 087	2.00	1960

Station	Stratum	Date 1995	Start Latitude ° 'S	Start Longitude ° 'E/W	Finish Latitude ° 'S	Finish Longitude ° 'E/W	Depth (m) Min.	Depth (m) Max.	Distance towed (n. mile)	Warp length (m)
32	9	10 Oct	44 02.47	177 31.81 E	44 03.58	177 29.47 E	809	845	2.02	1440
33	10	10 Oct	44 06.55	177 38.95 E	44 05.20	177 41.01 E	919	963	2.00	1660
34	10	10 Oct	44 04.30	177 51.04 E	44 04.76	177 53.74 E	906	980	1.99	1660
35	11	10 Oct	44 06.27	178 04.34 E	44 07.30	178 06.74 E	1 037	1 041	2.01	1860
36	11	10 Oct	44 09.59	178 04.61 E	44 09.63	178 01.78 E	1 084	1 090	2.03	2000
37	12	10 Oct	44 21.72	177 52.90 E	44 21.52	177 55.69 E	1 143	1 145	2.00	2070
38	12	10 Oct	44 15.84	178 27.17 E	44 16.90	178 29.53 E	1 146	1 167	2.00	1200
39	12	11 Oct	44 13.07	178 25.10 E	44 12.11	178 22.66 E	1 102	1 115	2.00	2000
40	10	11 Oct	44 06.99	178 26.01 E	44 06.23	178 28.61 E	936	999	2.00	1800
41	8	12 Oct	43 58.98	178 33.28 E	43 59.01	178 36.02 E	681	689	2.00	1220
42	11	12 Oct	44 13.43	178 41.59 E	44 14.00	178 44.29 E	1 066	1 073	2.02	1200
43	10	12 Oct	44 08.45	178 47.31 E	44 08.38	178 50.10 E	922	928	2.00	1660
44	11	12 Oct	44 12.60	178 51.68 E	44 13.01	178 54.41 E	1 004	1 011	2.00	1750
45	8	12 Oct	44 04.39	178 55.93 E	44 04.94	178 58.61 E	788	788	2.00	1560
46	10	12 Oct	44 12.51	179 06.57 E	44 13.02	179 09.26 E	934	945	1.99	1630
47	12	12 Oct	44 17.28	179 12.00 E	44 18.24	179 13.59 E	1 111	1 130	1.50	2000
48	9	12 Oct	44 09.38	179 15.57 E	44 09.45	179 12.78 E	830	841	2.00	1520
49	12	13 Oct	44 21.06	179 25.63 E	44 21.66	179 28.31 E	1 123	1 134	2.01	2000
50	13	13 Oct	44 07.06	179 55.25 E	44 06.69	179 52.52 E	609	616	1.99	1100
51	13	13 Oct	44 14.48	179 57.27 E	44 16.01	179 58.81 E	774	799	1.89	1420
52	14	13 Oct	44 22.13	179 58.17 E	44 22.66	179 59.11 W	972	991	2.02	1780
53	15	13 Oct	44 29.70	179 42.71 W	44 29.41	179 45.48 W	1 119	1 126	2.00	2020
54	14	13 Oct	44 19.76	179 43.25 W	44 19.74	179 40.46 W	821	837	2.00	1460
55	13	13 Oct	44 17.01	179 36.15 W	44 17.30	179 38.91 W	704	740	2.00	1350
56	16	14 Oct	44 46.27	179 31.86 W	44 46.41	179 29.06 W	1 304	1 328	1.99	2270
57	16	14 Oct	44 47.79	179 06.57 W	44 48.33	179 09.29 W	1 417	1 438	2.00	2400
58	15	14 Oct	44 28.74	179 00.33 W	44 28.39	179 03.09 W	1 014	1 031	2.00	1840
59*	15	14 Oct	44 29.42	178 44.88 W	44 29.14	178 47.65 W	1 030	1 040	2.00	1840
60	14	14 Oct	44 28.32	178 45.04 W	44 28.44	178 42.25 W	974	995	2.00	1780
61	15	15 Oct	44 30.82	178 38.13 W	44 31.63	178 35.56 W	1 061	1 069	2.00	1900
62	16	15 Oct	44 41.21	178 26.47 W	44 41.24	178 23.66 W	1 264	1 276	2.00	2259
63	18	15 Oct	44 22.52	178 12.94 W	44 22.59	178 10.14 W	820	855	2.00	1470

Station	Stratum	Date 1995	Start Latitude ° 'S	Start Longitude ° 'E/W	Finish Latitude ° 'S	Finish Longitude ° 'E/W	Depth (m) Min.	Depth (m) Max.	Distance towed (n. mile)	Warp length (m)
64	19	15 Oct	44 29.84	178 06.97 W	44 29.18	178 09.62 W	997	999	2.00	1800
65	20	15 Oct	44 30.87	178 07.79 W	44 32.83	178 07.15 W	1 014	1 078	2.00	1840
66	21	16 Oct	44 37.26	178 06.53 W	44 37.78	178 04.29 W	1 156	1 181	1.68	2040
67	22	16 Oct	44 47.00	178 02.47 W	44 47.14	177 59.66 W	1 368	1 377	2.00	2270
68	21	16 Oct	44 36.50	178 01.40 W	44 36.49	177 59.75 W	1 095	1 126	1.17	2000
69	20	16 Oct	44 33.41	177 59.17 W	44 34.82	177 57.18 W	1 002	1 010	2.00	1820
70	18	16 Oct	44 24.70	177 59.17 W	44 25.51	177 56.62 W	816	823	1.99	1480
71	19	16 Oct	44 32.75	177 50.34 W	44 32.88	177 51.85 W	913	920	1.07	1620
72	21	16 Oct	44 38.80	177 40.21 W	44 39.30	177 38.14 W	1 169	1 182	1.56	2100
73	19	16 Oct	44 37.19	177 31.60 W	44 37.80	177 28.96 W	939	948	1.98	1710
74	18	17 Oct	44 35.49	177 26.67 W	44 35.69	177 28.33 W	852	858	1.20	1550
75	21	17 Oct	44 41.90	177 23.71 W	44 42.06	177 20.90 W	1 135	1 157	2.00	2070
76	17	17 Oct	44 26.10	177 20.62 W	44 24.59	177 22.48 W	642	674	2.01	1230
77	18	17 Oct	44 33.07	177 12.89 W	44 35.02	177 12.25 W	802	833	2.00	1360
78	21	17 Oct	44 43.80	177 15.78 W	44 44.15	177 13.01 W	1 174	1 195	2.00	2140
79	20	17 Oct	44 42.85	177 09.37 W	44 42.86	177 06.56 W	1 065	1 096	2.00	1900
80	18	17 Oct	44 37.67	176 53.16 W	44 38.04	176 55.92 W	802	856	2.00	1520
81	20	17 Oct	44 42.49	176 31.74 W	44 42.61	176 28.95 W	1 016	1 048	1.99	1850
82	19	18 Oct	44 38.24	176 03.79 W	44 38.48	176 06.59 W	915	941	2.01	1650
83	17	18 Oct	44 34.63	175 58.33 W	44 33.64	175 55.88 W	765	781	2.01	1420
84	22	18 Oct	44 39.61	175 54.20 W	44 38.90	175 51.58 W	1 201	1 210	1.99	2100
85	22	18 Oct	44 40.42	175 48.20 W	44 39.46	175 45.72 W	1 358	1 366	2.01	2295
86	19	18 Oct	44 35.37	175 52.25 W	44 35.35	175 49.44 W	937	981	2.00	1750
87	18	18 Oct	44 33.71	175 52.33 W	44 32.82	175 49.81 W	823	829	2.00	1480
88	19	18 Oct	44 31.96	175 28.37 W	44 32.40	175 31.10 W	935	960	2.00	1620
89	20	18 Oct	44 33.75	175 23.21 W	44 34.28	175 25.93 W	1 051	1 054	2.00	1890
90	21	19 Oct	44 35.62	175 23.54 W	44 35.42	175 22.13 W	1 114	1 119	1.01	1900
91	20	19 Oct	44 30.96	175 12.86 W	44 30.92	175 15.28 W	1 001	1 098	1.73	1870
92	25	19 Oct	44 30.58	175 09.75 W	44 32.53	175 09.81 W	1 097	1 197	1.95	2040
93	23	19 Oct	44 22.50	175 03.99 W	44 20.67	175 02.86 W	774	798	2.00	1420
94	24	19 Oct	44 24.46	175 03.08 W	44 22.60	175 02.06 W	828	865	2.00	1530
95	25	19 Oct	44 29.35	174 56.79 W	44 29.48	174 53.99 W	1 100	1 200	2.00	2070

Station	Stratum	Date 1995	Start Latitude ° 'S	Start Longitude ° 'E/W	Finish Latitude ° 'S	Finish Longitude ° 'E/W	Depth (m) Min.	Depth (m) Max.	Distance towed (n. mile)	Warp length (m)
96	26	19 Oct	44 24.20	174 37.36 W	44 22.31	174 36.41 W	1 401	1 465	2.01	2540
97	26	19 Oct	44 20.58	174 41.65 W	44 22.24	174 43.18 W	1 292	1 297	1.99	2340
98	24	20 Oct	44 18.98	174 52.46 W	44 20.18	174 54.72 W	832	856	2.01	1500
99	24	20 Oct	44 12.47	174 51.22 W	44 13.53	174 49.24 W	935	960	1.77	1700
100	23	20 Oct	44 05.03	175 01.17 W	44 03.01	175 01.06 W	751	759	2.02	1350
101	23	20 Oct	44 05.62	174 52.24 W	44 03.61	174 52.28 W	783	799	2.01	1400
102	25	20 Oct	44 13.23	174 45.32 W	44 12.75	174 42.61 W	1 128	1 175	2.00	2100
103	26	20 Oct	44 07.86	174 22.25 W	44 07.74	174 25.02 W	1 321	1 372	1.99	2430
104	19	21 Oct	44 29.22	175 15.46 W	44 29.22	175 12.64 W	902	998	2.01	1680
105	19	21 Oct	44 32.52	175 25.42 W	44 32.32	175 22.61 W	966	974	2.01	1680
106	18	21 Oct	44 30.18	175 24.70 W	44 30.26	175 21.88 W	810	825	2.01	1460
107	19	21 Oct	44 34.22	175 45.02 W	44 34.55	175 47.79 W	981	1 002	2.00	1790
108	19	21 Oct	44 35.27	175 52.22 W	44 35.57	175 54.99 W	930	949	2.00	1710
109	18	21 Oct	44 34.30	175 51.69 W	44 34.62	175 54.46 W	872	899	2.00	1560
110	19	21 Oct	44 38.11	176 00.95 W	44 39.10	176 03.39 W	978	998	2.00	1760
111	19	21 Oct	44 38.33	176 04.91 W	44 38.51	176 07.71 W	907	930	2.00	1660
112	19	22 Oct	44 41.49	176 25.28 W	44 41.20	176 23.48 W	965	984	1.31	1700
113	19	22 Oct	44 42.34	176 27.88 W	44 41.71	176 25.20 W	995	998	2.01	1700
114	19	22 Oct	44 41.76	176 31.91 W	44 41.81	176 29.07 W	931	985	2.02	1680
115	19	22 Oct	44 42.38	176 38.26 W	44 43.07	176 37.88 W	928	955	0.74	1710
116	19	22 Oct	44 41.20	176 37.62 W	44 41.25	176 38.97 W	900	914	0.96	1620
117	19	22 Oct	44 42.04	176 47.56 W	44 41.82	176 44.82 W	972	999	1.97	1800
118	19	22 Oct	44 41.10	176 49.02 W	44 40.30	176 51.59 W	947	990	2.00	1750
119	18	23 Oct	44 38.70	176 53.96 W	44 39.29	176 52.83 W	861	866	1.01	1570
120	19	23 Oct	44 39.41	176 57.26 W	44 39.80	176 54.50 W	934	998	2.00	1670
121	19	23 Oct	44 40.64	176 57.71 W	44 38.67	176 58.30 W	965	990	2.01	1700
122	19	23 Oct	44 37.99	177 04.22 W	44 38.77	177 06.83 W	927	965	2.01	1660
123	18	23 Oct	44 36.09	177 10.72 W	44 35.64	177 07.99 W	860	874	2.00	1530
124	17	23 Oct	44 24.54	177 14.20 W	44 24.74	177 12.57 W	631	633	1.20	1120
125	19	23 Oct	44 37.83	177 20.40 W	44 37.98	177 22.48 W	902	936	1.49	1620
126	19	23 Oct	44 33.13	177 37.44 W	44 34.15	177 35.01 W	926	933	2.01	1660
127	19	24 Oct	44 34.50	177 37.38 W	44 35.60	177 35.03 W	963	964	2.00	1700

Station	Stratum	Date 1995	Start Latitude ° 'S	Start Longitude ° 'E/W	Finish Latitude ° 'S	Finish Longitude ° 'E/W	Depth (m) Min.	Depth (m) Max.	Warp towed (n. mile)	Distance length (m)
128	19	24 Oct	44 33.89	177 43.82 W	44 34.31	177 41.07 W	983	995	2.00	1730
129	18	24 Oct	44 29.39	177 49.63 W	44 30.09	177 48.36 W	859	860	1.14	1530
130	18	24 Oct	44 28.44	177 46.79 W	44 28.01	177 49.53 W	807	810	2.00	1530
131	19	24 Oct	44 34.83	177 52.92 W	44 34.98	177 50.12 W	975	987	2.00	1780
132	19	24 Oct	44 32.93	177 55.85 W	44 33.96	177 53.44 W	953	967	2.00	1710
133	18	24 Oct	44 26.60	178 01.35 W	44 26.52	177 58.56 W	871	875	2.00	1600
134	19	24 Oct	44 30.75	178 01.32 W	44 31.88	177 59.01 W	971	985	2.00	1770
135	19	25 Oct	44 26.52	178 07.45 W	44 26.72	178 09.59 W	921	935	1.54	1670
136	19	25 Oct	44 29.27	178 17.59 W	44 28.86	178 14.84 W	990	996	2.00	1730
137	19	25 Oct	44 25.31	178 20.17 W	44 23.67	178 18.55 W	932	946	2.01	1650
138	18	25 Oct	44 34.15	177 25.27 W	44 33.25	177 27.78 W	828	835	2.00	1485
139	18	25 Oct	44 36.01	177 25.61 W	44 36.25	177 24.23 W	862	875	1.01	1550
140	18	25 Oct	44 36.10	177 14.82 W	44 34.78	177 16.92 W	863	880	2.00	1550
141	18	26 Oct	44 39.92	176 14.24 W	44 39.46	176 11.99 W	836	868	1.67	1480
142	18	26 Oct	44 32.62	175 47.94 W	44 33.06	175 50.70 W	823	828	2.02	1450
143	18	26 Oct	44 32.56	175 45.94 W	44 32.71	175 43.12 W	822	840	2.02	1460
144	18	26 Oct	44 30.61	175 24.42 W	44 29.89	175 27.03 W	831	853	2.00	1500
145	18	26 Oct	44 31.10	175 23.80 W	44 30.77	175 21.04 W	862	885	2.00	1560
146	36	28 Oct	44 42.16	177 03.99 W	44 42.06	177 04.11 W	668	690	0.13	1300
147	36	28 Oct	44 42.12	177 04.07 W	44 42.01	177 04.16 W	670	674	0.13	1250
148	36	28 Oct	44 42.51	177 04.62 W	44 42.52	177 04.83 W	730	780	0.15	1400
149	36	28 Oct	44 42.51	177 04.99 W	44 42.49	177 05.30 W	899	948	0.22	1540
150	18	28 Oct	44 33.55	177 06.02 W	44 33.16	177 08.77 W	809	846	2.00	1470
151	18	28 Oct	44 37.32	177 23.07 W	44 37.07	177 20.29 W	880	896	1.99	1620
152	18	28 Oct	44 24.99	178 02.58 W	44 25.26	178 00.86 W	837	838	1.25	1510
153	103	1 Nov	44 41.77	173 01.25 E	44 41.66	173 02.68 E	790	799	1.02	1400
154	103	1 Nov	44 49.73	173 03.06 E	44 49.78	173 02.95 E	1 068	1 068	0.09	1840
155	103	2 Nov	44 36.22	173 14.71 E	44 36.51	173 14.61 E	627	630	0.30	1160
156	103	2 Nov	44 41.27	173 18.00 E	44 40.27	173 18.00 E	864	869	1.00	1450
157	103	2 Nov	44 45.54	173 23.66 E	44 45.90	173 23.62 E	989	1 083	0.36	1790
158	103	3 Nov	44 39.91	173 37.30 E	44 39.40	173 37.23 E	932	938	0.51	1570

Station	Stratum	Date 1995	Start Latitude ° 'S	Start Longitude ° 'E/W	Finish Latitude ° 'S	Finish Longitude ° 'E/W	Distance Depth (m) Min.	Distance Depth (m) Max.	Warp towed (n. mile)	length (m)
159	103	3 Nov	44 45.73	173 42.49 E	44 46.47	173 42.15 E	942	969	0.78	1670
160	2	3 Nov	44 43.40	173 45.83 E	44 43.12	173 43.04 E	930	992	2.00	1700
161	103	4 Nov	44 43.89	174 02.99 E	44 43.37	174 03.00 E	813	816	0.52	1460
162	37	4 Nov	44 57.35	174 37.57 E	44 57.15	174 37.34 E	780	932	0.26	1600
163	37	4 Nov	44 57.09	174 37.34 E	44 56.68	174 37.07 E	966	1 026	0.45	1776
164	4	5 Nov	44 24.40	175 21.45 E	44 25.78	175 23.45 E	678	699	1.99	1215
165	38	5 Nov	44 38.78	176 05.30 E	44 38.87	176 05.15 E	840	860	0.14	1500
166	38	5 Nov	44 38.97	176 05.37 E	44 39.28	176 05.10 E	846	1 022	0.36	1655
167	10	5 Nov	44 14.48	177 10.43 E	44 13.94	177 13.15 E	940	977	2.02	1725
168	10	5 Nov	44 10.64	177 22.31 E	44 10.18	177 25.03 E	906	909	2.00	1625
169	10	5 Nov	44 12.77	177 35.79 E	44 12.18	177 38.47 E	997	1 004	2.00	1740
170	10	6 Nov	44 03.61	178 22.92 E	44 04.12	178 25.63 E	900	904	2.01	1640
171	10	6 Nov	44 08.34	178 32.55 E	44 09.06	178 35.08 E	958	967	1.95	1790
172	10	6 Nov	44 09.89	178 41.79 E	44 09.84	178 44.57 E	974	990	2.00	1760
173	39	6 Nov	44 17.53	179 52.29 E	44 17.76	179 52.21 E	860	907	0.24	1450
174	30	6 Nov	44 26.84	179 15.19 W	44 26.84	179 15.00 W	883	914	0.14	1600
175	30	6 Nov	44 26.55	179 17.42 W	44 26.39	179 17.71 W	928	957	0.26	1660
176	18	7 Nov	44 23.80	178 08.46 W	44 24.33	178 05.76 W	844	845	2.00	1540
177	22	7 Nov	44 42.31	178 00.44 W	44 42.20	177 57.63 W	1 258	1 267	2.00	2200
178	18	7 Nov	44 26.47	177 53.87 W	44 27.42	177 51.38 W	821	835	2.02	1444
179	18	7 Nov	44 30.08	177 49.14 W	44 30.65	177 46.46 W	866	867	1.99	1560
180	18	7 Nov	44 37.73	176 53.60 W	44 37.47	176 55.52 W	809	850	1.40	1490
181	22	7 Nov	44 51.48	176 46.55 W	44 51.88	176 49.31 W	1 393	1 403	2.00	2470
182	22	8 Nov	44 45.71	176 37.92 W	44 46.07	176 40.71 W	1 220	1 222	2.01	2150
183	18	8 Nov	44 39.79	176 32.20 W	44 40.25	176 33.50 W	802	820	1.03	1440
184	18	8 Nov	44 37.55	176 05.40 W	44 38.48	176 07.90 W	865	878	2.01	1495
185	18	8 Nov	44 30.16	175 24.68 W	44 29.72	175 27.38 W	814	820	1.98	1420
186	19	8 Nov	44 29.62	175 11.71 W	44 30.17	175 13.58 W	960	995	1.44	1790
187	31	8 Nov	44 35.67	175 45.89 W	44 35.54	175 45.97 W	860	906	0.14	1600
188	31	8 Nov	44 35.35	175 45.19 W	44 35.10	175 45.16 W	967	1 105	0.25	1500
189	19	9 Nov	44 35.07	175 50.88 W	44 35.71	175 53.56 W	948	954	2.01	1717
190	19	9 Nov	44 37.59	176 01.63 W	44 38.50	176 04.16 W	927	948	2.02	1740

Station	Stratum	Date 1995	Start Latitude ° 'S	Start Longitude ° 'E/W	Finish Latitude ° 'S	Finish Longitude ° 'E/W	Depth (m) Min.	Depth (m) Max.	Distance towed (n. mile)	Warp length (m)
191	19	9 Nov	44 41.42	176 32.48 W	44 41.22	176 33.88 W	913	919	1.01	1600
192	36	10 Nov	44 41.42	177 03.37 W	44 41.26	177 03.30 W	861	950	0.17	1600
193	36	10 Nov	44 43.21	177 02.08 W	44 42.51	177 02.12 W	1 033	1 078	0.70	1800
194	36	10 Nov	44 42.59	177 04.50 W	44 42.62	177 05.06 W	709	853	0.40	1493
195*	36	10 Nov	44 42.10	177 03.86 W	44 41.93	177 03.97 W	649	680	0.19	1150
196	36	10 Nov	44 42.01	177 03.98 W	44 41.45	177 04.42 W	688	900	0.64	1600
197	36	10 Nov	44 44.81	177 03.60 W	44 44.96	177 03.57 W	1 136	1 154	0.15	2041
198	19	11 Nov	44 37.78	177 30.78 W	44 38.11	177 29.44 W	957	973	1.01	1750
199	19	11 Nov	44 36.53	177 35.50 W	44 35.67	177 36.60 W	976	998	1.16	1760
200	19	11 Nov	44 32.32	177 39.15 W	44 32.56	177 41.01 W	900	947	1.35	1645
201	19	11 Nov	44 34.61	177 52.15 W	44 34.86	177 54.94 W	960	977	2.00	1765
202	19	11 Nov	44 32.61	177 45.06 W	44 32.51	177 47.86 W	927	957	2.00	1640
203	19	11 Nov	44 25.42	178 11.92 W	44 24.89	178 14.64 W	958	1 000	2.01	1800
204	19	11 Nov	44 23.95	178 15.30 W	44 23.75	178 15.97 W	923	934	0.52	1635
205	19	11 Nov	44 26.40	178 13.57 W	44 26.72	178 16.36 W	970	998	2.02	1780

* These stations were not used to estimate biomass because of unsatisfactory gear performance.

Appendix 3: **Catch (kg) of black oreo, smooth oreo, and orange roughy at each station**

Station	Black oreo	Smooth oreo	Orange roughy
1	76.2	35.9	0
2	0	1.2	0
3	0	0.6	0
4	13.6	3.9	0
5	112.0	0	0
6	196.0	1.7	0
7	28.7	0.4	0
8	626.6	0	0
9	328.7	1.1	0
10	48.2	3.4	0
11	15.1	8.1	0
12	0	1.0	0
13	13.8	13.3	0
14	13.3	3.8	0
15	0.8	1.5	0
16	0	1.2	0
17	0	0.7	0
18	107.3	8.0	0
19	52.0	0	0
20	204.2	1.7	0
21	87.3	0	0
22	182.1	9.1	0
23	96.7	0	0
24	431.8	1.7	0
25	100.6	3.0	0
26	10.4	4.0	0
27	17.0	3.6	1.5
28	24.6	0	0
29	461.4	2 000.3	1.8
30	14.6	13.3	1.4
31	1.0	2.0	0
32	250.2	9.3	0
33	40.5	6.3	0
34	22.5	3.5	2.2
35	3.7	7.5	2.8
36	0.8	2.5	0
37	2.0	3.3	0
38	0	5.0	0
39	0	2.5	0
40	168.3	35.4	0
41	935.6	6.1	0
42	5.0	0	0
43	67.8	9.8	0
44	2.2	1.8	2.6
45	188	0.1	0
46	145.2	2.4	0
47	3.4	1.9	0
48	679.0	17.9	1.0
49	18.3	33.5	0
50	129	0.8	0
51	171.5	4.1	0
52	28.9	0	1.9
53	1.2	2.6	1
54	57.8	1.2	0
55	231.7	0.9	0

Station	Black oreo	Smooth oreo	Orange roughy
56	0	0	0
57	0	1.2	0
58	2.3	4.1	1.3
59*	0	0	0
60	5.1	4.1	2.4
61	0	8.4	13
62	0	0	0
63	7.5	108.4	0.6
64	0.6	0.5	3.5
65	4.4	1.5	5.6
66	0	1.5	1.4
67	0	1.1	0
68	0	2.0	1.3
69	0.3	3.4	10.9
70	5.7	104.9	1.7
71	293.9	8 674.6	12.8
72	0	4.2	0
73	145.9	2 729.4	55.8
74	168.8	4 313.5	15.8
75	2.6	211.6	6.8
76	84.0	4.2	0
77	20	1 794.3	0
78	0	19.7	3.7
79	7.0	24.9	6.9
80	42.6	14.8	3.1
81	4.2	307.9	53.4
82	0.7	1 070.4	46.8
83	0.8	41.0	0
84	1.1	77.7	4.9
85	0	45.5	0
86	6.1	41.3	14.0
87	3.6	14.7	9.8
88	16.9	6.3	19.7
89	4.8	1 602.0	7.2
90	3.2	2 052.6	4.8
91	14.7	41.7	19.7
92	22.0	11.7	18.3
93	1.4	1.7	0
94	2.1	1.4	15
95	2.2	6.1	10.2
96	0	1.6	2
97	0	5.8	21.7
98	0	0.5	4
99	0	1.5	96.3
100	0	0	1.3
101	0	0	9.2
102	0.6	0.4	369.4
103	0	0	18.8
104	51.8	105.3	61.5
105	27.1	1 305.9	11.4
106	2.9	13.8	6.1
107	3.1	20.1	4.5
108	3.6	38.5	6.7
109	2.7	27.9	6.2
110	3.9	42.4	10.2
111	2.7	358.2	19.9
112	9.4	4 270.8	31.1

Station	Black oreo	Smooth oreo	Orange roughy
113	3.9	363.2	42.6
114	3.8	900.9	29.6
115	1.9	1 072.0	97.4
116	1.6	2 446.6	17.6
117	10.0	454.3	164.7
118	1.6	105.9	25.1
119	5.9	7.9	3.3
120	1.9	65.3	11.1
121	2.7	71.1	40.4
122	2.4	110.9	88.5
123	19.5	1 591.6	0.6
124	28.9	2.5	0
125	29.4	150.7	50.3
126	4.1	66.4	14
127	2.5	22.2	14.7
128	3.3	11.1	22.6
129	14.7	2 062.1	0.8
130	133.6	4 286.2	0
131	7.7	270.6	53.8
132	8.9	609.0	43.1
133	2.5	1 447.1	0
134	0.8	397.0	45.1
135	9.6	4 298.7	60.5
136	1.6	39.4	5.6
137	0.9	24.4	8.7
138	110.9	4 521.2	5.2
139	62.7	2 917.2	14.3
140	8.9	632.6	28.9
141	6.7	1484.2	6.3
142	1.0	8.4	0
143	1.5	3.2	0.6
144	0	2.1	3.0
145	2.1	7.8	3.2
146	5.7	50.7	0
147	1.7	0	0
148	105.3	2140.9	0
149	7.4	1402.5	5.3
150	13.5	406.3	0
151	206.4	1 952.0	20.1
152	5.7	1 188.7	0.7
153	630.4	13.3	0
154	0	8 889.3	0
155	1 825.3	0	0
156	398.9	306.9	0
157	952.3	1 072.7	0
158	405.3	30.9	0
159	258.8	308.4	0
160	16.4	1.0	0
161	697.2	0	0
162	596.2	335.9	0
163	9.3	0	0
164	161.9	0	0
165	55.2	271.4	0
166	13.7	9.5	0
167	10.8	1.6	2.9
168	421.1	1315.3	0
169	28.3	58.5	1.8

Station	Black oreo	Smooth oreo	Orange roughy
170	297.1	8.3	0.5
171	114.6	360.8	2.9
172	2.7	1.6	0.7
173	120.7	573.5	336.1
174	0	2 090.6	0
175	102.5	29.0	10.6
176	16.6	113.6	0
177	0	1.4	0
178	2.2	764.1	0
179	41.3	2413	11.2
180	62.3	91.0	0.8
181	0	6.1	0
182	0	57.4	4.4
183	7.1	174.9	9
184	2.6	918.3	3
185	0.7	7.0	1.5
186	36.6	256.2	18.2
187	35.6	365.7	135.5
188	14.5	123.9	9.8
189	5.0	95.2	16.8
190	15.4	1 422.5	13.9
191	2.3	628.8	16.5
192	36.2	763.0	12.2
193	116.1	1 346.5	722.4
194	111.9	856.6	0
195*	2.3	1.7	0
196	166.4	3 870.8	454.2
197	0	1 669.4	2.2
198	366.6	20 129.0	176.7
199	34.5	3 408.0	28.2
200	29.0	734.2	8.5
201	9.2	488.3	22.7
202	5.5	15.7	10.9
203	8.3	138.3	454.4
204	0	1 112.7	12.0
205	0	504.8	8.0

* These stations were not used to estimate biomass because of unsatisfactory gear performance.

Appendix 4: **Species caught**

Species code	Scientific name	Common name
Crustacea		
APE	*Acanthephyra pelagica*	
CAM	*Camplyonotus rathbonae*	sabre prawn
LHO	*Lipkius holthuisi*	omega prawn
LMU	*Lithodes murrayi*	king crab
MYS	Mysididae	
NEB	*Neolithodes brodiei*	southern stone crab
NEC	*Nematocarcinus* sp.	
NAU	*Notostomus auriculatus*	
PZE	*Paralomis zelandica*	
PBA	*Pasiphaea barnardi*	
SEP	*Sergia potens*	
Cephalopods		
CHQ	Cranchiidae	cranchiid squid
VSQ	*Histioteuthis* spp.	violet squid
MIQ	*Moroteuthis ingens*	warty squid
MRQ	*M. robsoni*	warty squid
DWO	*Graneledone* sp.	deepwater octopus
RSQ	*Ommastrephes bartrami*	red squid
OSQ	Octopoteuthiidae	
OPI	*Opisthoteuthis* sp.	
Chondrichthyes		
Squalidae		
CYL	*Centroscymnus coelolepis*	Portuguese dogfish
CYO	*C. owstoni*	smooth skinned dogfish
CYP	*C. crepidater*	longnosed velvet dogfish
CSQ	*Centrophorus squamosus*	leafscaled gulper shark
SND	*Deania calcea*	shovelnosed spiny dogfish
ETB	*Etmopterus baxteri*	Baxter's lantern dogfish
ETL	*E. lucifer*	Lucifer dogfish
ETM	*Etmopterus* sp.	
PLS	*Scymnodon plunketi*	Plunket's shark
BSH	*Scymnorhinus licha*	seal shark
Scyliorhinidae		
APR	*Apristurus* spp.	catshark
Rajidae		
	Bathyraja richardsoni	
PSK	*Bathyraja shuntovi*	longnosed deepsea skate
BTH	*Pavoraja* spp.	bluntnosed skate
SSK	*Raja innominata*	smooth skate
DSK	*Raja* sp.	deepwater spiny skate
Rhinochimaeridae		
LCH	*Harriotta raleighana*	longnosed chimaera
RCH	*Rhinochimaera pacifica*	widenosed chimera
Chimaeridae		
CHG	*Chimaera* sp. B	giant chimaera
CHP	*Chimaera* sp. C	purple chimaera
HYB	*Hydrolagus* sp. A	black hydrolagus

GSP	*Hydrolagus* sp. B	pale hydrolagus
HYP	*Hydrolagus* sp. C	longnosed blue hydrolagus

Teleosts

Notacanthiformes		
Notocanthidae		
NOC	*Notacanthus chemnitzi*	spineback eel
SBK	*N. sexspinis*	spineback eel
Anguilliformes		
Nemichthyidae		
AVO	*Avocettina* sp.	
Synaphobranchidae		
BEE	*Diastobranchus capensis*	basketwork eel
Congridae		
SCO	*Bassanago bulbiceps*	swollenheaded conger
HCO	*B. hairsutus*	hairy conger
Serrivomeridae		
SAW	*Serrivomer* sp.	sawtooth eel
Salmoniformes		
Platytroctidae		
PER	*Persparsia kopua*	tubeshoulder
Bathylagidae		
DSS	*Bathylagus* sp.	deepsea smelt
Alepocephalidae		
SSM	*Alepocephalus australis*	smallscaled brown slickhead
SBI	*Alepocephalus* sp.	bigscaled brown slickhead
BAT	*Rouleina* sp.	large headed slickhead
BSL	*Xenodermichthys copei*	black slickhead
Stomiiformes		
Sternoptychidae		
HAT	Sternoptychidae (family)	hatchetfish
AGI	*Argyropelecus gigas*	giant hatchetfish
Photichthyidae		
PHO	*Photichthys argenteus*	lighthouse fish
Chauliodontidae		
CHA	*Chauliodus sloani*	viperfish
Astronesthidae		
BAN	*Borostomias antarticus*	
Melanostomiidae		
MEL	Melanostomiidae (family)	scaleless black dragonfish
OMI	*Opostomias micripnus*	scaleless black dragonfish
Malacosteidae		
MAL	Malacosteidae (family)	loosejaws

Idiacanthidae		
IDI	*Idiacanthus* spp.	black dragonfishes
Aulopiformes		
Paralepididae		
PAL	Paralepididae (family)	barracudinas
BCA	*Magnisudis prionosa*	barracudina
Alepisauridae		
ABR	*Alepisaurus brevirostris*	shortsnouted lancetfish
Myctophiformes		
Myctophidae		
LAN	Myctophidae (family)	lanternfish
DIA	*Diaphus* spp.	
GYM	*Gymnoscopelus* spp.	
LPD	*Lampadena* spp.	
LHE	*Lampanyctodes hectorisiu*	
LPA	*Lampanyctus* spp.	
Gadiformes		
Muraenolepididae		
MUR	*Muraenolepis marmoratus*	moray cod
Moridae		
VCO	*Antimora rostrata*	violet cod
HJO	*Halargyreus johnsonii*	Johnson's cod
LAE	*Laemonema* sp.	
SMC	*Lepidion microcephalus*	smallheaded cod
LPS	*L. schmidti*	giant lepidion
RIB	*Mora moro*	ribaldo
Melanonidae		
MEL	*Melanonus gracilis*	pelagic cod
Merlucciidae		
LYC	*Lyconus* sp.	blackmouth hake
HOK	*Macruronus novaezelandiae*	hoki
HAK	*Merluccius australis*	hake
Macrouridae		
CKX	*Caelorinchus acanthiger*	spottyfaced rattail
CBO	*C. bollonsi*	Bollons's rattail
CFA	*C. fasciatus*	banded rattail
CIN	*C. innotabilis*	notable rattail
CKA	*C. kaiyomaru*	Kaiyomaru rattail
CMA	*C. matamua*	Mahia rattail
COL	*C. oliverianus*	Oliver's rattail
CMX	*Coryphaenoides mcmillani*	
CMU	*C. murrayi*	abyssal rattail
CSE	*C. serrulatus*	serrulate rattail
CSU	*C. subserrulatus*	fourrayed rattail
CTR	*C. striatura*	abyssal rattail
CSL	*Coryphaenoides* sp. A	slender rattail
CBA	*Coryphaenoides* sp. B	long barbelled rattail
NPU	*Kuronezumia leonis*	
JAV	*Lepidorhynchus denticulatus*	javelinfish
MCA	*Macrourus carinatus*	ridgescaled rattail
BJA	*Mesobius antipodum*	black javelinfish

NNA	*Nezumia namatahi*	squashedfaced rattail
OMU	*Odontomacrurus murrayi*	largefanged rattail
WHR	*Trachyrincus longirostris*	white rattail
WHX	*Trachyrincus aphyodes*	unicorn rattail
VNI	*Ventrifossa nigromaculata*	blackspot rattail
Ophidiiformes		
Ophidiidae		
LIN	*Genypterus blacodes*	ling
Carapidae		
ECR	*Echiodon cryomargarites*	messmate fish
Lophiiformes		
Ceratiidae		
SDE	*Cryptopsaras couesi*	seadevil
Himantolophidae		
HIA	*Himantolophus appelii*	prickly anglerfish
Lampriformes		
Trachipteridae		
DEA	*Trachipterus trachypterus*	dealfish
Regalecidae		
AGR	*Agrostichthys parkeri*	ribbonfish
Beryciformes		
Trachichthyidae		
ORH	*Hoplostethus atlanticus*	orange roughy
Diretmidae		
DIS	*Diretmus argenteus*	discfish
Anoplogastridae		
ANO	*Anoplogaster cornuta*	fangtooth roughy
Berycidae		
BYS	*Beryx splendens*	alfonsino
Melamphaidae		
MPH	*Melamphaes* sp.	bigscaled fish
Rondeletiidae		
RMW	*Rondeletia loricata*	red-mouth whalefish
Zeiformes		
Zeidae		
LDO	*Cyttus traversi*	lookdown dory
Oreosomatidae		
BOE	*Allocyttus niger*	black oreo
WOE	*A. verrucosus*	warty oreo
SOR	*Neocyttus rhomboidalis*	spiky oreo
OXO	*Oreosoma atlanticum*	ox-eye oreo
SSO	*Pseudocyttus maculatus*	smooth oreo

Scorpaeniformes		
Psychrolutidae		
COT	*Cottunculus nudus*	bony skulled toadfish
PSY	*Psychrolutes* sp.	blobfish
Perciformes		
Serranidae		
SPE	*Helicolenus* sp.	sea perch
Apogonidae		
EPL	*Epigonus lenimen*	bigeyed cardinalfish
EPR	*E. robustus*	robust cardinalfish
Bramidae		
RBM	*Brama brama*	Ray's bream
Caristiidae		
PLA	*Platyberyx* sp.	
Zoarcidae		
EPO	*Melanostigma gelatinosum*	limp eelpout
Centrolophidae		
RUD	*Centrolophus niger*	rudderfish
SUM	*Schedophilus maculatus*	pelagic butterfish
TUB	*Tubbia tasmanica*	
Tetragonuridae		
TET	*Tetragonurus cuvieri*	squaretail
Pleuronectiformes		
Bothidae		
ACT	*Achiropsetta tricholepis*	
MAN	*Neoachiropsetta milfordi*	finless flounder

Others

AST		
EGC		egg case
SCC		sea cucumbers
ONG		sponges
COU		red coral
ECH		echinodermata
TAM	Echinothuriidae (family)	Tam o'shanter urchin
ACO	*Araeosoma* sp.	Tam o'shanter urchin
DHO	*Dermechinus horridus*	sea urchin
GRM	*Gracilechinus multidentatus*	sea urchin
SFI		starfish
ANT		anemones
ASR		starfish
GAS		gastropoda
OPH		brittle star
SAL		salp
JFI		jellyfish
VOL		volute

List of tables

List of figures

List of appendices