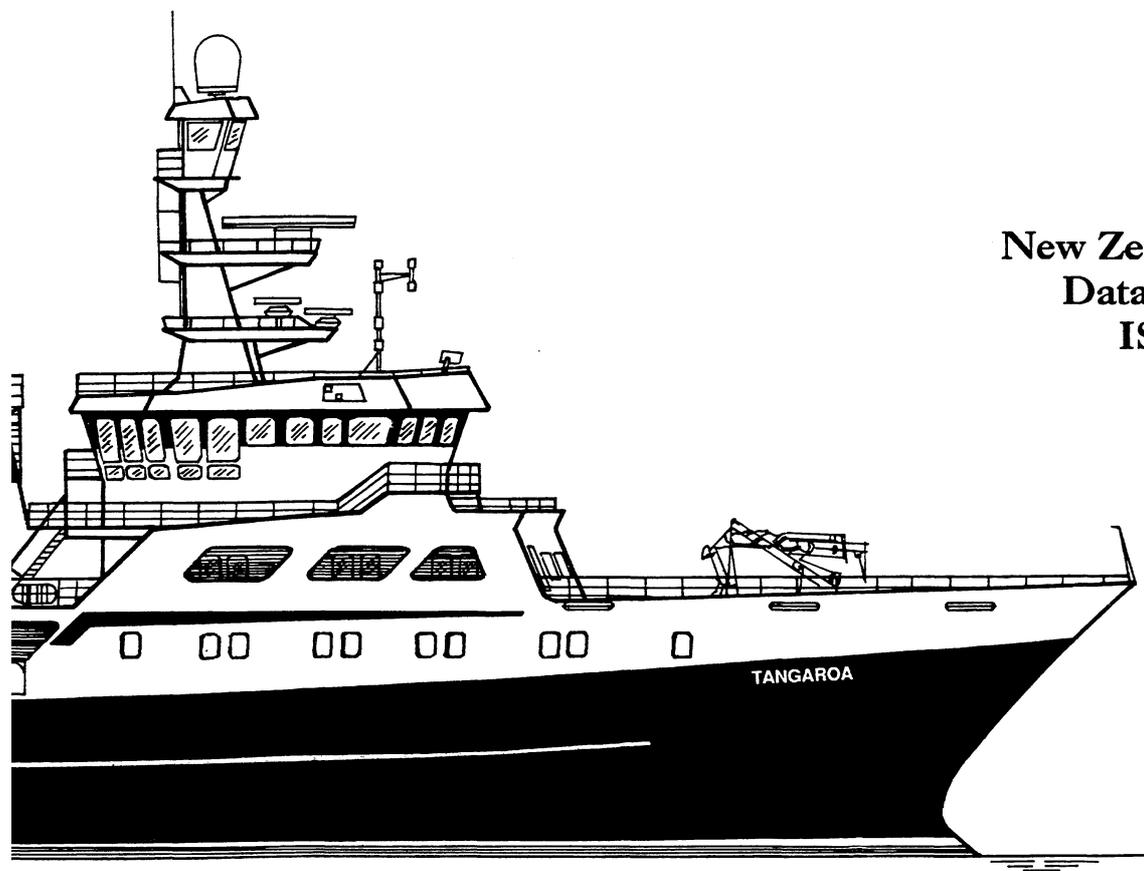


Trawl survey of oreos and orange roughy on the south Chatham Rise, October-November 1991 (TAN9104)

P. J. McMillan
A. C. Hart



New Zealand Fisheries
Data Report No. 50
ISSN 0113-2288
1994

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**New Zealand Fisheries Data Report No. 50
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**Published by MAF Fisheries
Wellington
1994**

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The Editor, MAF Fisheries Greta Point,
P O Box 297, Wellington, New Zealand.**

*The New Zealand Fisheries Data Report series
continues the Fisheries Research Division
Occasional Publication: Data Series.*

ISBN 0-478-04623-5

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Introduction

This report describes a stratified random bottom trawl survey of the south Chatham Rise carried out using GRV *Tangaroa* between 11 October and 9 November 1991. This was the first of a new time series of such surveys in this area to estimate the relative biomass of black oreo (*Allocyttus niger*), smooth oreo (*Pseudocyttus maculatus*), and orange roughy (*Hoplostethus atlanticus*). Relative biomass information is required for stock assessment of these species.

Three other stratified random trawl surveys of the south Chatham Rise have been carried out from chartered commercial trawlers: *Arrow* in 1986, *Amaltal Explorer* in 1987, and *Cordella* in 1990. (Reports of these surveys were by Fincham *et al.* (1987), Fenaughty *et al.* (1988), and McMillan & Hart (1994), respectively). Because different vessels and different trawl gear were used for these surveys, the biomass estimates of the oreo species and orange roughy are not comparable and were not used in previous stock assessments. Stock assessment of the oreo species in the period 1983 to 1993 was based on historical catch data (*see Annala 1993*).

Project objectives

1. To determine the location and distribution, and develop a time series, of relative abundance indices of pre-recruit and recruited smooth oreo, black oreo, and orange roughy on the south and east Chatham Rise using bottom trawl survey techniques.
2. To measure and monitor biological parameters, including length, weight, sex, reproductive state, and age of the populations of smooth oreo, black oreo, and orange roughy on the south Chatham Rise for use in population modelling.
3. To analyse the catch and effort data from the commercial oreo fishery in New Zealand waters.
4. To assess the Chatham Rise oreo fishery.

Survey objectives

1. To estimate the 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, and orange roughy and collect otoliths for age estimation.
3. To determine the spawning condition of the populations of black oreo, smooth oreo, and orange roughy.
4. To retain rare or unusual species of fish, molluscs, and crustaceans for the Museum of New Zealand, Wellington.

Methods

Survey area

The survey area was first defined for the 1986 survey and was subdivided into four subareas roughly equal in size. In 1987 the eastern end of the survey area was extended from

176° 20' W to 176° W. A further easterly extension, subarea 5, was made in the 1990 survey from 176° W curving east and north to latitude 44° S.

The 1991 survey area was the same as that for 1990, totalled 56 841 km², and was divided into five subareas as follows: subarea 1 from longitude 172° 30' to 174° 30' E, subarea 2 from 174° 30' to 176° E, subarea 3 from 176° to 178° 40' E, subarea 4 from 178° 40' E to 176° W, and subarea 5 from 176° to 174° 10' W (with a northern limit of latitude 44° S) (Figure 1).

Survey design

A two-phase stratified random bottom trawl survey design (*after* Francis 1984) was used with 121 stations planned for phase 1 and 50–60 for phase 2. Areas and depths were chosen to sample black oreo, smooth oreo, and orange roughy.

Stratification

Strata and stratum areas are given in Table 1. Depth stratification for all subareas in 1986, 1987, 1990, and 1991 included the intervals 600–800, 800–900, 900–1000, 1000–1100, and 1100–1200 m. An interval of 1200–1500 m was added in subareas 4 and 5 in 1990 in response to reported commercial fishing there at those depths, and those strata (21 and 27) were sampled again in 1991.

Station allocation

Allocation of stations to strata was decided after consideration of the station allocation in the 1986, 1987, and 1990 surveys. Equal weighting was given to the depth intervals 800–900, 900–1000, and 1000–1100 m because most of the biomass came from those depths. Subareas 2 and 3 had fewer stations because of low biomass there. Stratum 10 (1100–1200 m, subarea 2) and stratum 15 (1100–1200 m, subarea 3) were sampled in the 1986 and 1987 surveys, but not subsequently because of low biomass results.

Phase 2 stations were allocated after calculating the number of stations required to reduce the variability (coefficient of variation, *c.v.* (%)) of the biomass estimates for black oreo, smooth oreo, and orange roughy. Emphasis was placed on reducing the *c.v.* of the largest biomass estimate (smooth oreo) to less than 30%.

Station position selection

Phase 1 random station positions were first generated for the 1986 survey. The 1986 phase 1 stations were repeated in 1987, 1990, and 1991 for subareas 1–4. New phase 1 station positions were generated for strata 21–27 in 1990.

There were fewer stations in some strata in 1991 than in 1990 because less time was available. The number of stations was reduced by random selection from the 1990 list in the following strata by the numbers shown in parentheses: 21 (2), 23 (4), 24 (2), 25 (2), 26 (1), and 27 (1).

New random positions were generated on board for phase 2 stations.

Station execution

Phase 1 stations in subareas 1–4 used the actual start and finish positions of the 1990 stations because these positions were known precisely (Global Positioning System was used). For new phase 1 and phase 2 positions the station was carried out by towing through the random position. Where this was not possible because of bad 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 were 2 n. miles long where possible: the shortest acceptable station was 0.81 and the longest was 2.24 n. miles ($n = 154$, mean = 1.86, median = 2.0).

Survey timing

The survey was carried out from 11 October to 9 November 1991. This was slightly earlier in the year than previous surveys because of vessel planning constraints.

Vessel and gear

GRV *Tangaroa* has the following specifications: overall length, 70 m; beam, 14 m; gross tonnage, 2280 t; main engine power 3000 kW. Trawl gear specifications are given in Appendix 1. The plan of the net used was given in appendix 1 of Clark & Tracey (1994).

Biomass estimation

Biomass was estimated using the area-swept method (Francis 1981). The formulas are summarised in Vignaux (1994).

The effective fishing width of the net was assumed to be the width between the wings of the net, so the vulnerability, V , was assigned a value of 0.239. This is the ratio of the mean distance between the wings, assumed to be 28 m (measured during gear trials in July–September 1991), and the mean distance between the doors, 117 m.

Biomass was calculated with the MAF Fisheries Trawlsurvey Analysis Program held at Greta Point. 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 117.0 m; catch data weight as recorded in catch table; length-weight relationship calculated for each species from data collected during the 1991 survey; fish vulnerability, 0.239; vertical availability, 1.0; areal availability, 1.0. Catch rates were expressed as kg.km^{-1} .

Biomass estimates for the three main species (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 recruited length for each species was defined as the length on the left hand limb of the length distribution (to the left of the mode) at which 50% of the fish occurred and was calculated from the length frequency distribution of fish sampled from commercial catches by scientific observers. The length data were selected from the observer database from the area $43^{\circ}30'$ to $45^{\circ}30'$ and 172° E to 174° W for the years 1986 to 1992 and were not scaled. The mode was observed from a plot of numbers of fish versus length, i.e., 29 cm for black oreo, 36 cm for smooth oreo, and 35 cm for orange roughy. The length where 50% of the fish were to the left of the mode was calculated using a computer

spreadsheet. 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 on to 030 forms and were then entered by hand into the onboard computer. All catch and biological data were entered directly into the computer from the wet lab using the digitisers. All weights, including catch, individual fish, and gonad weights, were keyed in using the digitisers because the electronic capture of the weight data had not been developed. Data were checked on board (by Brent Wood and Alan Hart) and were checked and edited at Greta Point 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 2000 kg were weighed on the Seaway weighers.

For catches over about 2000 kg the weight of the black oreo, smooth oreo, or orange roughy was back-calculated from the amount of fish processed on board. This required the following information: the conversion factor (from unprocessed to headed and gutted state) estimated for most of the large catches from about 200 kg of unprocessed fish (results of conversion factor tests are given in Appendix 2); the average frozen block (tray) weights estimated from a sample of 10 blocks weighed at the start of the survey (Appendix 2); and the number of frozen blocks of each species produced at each station. The total catch of each species was then calculated from the product of the number of frozen blocks, the conversion factor, and the average block weight. Small specimens of the three main species that could not be processed were sorted out of large catches, weighed, recorded, and discarded.

Rare or unusual fish, molluscs, and crustaceans were labelled with the station number and frozen for the Museum of New Zealand, Wellington.

Biological sampling

A sample of up to about 200 individuals each of black oreo, smooth oreo, orange roughy (and other quota species when caught) was taken at each station to determine the length frequency distribution in different areas and depths. (Length was measured to the nearest centimetre below.) In addition, length (to the nearest millimetre), weight (nearest 10 g), sex, gonad stage, gonad weight (nearest 1 g), and otoliths were collected from up to 20 individual specimens of the three main species at each station for studies of size and age structure (not described in this report), length-weight relationship, and reproductive state of the populations. Reproductive state was assessed by macroscopic gonad staging using the definitions for black oreo, smooth oreo, and orange roughy given in Appendix 3. About 600 otolith pairs were collected for each species. The stomachs of smooth oreo sometimes contained a large amount of water, probably taken in during capture, so the stomach was removed 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 MAF Fisheries 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 1991 survey (*see* Table 10). The calculations within the program were described by Vignaux (1994).

Water temperatures

The sea surface temperature was recorded at each station from the bridge weather station. Bottom temperature readings were recorded from the Kaijo-Denki net monitor. The accuracy of the data from the net monitor is unknown because the device was not calibrated.

Results

Trawl stations

A total of 154 stations (116 in phase 1 and 38 in phase 2) were completed and used for biomass estimation (*see* Table 1). Station data are summarised in Appendix 4.

Catch and catch rates

A summary of the catch of the 10 most abundant species from all stations combined is given in Table 2 and catches of the three main species at each station are given in Appendix 5. The species caught during the survey are listed in Appendix 6.

Smooth oreo and black oreo were caught in most of the tows and orange roughy was caught at only about half of the stations. Smooth oreo contributed 81% of the total catch by weight.

Catch and catch rates of black oreo, smooth oreo, and orange roughy from each stratum and catch from each subarea are given in Table 3. Catch rates for the three main species are shown for each station in Figures 2–4.

Black oreo

Catch was spread across subareas 1–4; the highest catch was in subarea 3. Catch in subarea 5 was negligible. Most black oreo was caught at depths less than 1000 m with catch from shallow strata (600–800 and 800–900 m) dominated by small individuals with a modal size of 28 cm TL. The species dominated catch at 600–800 m everywhere except subarea 5.

Smooth oreo

Catch came mainly from subarea 4 with lesser amounts from subareas 3 and 5. Most was caught at depths of 900–1200 m. Stratum 20 (1100–1200 m) in subarea 4 contributed the largest catch. The species dominated catch at intermediate and deep strata (800–1200 m) in subareas 3–5.

Orange roughy

Catch came almost entirely from subareas 4 and 5. Most was caught at 900–1200 m at the eastern end of the survey area and the species was never a dominant catch component from any subarea or stratum.

Biomass estimates

Biomass estimates for all quota and commercially important non-quota species are given in Table 4. Catch and biomass estimates of hoki from the depth intervals 600–800, 800–1000, and 1000–1200 m for catches made in daylight (0451–1813 hours, New Zealand Standard Time) are given in Table 5. The survey covered only a fraction of the depth range of species such as hoki, hake, ling, ribaldo, and pale ghost shark and was not designed to measure the biomass of these species. The totals for all strata, individual stratum values, and separate values for recruited and fish of all lengths ("all fish") for the three main species are given in Table 6. Biomass estimates for the three main species for fish of all lengths are summarised by subarea in Table 7 and by depth in Table 8.

There was only a minor contribution to the biomass of the three main species from depths greater than 1200 m.

Black oreo

Black oreo came mainly from 600–800 m in subarea 2 where fish had modal sizes of 26 and 28 cm TL and from subarea 4 where the modal size was 33 cm TL. The 800–900 m stratum was next in importance.

Smooth oreo

Smooth oreo came mainly from 900–1100 m in subarea 3 and 800–1200 m in subarea 4.

Orange roughy

Biomass was relatively small compared to the oreo species with most coming from 1100–1200 m in subarea 4 and 900–1000 m in subarea 5.

Biological data

The numbers of length and other biological samples taken during the survey are shown in Table 9.

The length distributions of scaled samples of black oreo, smooth oreo, and orange roughy measured during the survey are shown in Figure 5.

Scaled length data for the three main species from the depth intervals 600–800, 800–1000, and 1000–1200 m are presented in Figure 6. Figure 7 presents scaled length data for the same species by three areas; 1, 172° 30′–176° E; 2, 176°–179° 30′ E; 3, 179° 30′ E–174° W. These areas were chosen because they had uniform species catch composition during the survey.

Length-weight relationships for the fish sampled are shown in Table 10, and the results of macroscopic staging of gonads for the three species sampled throughout the survey are summarised in Table 11. A large proportion of samples of black and smooth oreo were either immature or developing (stages 1–3). Most of the orange roughy were immature or resting (stages 1–2).

Tables 12 and 13 give the incidence of each gonad stage for the three main species by depth interval and subarea respectively.

Black oreo

Immature (stage 1) fish of both sexes were found at all depths to 1200 m. Small sample sizes of spawners makes it difficult to draw conclusions, but most of the females with hyaline oocytes (stage 4) were found at depths of 800–1000 m. Immature fish of both sexes were widespread in subareas 1–4, but were largely absent from subarea 5. Females with hyaline oocytes were found only in subareas 2–4. The survey began in subarea 1 and it may have been too early to find stage 4 fish there.

Smooth oreo

Most of the immature fish of both sexes were spread through the 800–1200 m depth range. There were too few maturing fish to draw conclusions about depth preferences. Immature fish of both sexes were distributed throughout the survey area, but were most abundant in subarea 4. Too few mature smooth oreo were sampled to draw conclusions about the distribution of spawning.

Orange roughy

Immature fish of both sexes were distributed at depths of 800–1200 m. Fish were resting after winter spawning and no other patterns are evident from the data. Most of the fish were in subareas 4 and 5 and most were immature or resting.

Water temperatures

Surface temperatures ranged from 8.4 to 12.9 °C ($n = 142$). Temperatures were low at the western end and high at the eastern end of the survey area. There was also a less pronounced trend of increasing temperature at the same locality with time.

Bottom temperature ranged from 2.4 to 7.9 °C ($n = 139$), and as expected lower temperatures were recorded at greater depths (Figure 8).

Discussion

This discussion is limited to the methods employed in this first survey of the new series and to methods to consider for future surveys. Results are not compared with those from other surveys. Similarities and differences between the four south Chatham Rise surveys are summarised in Table 14.

The 1200–1500 m depth interval contributed 0, 0.1, and 1.9% of the total biomass of black oreo, smooth oreo, and orange roughy respectively (Table 8). However, the 1100–1200 m interval produced a substantial amount of smooth oreo (25.5%) and orange roughy (37.4 %) biomass. No catches of the three main species greater than 100 kg were taken from the stations deeper than 1300 m during this and the 1990 survey (McMillan & Hart 1994). This suggests that depths greater than 1300 m should not be sampled in future surveys.

Commercial vessels catch considerable quantities of the three main species from a series of hills not sampled in this survey. For the next survey we need to know precisely where these hills are and to develop methods for estimating biomass from hills. Relative biomass from the hills could be compared between surveys and with that from the non-hill areas.

The next survey should be as similar to the 1991 survey as possible and should continue to aim to refine the biomass estimate of smooth oreo.

Acknowledgments

Thanks to the *Tangaroa* staff including Roger Goodison (skipper), Richard Jack and Yoshihiro Suzuki (second and third mates), Arthur Muir (relieving first mate), Ian Popenhagen (bosun), and Peter Healey (acting bosun) for contributing to a successful and productive survey. Thanks to Jack Fenaughty who was a shift leader and provided advice on gear and survey planning and to the other scientific staff, David Burgess, Lynda Griggs, Kevin Mulligan, and Brent Wood. Special thanks to Barry Lanauze who provided transport and support at very short notice during our two visits to Chatham Island. Thanks to Adrian Colman and Stuart Hanchet for commenting on the manuscript and to Maria Fraser for typing parts of it.

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Table 1: Strata, subareas, and numbers of stations

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	800–900	1 732	8	0	8
3	900–1000	1 435	7	0	7
4	1000–1100	1 272	9	0	9
5	1100–1200	2 079	3	0	3
	Subtotal	10 148	30	0	30
Subarea 2					
6	600–800	4 180	3	0	3
7	800–900	2 162	5	0	5
8	900–1000	1 086	3	0	3
9	1000–1100	1 789	3	0	3
	Subtotal	9 217	14	0	14
Subarea 3					
11	600–800	3 781	3	0	3
12	800–900	1 571	5	0	5
13	900–1000	1 677	6	3	9
14	1000–1100	2 123	4	0	4
	Subtotal	9 152	18	3	21
Subarea 4					
16	600–800	4 270	3	0	3
17	800–900	2 890	7	1	8
18	900–1000	2 364	6	7	13
19	1000–1100	2 454	7	4	11
20	1100–1200	2 275	4	23	27
21	1200–1500	8 864	3	0	3
	Subtotal	23 117	30	35	65
Subarea 5					
22	600–800	1 329	3	0	3
23	800–900	465	4	0	4
24	900–1000	315	5	0	5
25	1000–1100	593	4	0	4
26	1100–1200	614	4	0	4
27	1200–1500	1 891	4	0	4
	Subtotal	5 207	24	0	24
	Total	56 841	116	38	154

Note: Strata 10 and 15, sampled during the 1986 and 1987 surveys, were not sampled on the 1991 survey and have been removed from this table. The numbering of the strata used in the previous surveys has been retained.

Table 2: Total catch and percentage catch composition by weight of the 10 most abundant species and the number of stations at which each occurred

	Total catch (kg)	Percentage composition	No. of stations
Smooth oreo	119 258	81.2	138
Black oreo	12 206	8.3	115
Orange roughy	4 099	2.8	80
Shovelnosed dogfish	2 248	1.5	58
Baxter's lantern dogfish	1 761	1.2	141
Johnson's cod	915	0.6	117
Hoki	668	0.5	52
Bigscaled brown slickhead	609	0.4	59
Black javelinfish	552	0.4	77
Smallscaled brown slickhead	508	0.3	86
All other species	3 956	2.7	—
All species	146 780		154

Table 3: Catch, percentage of total catch, and mean catch rates of black oreo (BOE), smooth oreo (SSO), and orange roughy (ORH) by stratum and subarea

Stratum	Catch (kg)			All species	% of total catch			Mean catch rate (kg.km ⁻¹)		
	BOE	SSO	ORH		BOE	SSO	ORH	BOE	SSO	ORH
Subarea 1										
1	747	1	0	1 001	74.6	0.1	0.0	274	< 0.5	0
2	1 902	3 931	0	6 260	30.4	62.8	0.0	273	555	0
3	202	52	0	624	32.4	8.3	0.0	38	10	0
4	39	27	0	446	8.7	6.1	0.0	6	4	0
5	7	6	0	101	6.9	5.9	0.0	3	2	0
Subtotal	2 897	4 017	0	8 432	34.4	47.6	0.0			
Subarea 2										
6	2 115	7	0	2 436	86.8	0.3	0.0	807	3	0
7	818	49	1	1 116	73.3	4.4	0.1	187	12	< 0.5
8	88	101	1	496	17.7	20.4	0.2	35	40	< 0.5
9	0	3	0	127	0.0	2.4	0.0	0	1	0
Subtotal	3 021	160	2	4 175	72.4	3.8	0.0			
Subarea 3										
11	826	62	0	1 053	78.4	5.9	0.0	308	23	0
12	1 317	2 110	3	3 705	35.5	57.0	0.1	296	477	1
13	1 700	17 139	22	19 439	8.7	88.2	0.1	217	2 298	3
14	30	4 412	46	4 713	0.6	93.6	1.0	10	1 538	14
Subtotal	3 873	23 723	71	28 910	13.4	82.1	0.2			
Subarea 4										
16	1 028	8	0	1 262	81.5	0.6	0.0	402	3	0
17	1 103	9 093	70	10 827	10.2	84.0	0.6	169	1 342	11
18	174	7 270	154	8 400	2.1	86.5	1.8	27	1 494	20
19	43	6 759	180	7 602	0.6	88.9	2.4	5	723	20
20	53	59 407	1 977	63 357	0.1	93.8	3.1	2	2 634	87
21	0	3	0	91	0.0	3.3	0.0	0	1	0
Subtotal	2 401	82 540	2 381	91 539	2.6	90.2	2.6			
Subarea 5										
22	0	0	9	491	0.0	0.0	1.8	0	0	3
23	1	503	27	1 468	0.1	34.3	1.8	< 0.5	140	8
24	6	4 682	1 473	7 013	0.1	66.8	21.0	2	1 364	523
25	4	1 093	60	1 661	0.2	65.8	3.6	1	359	19
26	3	2 501	59	2 944	0.1	85.0	2.0	1	792	24
27	0	39	17	147	0.0	26.5	11.6	0	12	6
Subtotal	14	8 818	1 645	13 724	0.1	64.3	12.0			
Total	12 206	119 258	4 099	146 780	8.3	81.2	2.8			

Table 4: Biomass estimates (for fish of all lengths) for all quota species and commercially important non-quota species*

	Biomass (t)	<i>c.v.</i> (%)
Smooth oreo	217 455	25.7
Black oreo	82 500	28.8
Hoki	5 751	30.5
Orange roughy	4 863	37.9
Shovel-nosed dogfish	4 382	16.5
Pale ghost shark	2 011	15.3
Ling	509	41.2
Ribaldo	320	37.4
Hake	151	54.7
Total	341 243	18.3

* The total biomass was calculated using the "Biopc" program held on the main computer at Greta Point. The vulnerability value used in the calculation was restricted to two decimal points, i.e., 0.24 was used rather than the 0.239 which was used for the rest of the biomass calculations.

Table 5: Catch and biomass of hoki (all lengths) from catches taken between 0451 and 1813 hours NZST

Depth (m)	Catch (kg)	Biomass (t)	<i>c.v.</i> (%)	No. of stations where caught
600–800	299.3	4 226	63.0	12
800–1000	64.8	406	32.1	33
1000–1200	0.8	–	–	1

Table 6: Biomass estimates (t) for fish of all lengths (all fish) and for recruited fish for black oreo, smooth oreo, and orange roughly*

Stratum	Area (km ²)	No. of stations	Black oreo			Smooth oreo			Orange roughly			
			All fish	c.v. (%)	Recruited	All fish	c.v. (%)	Recruited	All fish	c.v. (%)	Recruited	
Subarea 1												
1	3 630	3	8 523	31	6 990	30	14	100	10	0	0	0
2	1 732	8	4 033	43	3 781	45	8 222	99	1 375	0	0	0
3	1 435	7	462	57	383	61	118	54	65	0	0	0
4	1 272	9	61	32	46	34	41	35	31	0	0	0
5	2 079	3	49	90	42	88	37	57	32	0	0	0
Subarea 2												
6	4 180	3	28 820	67	22 007	74	119	48	29	0	0	0
7	2 162	5	3 449	54	2 800	55	224	65	100	3	100	0
8	1 086	3	325	78	251	80	372	95	186	3	100	0
9	1 789	3	0	0	0	0	20	6	20	0	0	0
Subarea 3												
11	3 781	3	9 967	41	8 723	46	740	67	134	0	0	0
12	1 571	5	3 970	56	3 883	57	6 411	98	1 123	10	100	5
13	1 677	9	3 112	54	3 082	54	32 938	42	26 044	41	35	28
14	2 123	4	174	57	145	60	27 904	100	24 068	258	55	214
Subarea 4												
16	4 270	3	14 657	83	13 918	89	103	100	45	0	0	0
17	2 890	8	4 182	29	4 016	30	33 151	73	17 840	259	100	61
18	2 364	13	549	69	492	69	30 190	87	15 802	399	41	80
19	2 454	11	106	40	95	43	15 163	88	9 173	406	26	267
20	2 275	27	47	43	45	44	51 221	47	33 742	1 693	70	1 412
21	8 864	3	0	0	0	0	75	15	58	0	0	0
Subarea 5												
22	1 329	3	0	0	0	0	0	100	0	38	100	23
23	465	4	1	58	0	0	556	99	130	30	20	6
24	315	5	4	57	2	57	3 674	59	1 840	1 407	97	726
25	593	4	6	81	2	81	1 821	60	892	97	24	35
26	614	4	6	43	4	45	4 154	95	2 456	126	25	96
27	1 891	4	0	0	0	0	186	80	145	93	48	70
Total	56 841	154	82 500		70 706		217 455		135 341	4 863		3 023
Lower bound †			34 975		28 126		105 648		54 754	1 179		495
Upper bound †			130 025		113 285		329 262		215 928	8 547		5 551
c.v. (%)			28.8		30.1		25.7		29.8	37.9		41.8

* Recruited size for black oreo is ≥ 27 cm TL, for smooth oreo ≥ 34 cm TL, and for orange roughly ≥ 33 cm SL.

† ± 2 standard deviation.

Table 7: Biomass estimates for black oreo (BOE), smooth oreo (SSO), and orange roughy (ORH) of all lengths by subarea

Subarea	Area (km ²)	% of area	Biomass (t)			% of biomass		
			BOE	SSO	ORH	BOE	SSO	ORH
1	10 148	17.9	13 128	8 432	0	15.9	3.9	0.0
2	9 217	16.2	32 594	735	6	39.5	0.3	0.1
3	9 152	16.1	17 223	67 993	309	20.9	31.3	6.4
4	23 117	40.7	19 541	129 903	2 757	23.7	59.7	56.7
5	5 207	9.2	17	10 391	1 791	0.0	4.8	36.8
Total	56 841	100	82 500	217 455	4 863			

Table 8: Biomass estimates for black oreo (BOE), smooth oreo (SSO), and orange roughy (ORH) of all lengths by depth

Depth interval	Area (km ²)	Biomass (t)			% of biomass		
		BOE	SSO	ORH	BOE	SSO	ORH
600–800	17 190	61 967	976	38	75.1	0.4	0.8
800–900	8 820	15 635	48 564	302	19.0	22.3	6.2
900–1000	6 877	4 452	67 292	1 850	5.4	30.9	38.0
1000–1100	8 231	347	44 949	761	0.4	20.7	15.6
1100–1200	4 968	102	55 412	1 819	0.1	25.5	37.4
1200–1500	10 755	0	261	93	0.0	0.1	1.9
All depths	56 841	82 500	217 455	4 863			

Table 9: Numbers of length and sex and "biological" (i.e., up to 20 fish per station) samples taken during the survey

	Length & sex	Biological	Otoliths
Black oreo	8 494	1 383	yes
Smooth oreo	9 426	1 528	yes
Orange roughy	1 744	850	yes
Hoki	27	0	no
Hake	3	3	no

Table 10: Length-weight relationships for oreos and orange roughy*

	Weight range (g)	Length range (cm)	<i>a</i>	<i>b</i>	<i>r</i> ²	<i>n</i>
Black oreo	180–1 480	22.0–40.8	0.012	3.16	93.0	1 382
Smooth oreo	100–2 570	16.1–50.8	0.026	2.93	98.6	1 528
Orange roughy	47–2 325	10.4–43.0	0.063	2.81	98.8	850

* $W = a.L^b$. Lengths are total length for oreos and standard length for orange roughy.

Table 11: Relative proportions of gonad stages of the three main species

Gonad stage	Black oreo				Smooth oreo				Orange roughy			
	Male	%	Female	%	Male	%	Female	%	Male	%	Female	%
1	406	61.0	266	37.1	390	48.6	451	62.5	208	57.8	106	22.1
2	155	23.3	236	32.8	102	12.7	177	24.5	133	36.9	370	77.2
3	102	15.3	106	14.8	254	31.7	50	6.9	19	5.3	1	0.2
4	2	0.3	94	13.1	55	6.9	36	5.0				
5	1	0.2	2	0.3	1	0.1	8	1.1				
6			13	1.8							2	0.4
All	666	100.0	717	100.0	802	100.0	722	100.0	360	100.0	479	100.0

Table 12: Percentage of gonads at each stage by species by depth range from the total survey area

Black oreo

Depth range (m)	Males						Females						
	1	2	3	4	5	<i>n</i>	1	2	3	4	5	6	<i>n</i>
600–800	53.3	28.7	17.2	0.8		122	30.2	41.5	11.3	9.4		7.5	106
800–900	59.2	23.9	16.8			238	26.7	37.8	17.0	16.3	0.3	1.7	288
900–1000	57.9	24.4	16.8	0.5	0.5	197	48.0	24.0	14.0	13.5	0.3		200
1000–1100	80.2	14.8	4.9			81	50.6	36.8	11.5	1.1			87
1100–1200	75.0	10.7	14.3			28	47.2	8.3	19.5	25.0			36
1200–1500						0							0
Total <i>n</i>	406	155	102	2	1	666	266	236	106	94	2	13	717

Smooth oreo

Depth range (m)	Males						Females						
	1	2	3	4	5	<i>n</i>	1	2	3	4	5	6	<i>n</i>
600–800	65.6	3.1	31.3			32	65.7	20.0	8.6	5.7			35
800–900	69.5	6.1	21.3	3.0		164	78.1	9.0	7.7	3.2	1.9		155
900–1000	37.3	13.5	39.8	9.4		244	57.1	25.8	9.3	7.1	0.5		182
1000–1100	52.8	14.8	21.8	9.9	0.7	142	65.6	20.3	7.8	5.5	0.8		128
1100–1200	43.1	16.7	34.3	5.9		204	54.8	36.2	3.8	3.8	1.4		210
1200–1500	6.3	18.8	68.8	6.3		16	33.3	58.3		8.3			12
Total <i>n</i>	390	102	254	55	1	802	451	177	50	36	8	0	722

Orange roughy

Depth range (m)	Males						Females					
	1	2	5	<i>n</i>	1	2	3	4*	5*	6	<i>n</i>	
600–800	66.7		33.3	3		100.0					4	
800–900	98.0	2.0		51	70.7	29.3					41	
900–1000	75.5	20.4	4.1	98	31.8	66.4	0.9			0.9	107	
1000–1100	49.4	37.6	12.9	85	17.6	78.4					120	
1100–1200	33.6	63.7	2.7	113	10.2	87.9				0.5	203	
1200–1500	20.0	80.0		10		100.0					4	
Total <i>n</i>	208	133	19	360	106	370	1	0	0	2	479	

* 10 gonads initially staged 4 or 5 have been changed to atretic, stage 7.

Table 13: Percentage of gonads at each stage by species by subarea

Black oreo

Subarea	Males						Females						
	1	2	3	4	5	<i>n</i>	1	2	3	4	5	6	<i>n</i>
1	76.5	18.3	5.2			213	50.5	40.7	8.2			0.5	182
2	55.4	9.6	33.7	1.2		83	45.0	19.3	8.3	21.1		6.4	109
3	47.7	35.6	16.7			174	24.9	33.5	25.4	14.5	1.2	0.6	173
4	56.0	25.0	18.5	0.5		184	30.5	33.7	15.4	18.7		1.6	246
5	91.7				8.3	12	100.0						7
Total <i>n</i>	406	155	102	2	1	666	266	236	106	94	2	13	717

Smooth oreo

Subarea	Males						Females						
	1	2	3	4	5	<i>n</i>	1	2	3	4	5	6	<i>n</i>
1	47.2	16.7	33.3	2.8		108	77.1	13.3	9.6				83
2	41.2		55.9	2.9		34	51.2	29.3	7.3	12.2			41
3	41.3	13.5	36.5	8.7		126	49.6	27.3	17.3	5.3			133
4	46.0	13.9	32.3	7.8		396	61.8	27.3	3.9	5.5	1.5		330
5	65.9	8.7	18.1	6.5	0.7	138	71.1	20.0	2.2	4.4	2.2		135
Total <i>n</i>	390	102	254	55	1	802	451	177	50	36	8	0	722

Orange roughy

Subarea	Males					Females							
	1	2	5	<i>n</i>		1	2	3	4*	5*	6	<i>n</i>	
1				0								0	
2			100.0	1		100.0						1	
3			50.0	30.0	20.0	20	3.2	93.5				30	
4			51.5	41.6	7.0	200	16.4	80.5	0.3		0.3	310	
5			68.3	30.9	0.7	139	37.4	61.2			0.7	138	
Total <i>n</i>			208	133	19	360	106	370	1	0	0	2	479

* 10 gonads initially staged 4 or 5 have been changed to atretic, stage 7.

Table 14: Summary of the similarities and differences between the four south Chatham Rise stratified random trawl surveys*

Vessel	<i>Arrow</i> (1986)	<i>Amaltal Explorer</i> (1987)	<i>Cordella</i> (1990)	<i>Tangaroa</i> (1991)
Length (m)	57	65	76	70
Tonnage (t)	549	1000	1238	2282
Power (kW)	1342	2013	2610	3000
Navigation	Sat. nav.	GPS(18 h/day)	GPS(23 h/day)	GPS(24 h/day)
Net type	6 panel wingless	6 panel wingless	6 panel wingless	6 panel wingless
Groundrope (m)	18.7	22.4	20.8	22.4
Doorspread (m)	Unknown, 86.7 †	Unknown, 87 †	Unknown, 117 ‡	117§
Wingspread (m)	Unknown, 19.8 †	Unknown, 19.7 †	Unknown, 28 ‡	28 ‡
Headline hgt (m)	7.0	7.0	8.9	6.9
Codend mesh (mm)	100	100	100	100
Dates	31 Oct.-7 Dec.	3-30 Nov.	30 Oct.-30 Nov.	11 Oct.-9 Nov.
Survey area (km ²)	47 137	47 496	61 567	61 567
Subareas	1-4	1-4	1-5	1-5
Depths (m)	600-1200	600-1200	600-1500	600-1500
Strata	1-20	1-20	1-9, 11-14, 16-27	1-9, 11-14, 16-27
No. of stations	187	192	189	154

* GPS, Global Positioning System; hgt, height; sat. nav., satellite navigation system.

† Distances are assumed from tests of a model trawl in a flume tank.

‡ Assumed from gear trials of *Tangaroa* net.

§ Mean of the value measured during trawling.

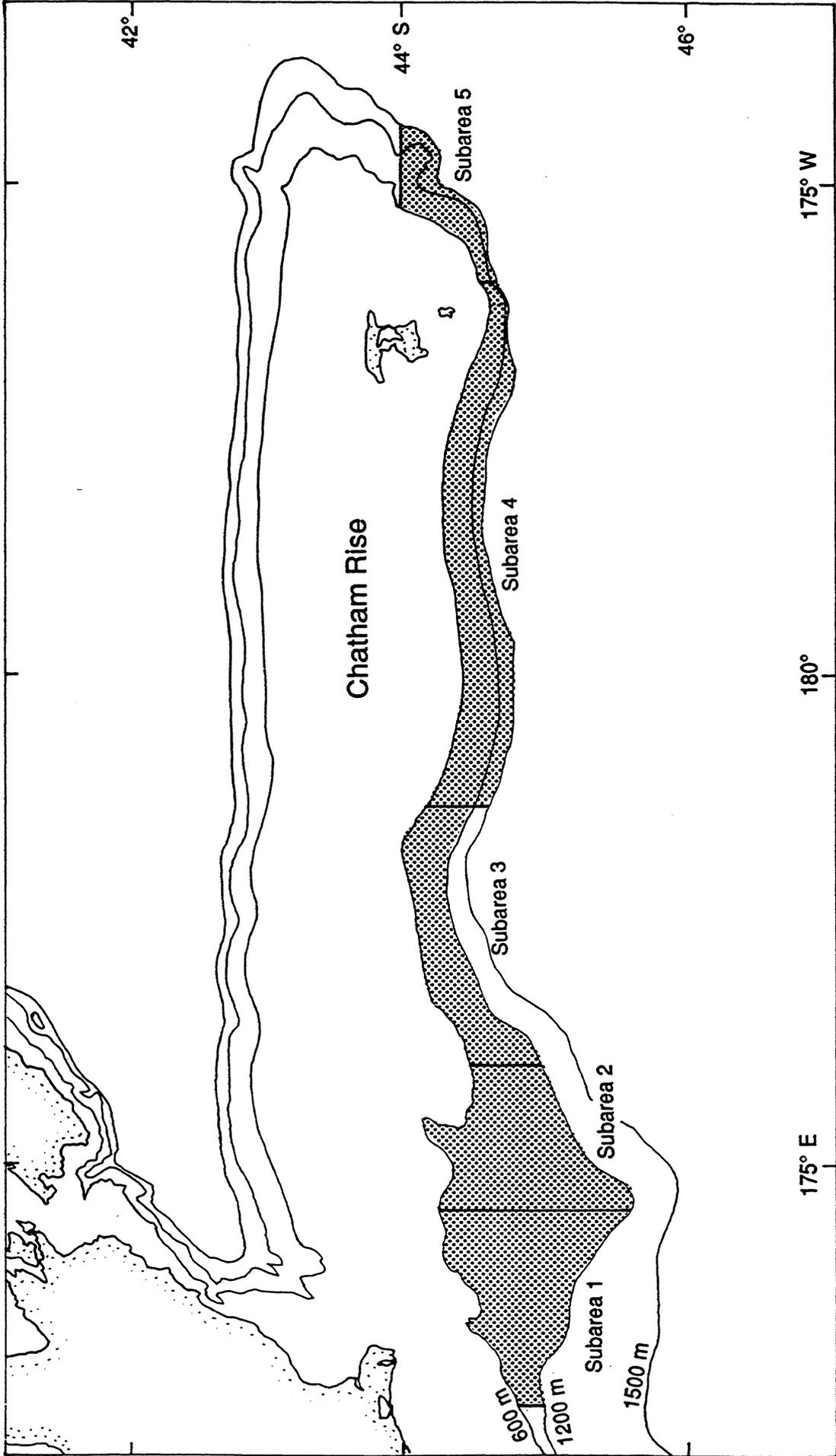


Figure 1: Survey area showing subareas.

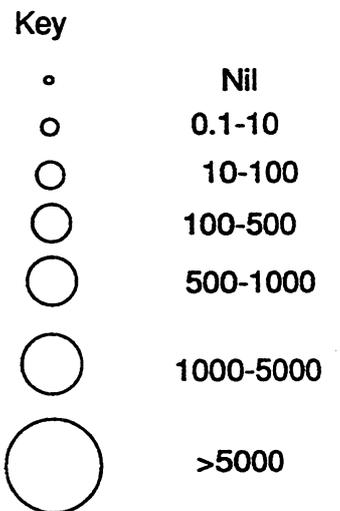
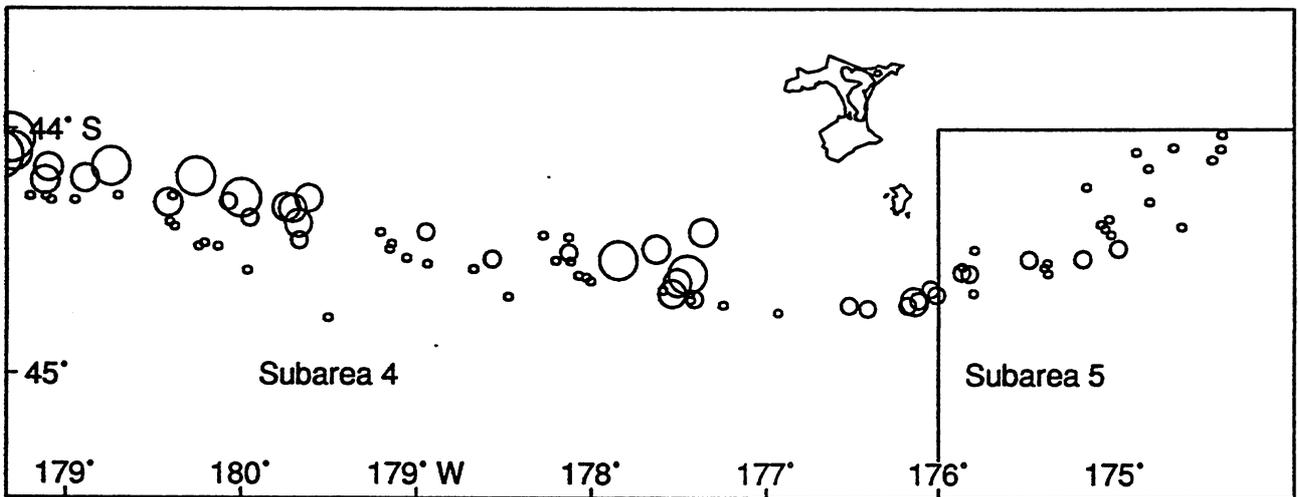
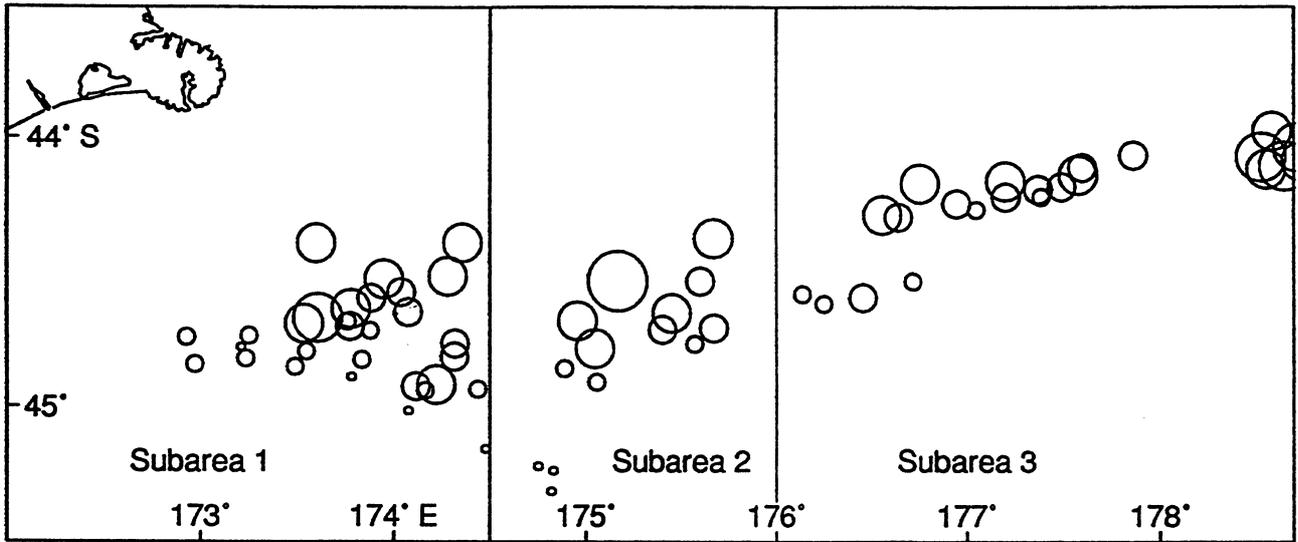


Figure 2: Catch rates (kg.km^{-1}) of black oreo.

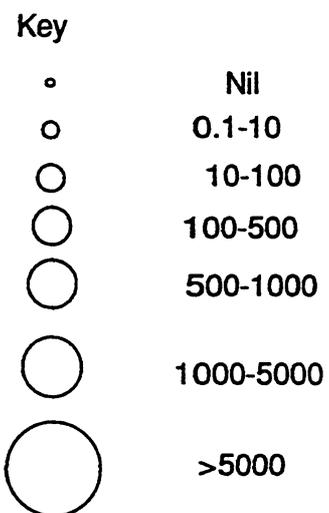
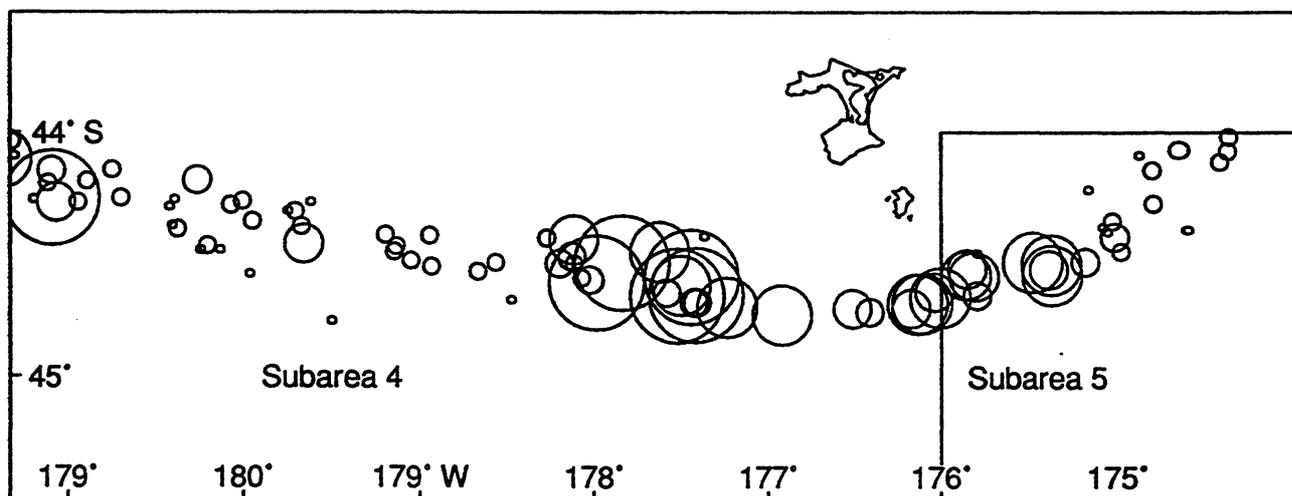
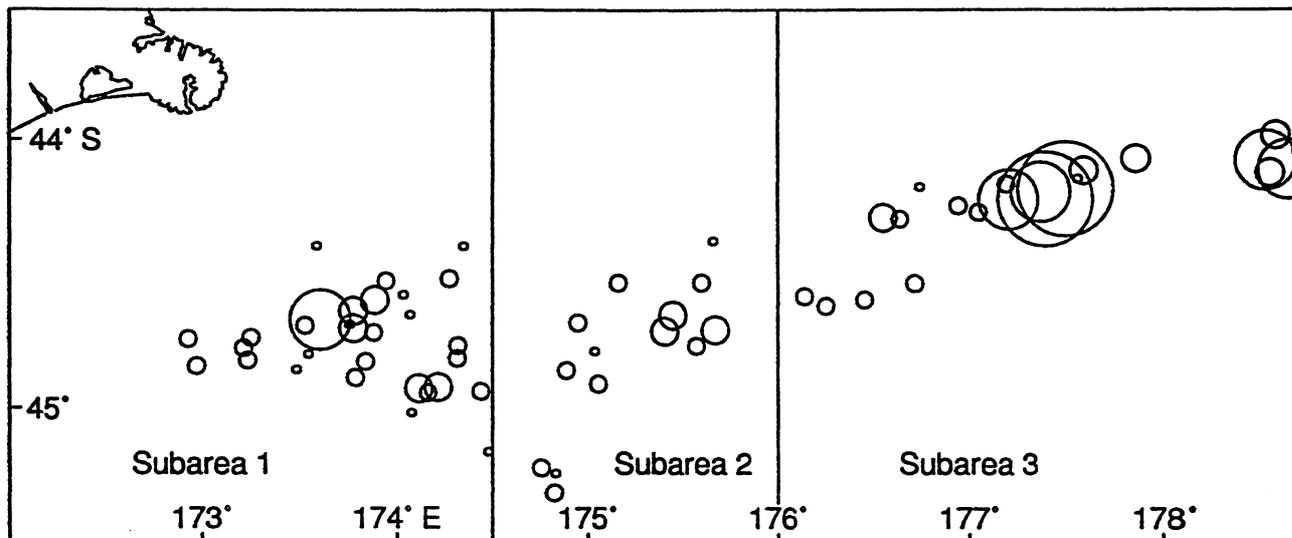


Figure 3: Catch rates ($\text{kg}\cdot\text{km}^{-1}$) of smooth oreo.

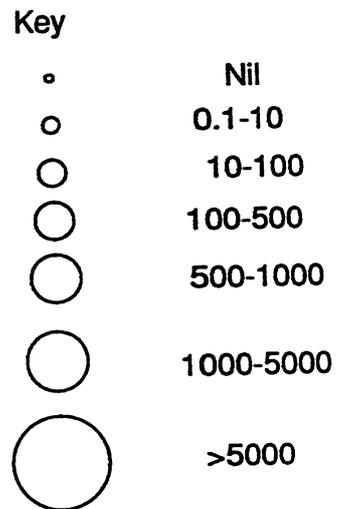
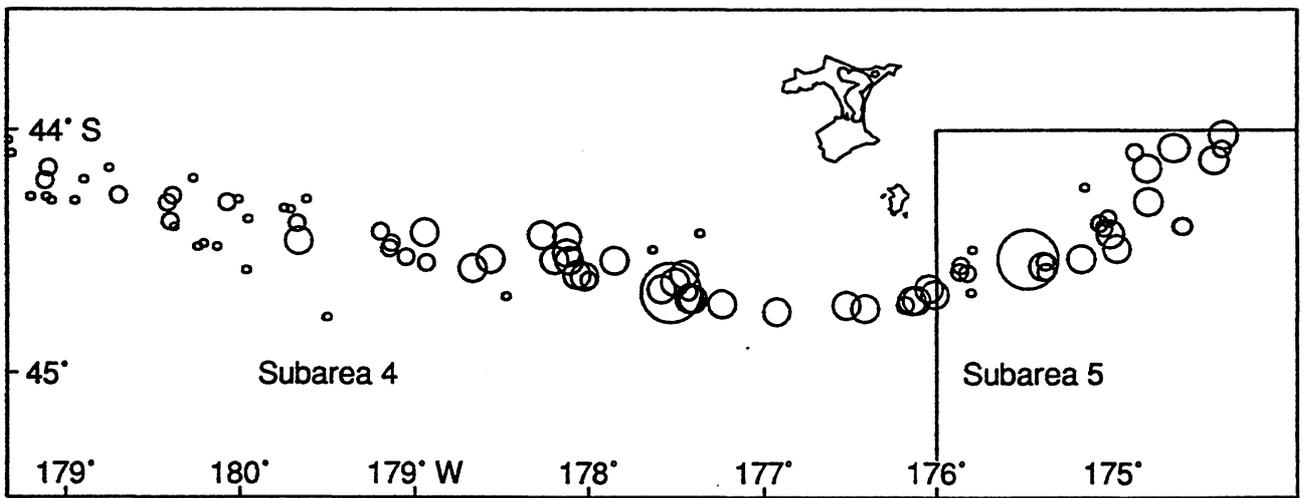
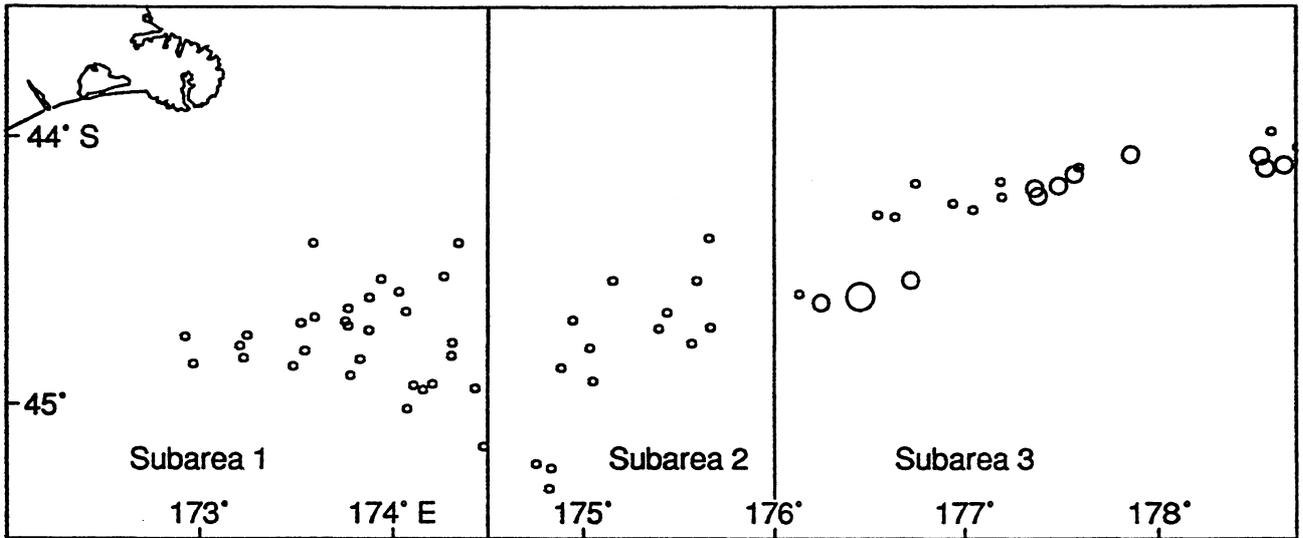


Figure 4: Catch rates (kg.km^{-1}) of orange roughy.

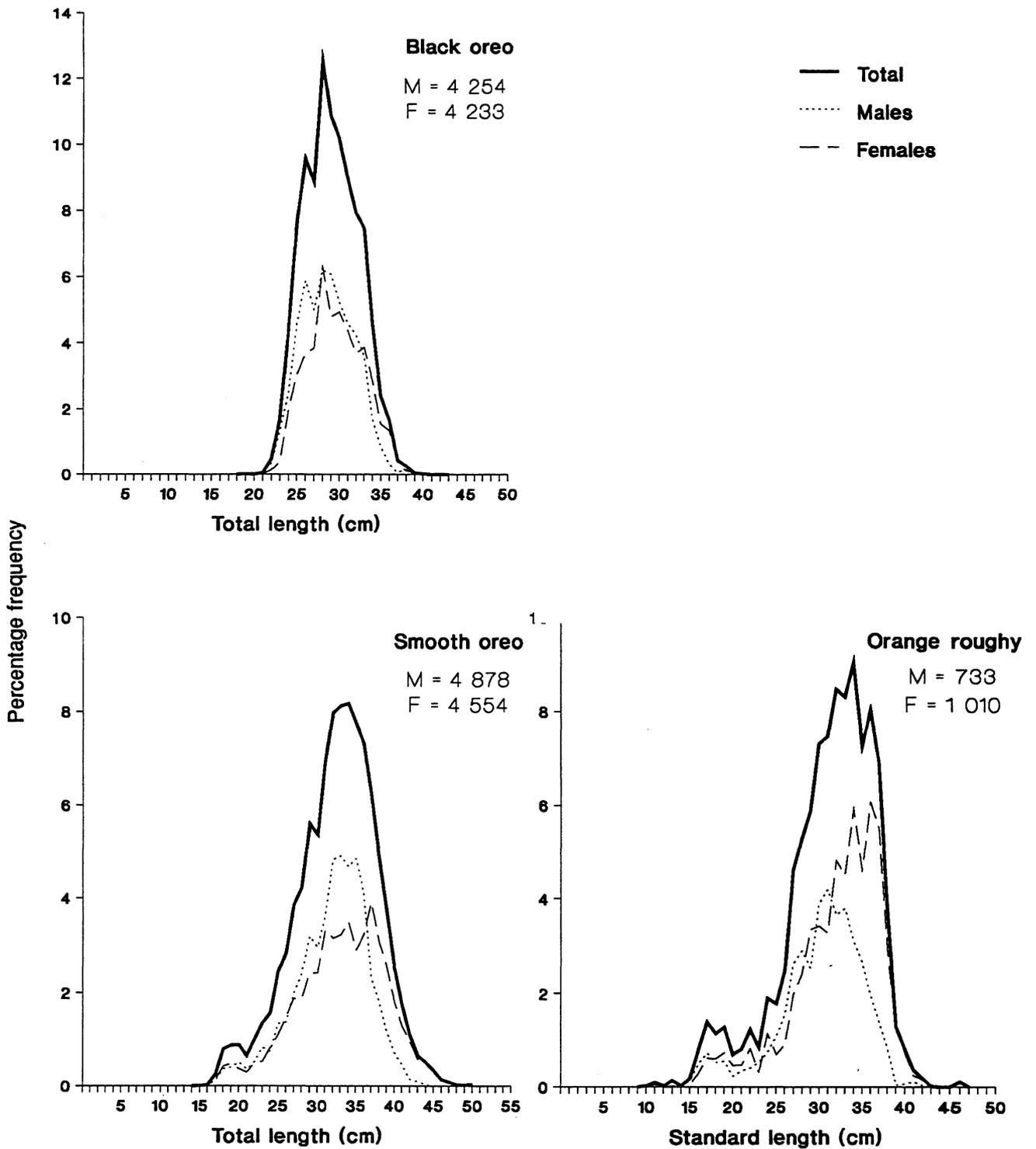


Figure 5: Distribution of scaled black oreo, smooth oreo, and orange roughy length samples for the entire survey area.

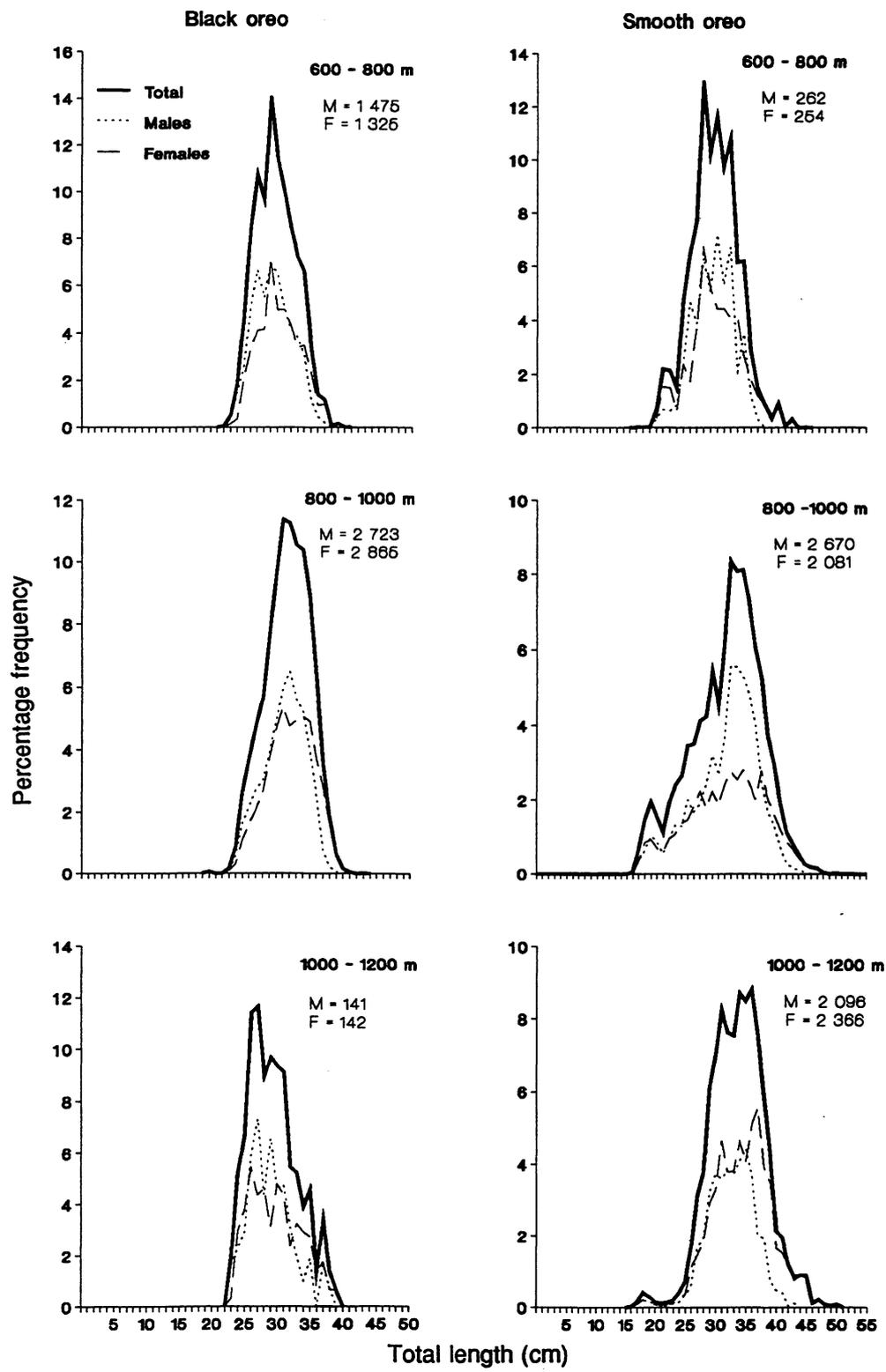


Figure 6: Distribution of scaled length data for black oreo, smooth oreo, and orange roughy by depth interval.

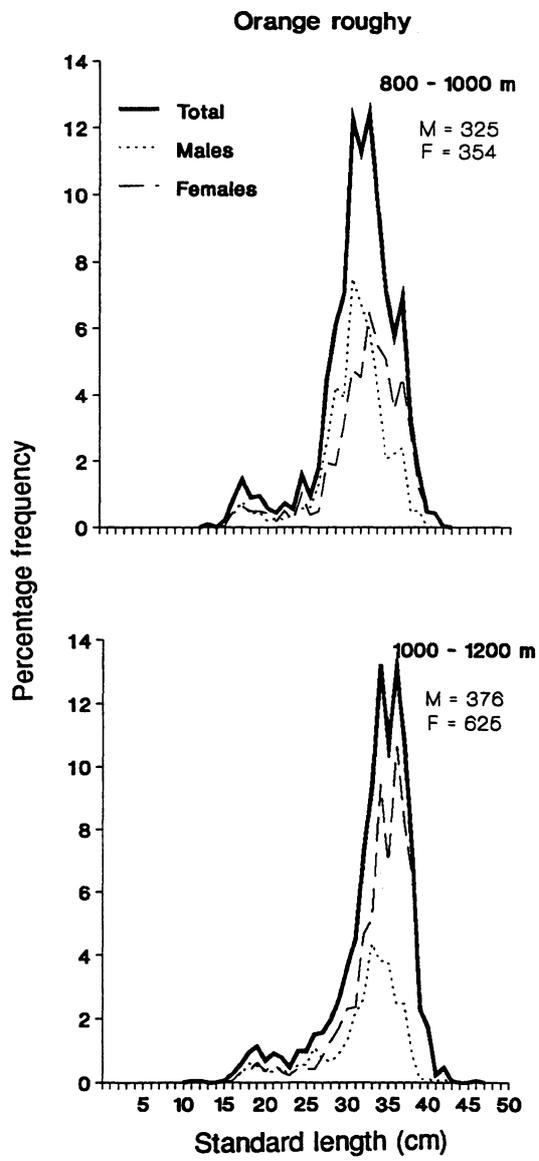


Figure 6: continued.

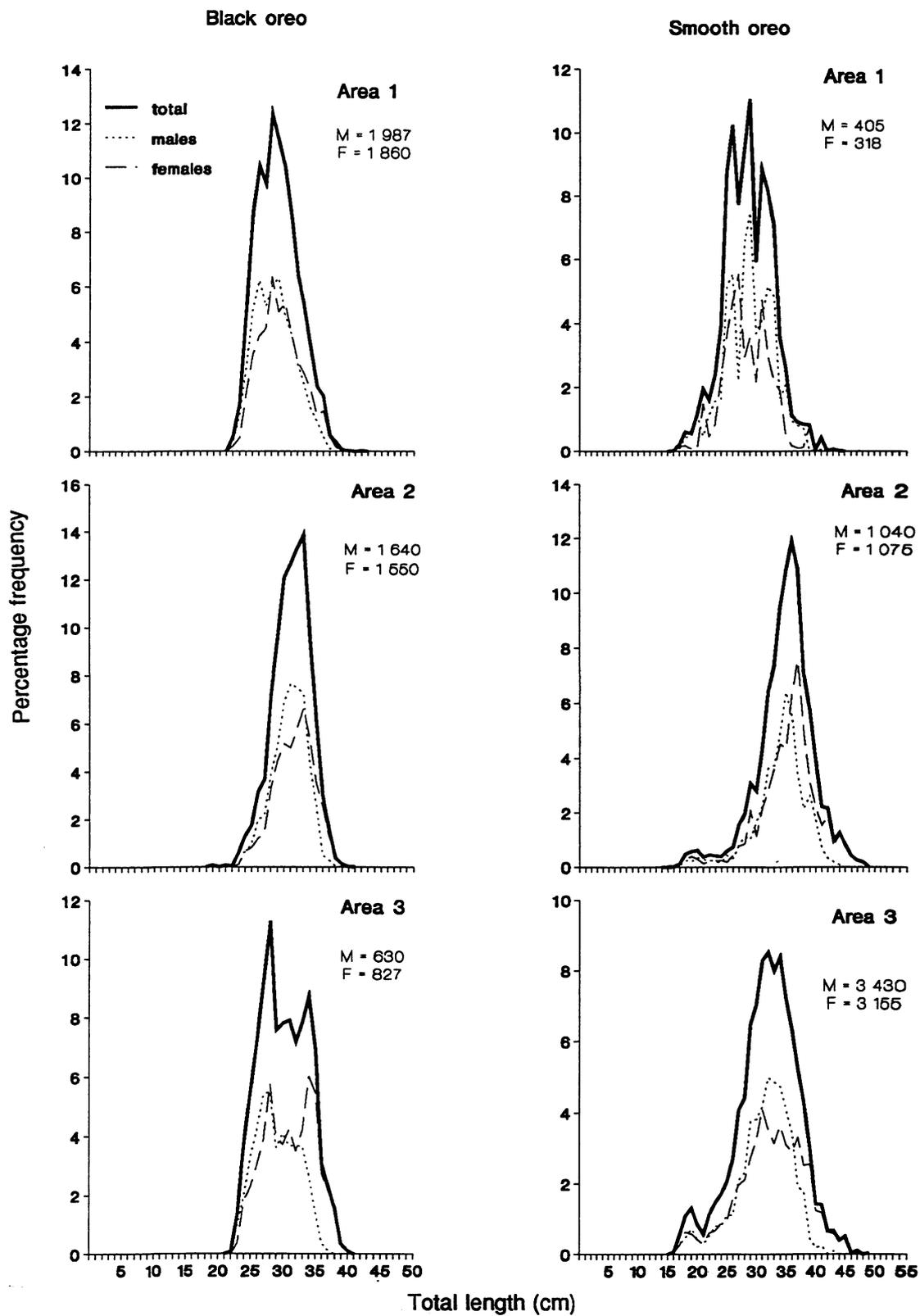


Figure 7: Distribution of scaled length data for black oreo, smooth oreo and orange roughy by area. Area 1 = 172° 30' to 176° E; area 2 = 176° to 179°30' E; area 3 179°30' E to 174°W.

Orange roughy

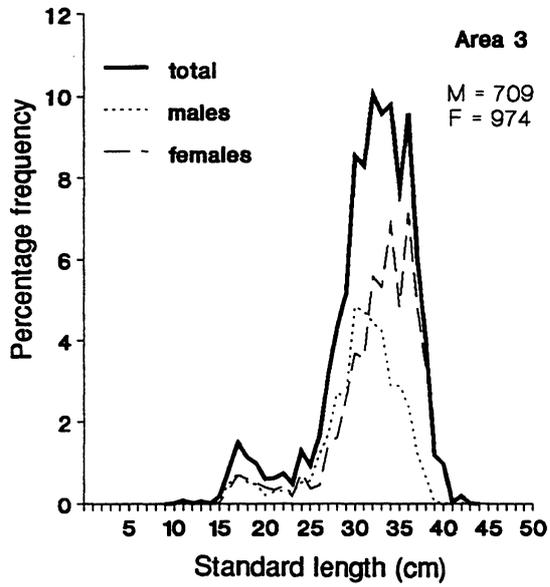


Figure 7: continued.

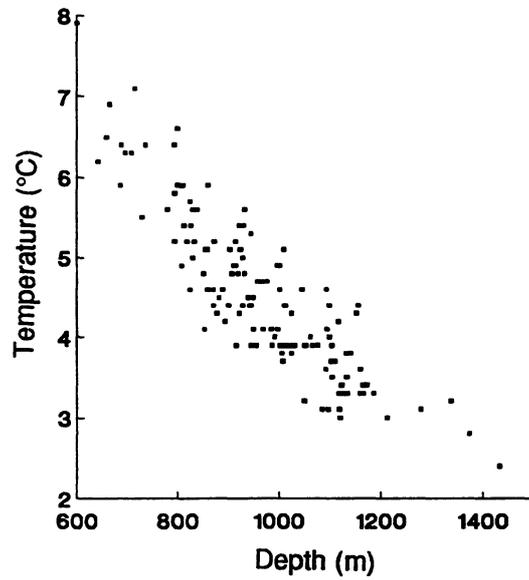


Figure 8: Bottom temperature data (of unknown accuracy) recorded from the net monitor.

Appendix 1: Gear specifications for survey TAN9104.

Trawl doors: type WV-doors, 6.1 m², 2300 kg (in air)

Trawl warp diameter: 24 mm

Net type: 6 panel wingless trawl used for orange roughy surveys. Codend mesh 100 mm. *See plan in Clark & Tracey (1994)*

Ground rope length: 22.4 m

Ground rope construction: 10 steel (diameter 0.6 m) with 9 alternating rubber bobbins (diameter 0.6 m)

Bridle length: 50 m

Sweep length: 50 m

Total length from lower wing end to door: approximately 122 m (includes sweep, bridles, plus 11.8 m ground chain and estimated backstop horizontal distance of 10 m)

Headline length: 38.2 m

Distance between the wings of the net: is assumed to be 28 m (from gear trial results)

Flotation: a total of 20 x 1500 m and 28 x 2000 m floats were used.

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

	Range (m)	Mean (m)	Median (m)	No. of tows
Headline height †	5.0–11.0	6.9	6.7	154
Distance between doors ‡	103–128	117	117	146

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

Appendix 2: Conversion factor (C.F.) and block weight measurements used to back-calculate large catches*.

Conversion factor

Station	Green weight	Headed and gutted	C.F.
Smooth oreo			
41	216.3	97.5	2.22
43	231.7	104.3	2.22
49	147.7	66.0	2.24
72	240.6	106.1	2.27
75	263.0	96.2	2.73
76	247.4	104.0	2.38
76	228.1	94.4	2.42
92	180.3	75.8	2.38
103	196.5	76.8	2.56
115	148.3	53.7	2.76
Orange roughy			
95	206.9	87.1	2.37

Frozen block weights

Station	No. of blocks	Total weight	Mean block weight
Smooth oreo			
41	10	123.0	12.3

* All weights were measured on a Seaway weigher. Green weight is the weight before processing; Headed and gutted is the weight after processing; C.F. is the conversion factor calculated by dividing the green weight by the headed and gutted weight.

**Appendix 3: Black oreo, smooth oreo, and orange roughly gonad stages used during the survey
(from Pankhurst *et al.* 1987).**

Stage	Macroscopic condition	Histological condition
Females		
1	Immature or regressed; ovary clear.	Previtellogenic oocytes only.
2	Ovary pink or clear; small clear oocytes visible against the light.	Endogenous vitellogenesis (yolk globule accumulation).
3	Opaque white (oreos) or orange (orange roughly) oocytes present.	Exogenous vitellogenesis (yolk granule accumulation).
4	Mature ovary; hyaline oocytes present.	Final oocyte maturation; nuclear migration and breakdown; coalescence of yolk material and oil droplet formation.
5	Ovulated; eggs flow freely when light pressure applied to abdomen.	Follicular separation and rupture.
6	Spent; ovary flaccid and "bloody"; residual eggs sometimes present in oviduct.	Post-ovulatory follicles, increased vascularization, follicular atresia.
Males		
1	Immature or regressed; testis threadlike.	Spermatogonia and primary spermatocytes predominate.
2	Testis increased in size but no milt expressible	Secondary spermatocytes and spermatids present, spermatozoa in larger gonads.
3	Partially spermiated; viscous milt expressible.	Spermatozoa predominate.
4	Fully spermiated; hydrated, freely flowing milt.	Spermatozoa predominate.
5	Spent; testis "bloody" or grey; no milt expressible.	Residual spermatozoa, spermatogonia present towards testis margin.

Appendix 4: Summary of station data*

Station	Stratum	Date	Start		Latitude	Longitude	Finish		Depth (m)	Distance towed (n. mile)	Warp length (m)
			'S	'E/W			'S	'E/W			
1	1	11 Oct	44 23.93	173 35.34 E	44 22.60	173 38.04 E	664	669	2.00	1 200	
2	3	12 Oct	44 44.85	172 55.52 E	44 45.91	172 53.03 E	940	977	2.00	1 720	
3	5	12 Oct	44 50.88	172 58.19 E	44 52.62	172 55.14 E	1 135	1 184	2.00	2 050	
4	4	12 Oct	44 46.89	173 12.67 E	44 47.10	173 10.11 E	1 051	1 078	2.00	2 000	
5	3	12 Oct	44 49.53	173 13.90 E	44 49.28	173 11.22 E	982	987	2.00	1 850	
6	4	12 Oct	44 44.58	173 14.86 E	44 44.27	173 15.99 E	1 010	1 025	0.98	1 700	
7	4	12 Oct	44 51.45	173 29.04 E	44 50.24	173 27.35 E	1 050	1 105	1.70	2 150	
8	4	12 Oct	44 47.96	173 32.78 E	44 48.49	173 33.81 E	1 016	1 081	0.90	2 020	
9	2	12 Oct	44 41.78	173 31.49 E	44 43.72	173 31.67 E	851	878	2.00	1 630	
10	2	12 Oct	44 40.49	173 35.81 E	44 42.38	173 36.60 E	830	867	2.00	1 650	
11	3	13 Oct	44 42.45	173 46.17 E	44 43.47	173 43.83 E	894	968	2.00	1 800	
12	3	13 Oct	44 41.36	173 45.42 E	44 40.63	173 42.72 E	889	956	2.00	1 800	
13	2	13 Oct	44 38.56	173 46.12 E	44 39.57	173 43.97 E	808	886	1.82	1 550	
14	4	13 Oct	44 43.44	173 52.60 E	44 43.82	173 49.98 E	1 000	1 032	1.80	1 900	
15	4	13 Oct	44 49.77	173 49.93 E	44 51.58	173 48.15 E	1 001	1 100	1.82	2 000	
16	5	13 Oct	44 53.43	173 46.96 E	44 55.08	173 48.47 E	1 158	1 163	2.00	2 000	
17	2	13 Oct	44 36.15	173 52.92 E	44 37.52	173 50.71 E	882	886	2.00	1 630	
18	2	14 Oct	44 31.96	173 56.50 E	44 33.11	173 54.02 E	816	819	2.11	1 640	
19	2	14 Oct	44 34.81	174 02.15 E	44 35.29	173 59.41 E	871	892	2.00	1 600	
20	2	15 Oct	44 39.23	174 04.31 E	44 37.91	174 02.20 E	813	863	2.00	1 672	
21	1	15 Oct	44 31.43	174 16.26 E	44 29.48	174 17.02 E	755	795	2.02	1 650	
22	1	15 Oct	44 23.97	174 21.04 E	44 22.53	174 23.14 E	685	696	2.08	1 330	
23	2	15 Oct	44 46.23	174 18.94 E	44 47.47	174 20.54 E	873	898	1.68	1 710	
24	3	15 Oct	44 49.15	174 18.67 E	44 50.91	174 18.99 E	901	1 000	1.77	1 710	
25	3	15 Oct	44 55.32	174 12.63 E	44 55.45	174 14.87 E	945	972	1.59	1 750	
26	4	15 Oct	44 55.71	174 06.79 E	44 55.80	174 03.99 E	1 009	1 068	2.00	1 950	
27	5	15 Oct	45 00.86	174 04.64 E	45 00.44	174 01.94 E	1 171	1 183	2.00	2 150	
28	4	16 Oct	44 56.66	174 09.77 E	44 58.78	174 09.48 E	992	1 100	2.13	1 900	
29	3	16 Oct	44 56.43	174 26.23 E	44 58.21	174 25.57 E	966	987	1.84	1 860	
30	4	16 Oct	45 09.46	174 28.88 E	45 07.80	174 27.29 E	1 085	1 086	2.01	1 960	
31	13	16 Oct	44 35.36	176 08.17 E	44 34.18	176 05.80 E	928	933	2.00	1 770	
32	14	16 Oct	44 37.48	176 14.98 E	44 37.39	176 17.54 E	1 008	1 036	1.82	1 884	
33	14	17 Oct	44 36.11	176 27.33 E	44 35.35	176 31.96 E	1 012	1 070	2.00	1 800	

Station	Stratum	Date 1991	Start		Finish		Depth (m) Min.	Depth (m) Max.	Distance towed (n. mile)	Warp length (m)
			Latitude ° 'S	Longitude ° 'E/W	Latitude ° 'S	Longitude ° 'E/W				
34	14	17 Oct	44 32.59	176 43.11 E	44 31.59	176 43.61 E	1 043	1 100	1.06	1 950
35	12	17 Oct	44 18.20	176 38.47 E	44 19.88	176 36.91 E	800	807	2.02	1 500
36	11	17 Oct	44 17.66	176 33.15 E	44 19.75	176 32.68 E	737	763	2.12	1 400
37	11	17 Oct	44 10.73	176 44.98 E	44 12.42	176 43.84 E	658	687	2.00	1 300
38	12	17 Oct	44 15.12	176 56.70 E	44 14.16	176 54.19 E	819	863	2.00	1 600
39	13	17 Oct	44 13.73	177 11.89 E	44 13.67	177 09.08 E	911	926	2.00	1 610
40	12	17 Oct	44 10.29	177 11.56 E	44 12.22	177 10.42 E	815	867	2.10	1 500
41	13	18 Oct	44 12.03	177 21.99 E	44 12.29	177 19.06 E	939	956	2.12	1 700
42	14	18 Oct	44 13.66	177 23.06 E	44 13.34	177 25.28 E	1 002	1 040	1.62	1 760
43	13	18 Oct	44 11.42	177 29.26 E	44 12.88	177 29.88 E	945	1 000	1.53	1 650
44	12	19 Oct	44 07.00	177 35.61 E	44 08.18	177 36.75 E	878	900	1.44	1 700
45	13	19 Oct	44 04.29	177 51.52 E	44 04.08	177 54.35 E	922	973	2.04	1 700
47	11	19 Oct	43 58.92	178 32.93 E	43 58.85	178 35.70 E	678	686	2.00	1 400
48	16	19 Oct	44 02.53	178 40.73 E	44 02.88	178 37.98 E	781	791	2.00	1 550
49	13	20 Oct	44 06.80	178 36.57 E	44 06.00	178 33.69 E	907	989	2.00	1 700
50	17	20 Oct	44 05.73	178 41.80 E	44 05.85	178 44.66 E	858	859	2.06	1 600
51	19	20 Oct	44 12.69	178 53.04 E	44 12.95	178 55.51 E	1 005	1 008	1.79	1 800
52	18	20 Oct	44 12.36	179 06.41 E	44 13.44	179 08.82 E	929	939	2.00	1 900
53	17	20 Oct	44 09.38	179 15.21 E	44 09.38	179 12.40 E	826	839	2.00	1 600
54	19	21 Oct	44 18.35	179 34.94 E	44 18.45	179 37.69 E	1 012	1 022	1.97	1 800
55	21	21 Oct	44 28.81	179 45.53 E	44 29.71	179 48.26 E	1 210	1 212	2.15	2 250
56	18	21 Oct	44 18.18	179 55.53 E	44 19.41	179 57.82 E	919	933	2.00	1 700
57	17	21 Oct	44 17.26	179 59.53 E	44 17.19	179 57.85 E	830	841	1.20	1 550
58	17	21 Oct	44 12.02	179 44.13 E	44 12.75	179 46.75 E	823	825	2.00	1 550
59	17	21 Oct	44 19.46	179 44.73 W	44 18.85	179 41.72 W	808	836	2.24	1 600
60	16	23 Oct	44 17.17	179 37.00 W	44 17.42	179 39.86 W	709	741	2.06	1 450
61	18	23 Oct	44 23.35	179 40.58 W	44 24.95	179 40.59 W	911	1 000	1.60	1 900
62	19	23 Oct	44 27.59	179 40.19 W	44 28.96	179 38.09 W	1 062	1 100	2.03	1 950
63	21	23 Oct	44 46.36	179 29.97 W	44 46.23	179 32.79 W	1 320	1 372	2.01	2 400
64	19	23 Oct	44 29.59	179 09.03 W	44 30.74	179 11.34 W	1 052	1 076	2.00	2 000
65	18	23 Oct	44 25.60	178 56.79 W	44 26.07	178 59.56 W	915	969	2.00	1 850
66	21	24 Oct	44 41.21	178 28.24 W	44 41.25	178 25.53 W	1 273	1 278	1.93	2 350
67	19	24 Oct	44 32.37	178 12.15 W	44 34.33	178 11.36 W	1 025	1 063	2.04	2 000

Station	Stratum	Date	Start		Finish		Depth (m)		Distance towed (n. mile)	Warp length (m)
			Latitude ° 'S	Longitude ° 'E/W	Latitude ° 'S	Longitude ° 'E/W	Min.	Max.		
68	19	24 Oct 1991	44 32.50	178 07.13 W	44 32.69	178 04.28 W	1 043	1 048	2.04	2 100
69	19	24 Oct	44 30.58	178 07.97 W	44 32.55	178 07.52 W	998	1 068	2.00	2 100
70	20	24 Oct	44 35.95	178 04.40 W	44 37.89	178 03.75 W	1 093	1 154	1.99	1 900
71	20	24 Oct	44 36.42	178 01.80 W	44 36.49	177 59.89 W	1 100	1 133	1.36	2 100
72	18	24 Oct	44 32.48	177 51.41 W	44 33.25	177 51.04 W	911	915	0.81	1 750
73	17	24 Oct	44 29.62	177 37.90 W	44 29.86	177 40.66 W	800	814	2.00	1 500
74	16	25 Oct	44 25.50	177 21.86 W	44 25.97	177 20.59 W	642	651	1.02	1 300
75	17	25 Oct	44 35.96	177 27.62 W	44 36.13	177 30.25 W	860	890	1.88	1 700
76	20	25 Oct	44 40.49	177 32.35 W	44 41.60	177 30.16 W	1 141	1 177	1.91	2 100
77	26	27 Oct	44 01.29	174 24.18 W	44 03.02	174 22.72 W	1 117	1 200	2.02	2 100
78	27	27 Oct	44 04.87	174 24.54 W	44 04.56	174 21.77 W	1 204	1 239	2.00	2 300
79	27	27 Oct	44 07.56	174 27.15 W	44 08.93	174 27.50 W	1 239	1 261	1.39	2 350
80	25	28 Oct	44 04.48	174 39.79 W	44 04.04	174 37.07 W	1 010	1 062	2.00	1 950
81	22	28 Oct	44 05.60	174 52.41 W	44 03.58	174 52.42 W	783	800	2.02	1 600
82	24	28 Oct	44 09.66	174 48.46 W	44 09.85	174 47.08 W	925	1 000	1.01	1 900
83	22	28 Oct	44 14.25	175 09.30 W	44 12.19	175 10.41 W	668	715	2.21	1 450
84	25	28 Oct	44 17.90	174 47.90 W	44 15.91	174 49.12 W	1 061	1 092	2.17	2 050
85	27	28 Oct	44 23.93	174 37.08 W	44 22.16	174 36.57 W	1 432	1 477	1.81	2 500
86	24	29 Oct	44 25.89	175 00.98 W	44 25.20	175 02.38 W	900	937	1.21	1 770
87	23	29 Oct	44 24.40	175 02.98 W	44 22.48	175 02.10 W	825	860	2.02	1 600
88	23	29 Oct	44 22.17	175 01.72 W	44 22.06	174 59.03 W	794	823	1.93	1 600
89	23	29 Oct	44 23.35	175 04.51 W	44 25.27	175 04.61 W	794	842	1.92	1 600
90	26	29 Oct	44 29.57	174 58.89 W	44 30.10	175 00.10 W	1 094	1 117	1.01	2 050
91	26	29 Oct	44 32.00	175 10.93 W	44 31.97	175 09.07 W	1 156	1 200	1.33	2 150
92	26	29 Oct	44 35.32	175 22.57 W	44 35.61	175 20.07 W	1 100	1 145	1.80	2 100
93	25	29 Oct	44 33.87	175 23.76 W	44 34.22	175 25.49 W	1 046	1 050	1.28	1 950
94	24	30 Oct	44 32.89	175 22.97 W	44 32.64	175 25.88 W	975	999	2.09	1 800
95	24	30 Oct	44 32.25	175 29.32 W	44 32.70	175 30.98 W	922	943	1.27	1 800
96	27	30 Oct	44 40.20	175 48.16 W	44 39.70	175 45.48 W	1 335	1 354	1.97	2 400
97	22	30 Oct	44 29.64	175 47.63 W	44 29.91	175 49.67 W	592	626	1.48	1 300
98	23	30 Oct	44 33.83	175 51.72 W	44 33.86	175 48.87 W	811	883	2.03	1 650
99	24	30 Oct	44 35.41	175 52.23 W	44 35.47	175 49.44 W	945	976	1.99	1 850
100	25	30 Oct	44 35.72	175 49.71 W	44 35.88	175 46.93 W	1 002	1 055	1.99	1 950

Station	Stratum	Date 1991	Start		Finish		Depth (m) Min.	Depth (m) Max.	Distance towed (n. mile)	Warp length (m)
			Latitude ° 'S	Longitude ° 'E/W	Latitude ° 'S	Longitude ° 'E/W				
101	20	31 Oct	44 45.15	176 55.64 W	44 46.26	176 57.99 W	1 095	1 172	2.00	2 150
102	18	1 Nov	44 37.93	177 30.53 W	44 37.88	177 32.84 W	940	1 000	0.97	1 800
103	20	1 Nov	44 40.81	176 00.96 W	44 42.57	176 02.25 W	1 105	1 200	1.98	2 150
104	19	1 Nov	44 39.37	176 02.79 W	44 39.94	176 03.61 W	998	1 038	0.82	1 950
105	20	1 Nov	44 42.21	176 07.10 W	44 43.69	176 07.82 W	1 110	1 196	1.50	2 150
106	20	1 Nov	44 42.48	176 08.65 W	44 44.45	176 09.44 W	1 120	1 200	2.05	2 150
107	20	1 Nov	44 43.49	176 10.78 W	44 44.73	176 11.51 W	1 102	1 212	1.34	2 200
108	20	2 Nov	44 44.30	176 24.70 W	44 44.91	176 22.38 W	1 103	1 181	1.76	2 150
109	20	2 Nov	44 43.45	176 31.22 W	44 43.98	176 28.83 W	1 100	1 125	1.78	2 100
110	20	2 Nov	44 43.13	177 14.64 W	44 43.17	177 12.01 W	1 122	1 139	1.87	2 150
111	20	2 Nov	44 41.93	177 24.75 W	44 42.23	177 20.71 W	1 158	1 174	2.20	2 150
112	19	2 Nov	44 40.34	177 25.89 W	44 40.83	177 23.17 W	1 065	1 066	2.00	2 000
113	20	3 Nov	44 41.92	177 25.86 W	44 41.73	177 28.67 W	1 128	1 173	1.78	2 150
114	20	3 Nov	44 39.58	177 35.25 W	44 40.79	177 32.66 W	1 123	1 183	2.20	2 200
115	20	3 Nov	44 37.41	178 00.26 W	44 37.29	178 02.36 W	1 133	1 188	1.50	2 200
116	18	3 Nov	44 26.72	178 07.72 W	44 26.68	178 05.90 W	924	924	1.30	1 750
117	18	3 Nov	44 26.26	178 16.28 W	44 26.18	178 13.53 W	967	976	1.97	1 800
118	19	3 Nov	44 32.20	178 34.08 W	44 32.17	178 31.31 W	1 066	1 077	1.97	2 000
119	20	3 Nov	44 34.36	178 40.23 W	44 34.38	178 37.39 W	1 150	1 152	2.09	2 150
120	20	4 Nov	44 33.12	178 56.15 W	44 33.19	178 53.28 W	1 150	1 166	2.05	2 150
121	20	4 Nov	44 31.73	179 03.29 W	44 31.78	179 06.07 W	1 122	1 132	1.98	2 150
122	19	4 Nov	44 28.22	179 08.31 W	44 30.25	179 07.74 W	1 002	1 056	2.07	2 100
123	18	4 Nov	44 25.44	179 12.02 W	44 25.26	179 14.83 W	955	959	2.01	1 900
124	17	4 Nov	44 19.78	179 42.47 W	44 19.80	179 39.80 W	819	838	2.00	1 600
125	18	4 Nov	44 22.08	179 57.08 W	44 22.08	179 54.18 W	939	950	2.07	1 800
126	20	4 Nov	44 34.65	179 57.70 W	44 33.29	179 59.82 W	1 199	1 205	2.03	2 300
127	20	5 Nov	44 28.92	179 52.18 E	44 29.92	179 54.49 E	1 164	1 173	1.93	2 200
128	20	5 Nov	44 28.16	179 47.65 E	44 27.06	179 45.45 E	1 171	1 186	1.92	2 250
129	20	5 Nov	44 24.02	179 37.33 E	44 24.57	179 40.05 E	1 139	1 151	2.02	2 100
130	18	5 Nov	44 16.57	179 36.77 E	44 16.59	179 33.93 E	971	977	2.03	1 850
131	20	5 Nov	44 22.89	179 35.81 E	44 22.91	179 32.99 E	1 128	1 130	2.02	2 200
132	18	6 Nov	44 16.34	179 18.23 E	44 17.08	179 20.94 E	984	987	2.08	1 750
133	20	6 Nov	44 17.51	179 03.41 E	44 17.45	179 00.61 E	1 166	1 176	2.01	2 200
134	20	6 Nov	44 17.53	178 55.46 E	44 18.30	178 58.03 E	1 120	1 176	1.99	2 200

Station	Stratum	Date	Start		Finish		Min.	Max.	Distance towed (n. mile)	Warp length (m)
			Latitude ° 'S	Longitude ° 'E/W	Latitude ° 'S	Longitude ° 'E/W				
135	20	6 Nov	44 16.56	178 53.75 E	44 16.49	178 56.60 E	1 097	1 119	2.04	2 100
136	20	6 Nov	44 16.49	178 48.40 E	44 15.73	178 45.86 E	1 108	1 122	1.97	2 120
137	18	6 Nov	44 09.58	178 54.14 E	44 08.91	178 51.47 E	938	943	2.03	1 900
138	13	7 Nov	44 07.42	178 31.07 E	44 07.48	178 33.78 E	939	946	1.95	1 800
139	13	7 Nov	44 08.76	177 34.12 E	44 08.16	177 36.83 E	912	925	2.04	1 800
140	13	7 Nov	44 16.62	177 02.88 E	44 15.94	177 05.47 E	929	957	1.98	1 800
141	6	7 Nov	44 22.97	175 39.59 E	44 21.64	175 37.41 E	688	723	2.05	1 680
142	7	7 Nov	44 32.36	175 35.78 E	44 33.87	175 37.55 E	808	851	1.97	1 680
143	8	8 Nov	44 42.89	175 40.00 E	44 43.57	175 37.50 E	903	926	1.90	1 800
144	8	8 Nov	44 46.40	175 34.23 E	44 48.28	175 33.28 E	916	968	2.00	1 800
145	7	8 Nov	44 43.14	175 24.01 E	44 42.83	175 25.64 E	853	900	1.20	1 700
146	7	8 Nov	44 39.57	175 26.46 E	44 37.59	175 26.64 E	806	833	1.98	1 600
147	8	8 Nov	44 54.79	175 03.25 E	44 53.72	175 05.28 E	927	954	1.79	1 800
148	9	8 Nov	45 14.28	174 49.90 E	45 15.56	174 47.83 E	1 080	1 097	1.94	2 050
149	9	8 Nov	45 18.74	174 49.39 E	45 18.93	174 52.19 E	1 067	1 087	1.98	2 050
150	9	8 Nov	45 13.26	174 45.40 E	45 11.29	174 44.67 E	1 046	1 054	2.04	2 000
151	7	9 Nov	44 51.88	174 53.09 E	44 51.95	174 55.97 E	871	883	2.04	1 750
152	7	9 Nov	44 47.37	175 02.11 E	44 47.71	174 59.31 E	825	903	2.02	1 660
153	6	9 Nov	44 41.25	174 56.72 E	44 42.45	174 57.09 E	782	804	1.23	1 550
154	6	9 Nov	44 32.34	175 09.36 E	44 30.34	175 10.13 E	708	730	2.07	1 600

* Stations 8, 72, 79, and 116 were rated performance 2.

Appendix 5: Catch (kg) of black oreo, smooth oreo, and orange roughy at each station.

Station	Black oreo	Smooth oreo	Orange roughy
1	110.9	0.0	0.0
2	8.1	3.5	0.0
3	6.8	1.9	0.0
4	1.0	1.4	0.0
5	1.1	3.6	0.0
6	2.4	2.8	0.0
7	3.9	0.8	0.0
8	1.1	0.0	0.0
9	468.3	1.7	0.0
10	833.5	3 887.3	0.0
11	50.9	12.1	0.0
12	2.0	0.0	0.0
13	332.3	23.9	0.0
14	6.1	3.2	0.0
15	3.6	2.9	0.0
16	0.0	3.7	0.0
17	27.7	12.7	0.0
18	174.5	3.3	0.0
19	25.3	0.9	0.0
20	22.4	0.3	0.0
21	248.6	1.2	0.0
22	387.4	0.0	0.0
23	18.3	1.1	0.0
24	19.9	1.9	0.0
25	111.2	27.4	0.0
26	16.6	11.4	0.0
27	0.5	0.0	0.0
28	4.2	3.5	0.0
29	8.4	3.4	0.0
30	0.4	0.8	0.0
31	5.3	1.1	0.0
32	1.8	5.8	4.0
33	22.4	7.8	33.3
34	4.2	1.0	3.3
35	78.1	5.3	0.0
36	122.1	15.9	0.0
37	211.3	0.0	0.0
38	53.6	1.2	0.0
39	37.5	2 461.7	0.0
40	361.5	7.6	0.0
41	25.7	5 341.0	1.9
42	1.3	4 397.8	5.2
43	69.9	4 792.9	2.7
44	24.4	8.9	0.0
45	18.0	21.6	8.7
46	799.5	2 087.2	3.2
47	492.6	45.8	0.0
48	945.5	7.5	0.0
49	896.7	4 503.5	1.3
50	184.6	0.0	0.0
51	12.7	3.4	4.7
52	21.0	6.4	0.0
53	155.7	2.5	0.0
54	15.3	1.0	4.2
55	0.0	1.1	0.0
56	4.3	2.9	2.8
57	119.0	4.9	0.0

Station	Black oreo	Smooth oreo	Orange roughy
58	120.6	59.5	0.3
59	19.3	0.2	0.0
60	41.5	0.0	0.0
61	10.8	1.4	2.8
62	1.3	156.7	15.3
63	0.0	1.0	0.0
64	0.6	5.9	7.1
65	1.2	1.7	15.9
66	0.0	0.6	0.0
67	0.3	93.6	17.6
68	0.0	3.0	34.2
69	8.3	12.2	29.5
70	0.0	8.5	17.6
71	0.4	11.0	18.6
72	89.3	6 065.3	7.7
73	20.4	2 621.9	0.0
74	41.2	0.0	0.0
75	384.4	6 398.2	69.5
76	18.8	24 790.5	1 407.8
77	0.0	5.3	16.3
78	0.0	2.4	5.8
79	0.0	2.6	8.0
80	0.0	2.6	23.1
81	0.0	0.1	9.0
82	0.0	1.9	11.6
83	0.0	0.0	0.0
84	0.0	2.3	14.3
85	0.0	0.0	2.7
86	0.3	8.4	10.5
87	0.0	0.0	10.7
88	0.3	1.4	5.3
89	0.0	0.9	5.9
90	0.8	1.8	16.0
91	1.2	58.1	19.1
92	0.5	2 435.9	7.9
93	0.4	312.7	15.4
94	0.8	1 480.9	10.9
95	0.8	2 454.3	1 431.6
96	0.0	34.1	0.0
97	0.0	0.0	0.0
98	0.3	500.5	4.7
99	4.4	736.6	8.3
100	3.4	774.9	7.5
101	0.0	1 803.1	47.2
102	5.4	743.4	31.5
103	3.4	4 286.6	32.2
104	3.1	197.7	5.9
105	3.7	1 998.3	39.3
106	12.9	3 235.9	43.1
107	1.4	136.6	6.2
108	1.1	24.4	61.2
109	9.5	329.1	87.1
110	0.4	1 372.6	18.8
111	1.5	12.8	28.0
112	0.3	6 278.4	10.7
113	0.0	11.3	34.5
114	0.0	28.9	107.5

Station	Black oreo	Smooth oreo	Orange roughy
115	0.0	5 542.5	5.8
116	0.0	418.6	51.5
117	0.9	9.6	27.0
118	1.3	5.5	48.8
119	0.0	5.2	14.3
120	0.0	5.8	1.4
121	0.3	9.0	3.8
122	0.0	1.5	1.8
123	0.7	3.6	4.2
124	98.5	6.1	0.0
125	6.9	3.2	1.1
126	0.0	0.1	0.0
127	0.0	0.0	0.0
128	0.0	1.9	0.0
129	0.0	1.5	0.8
130	1.0	0.2	5.2
131	0.0	0.7	2.0
132	0.6	2.3	2.8
133	0.0	3.1	0.0
134	0.0	411.4	0.0
135	0.0	15 376.4	0.0
136	0.0	0.0	0.0
137	31.6	11.4	1.3
138	494.7	15.1	3.5
139	148.8	0.4	3.4
140	3.5	1.4	0.7
141	235.2	0.1	0.0
142	43.4	1.9	0.0
143	75.1	98.2	0.8
144	6.5	1.3	0.0
145	9.2	6.6	0.4
146	428.5	37.4	0.0
147	6.6	1.7	0.0
148	0.0	1.0	0.0
149	0.0	1.1	0.0
150	0.0	1.3	0.0
151	9.3	3.0	0.0
152	328.0	0.0	0.0
153	145.9	2.7	0.0
154	1 734.3	4.5	0.0

Appendix 6: Species caught.

Species code	Scientific name	Common name
Crustacea		
APE	<i>Acanthephyra pelagica</i>	
LHO	<i>Lipkius holthuisi</i>	omega prawn
NEB	<i>Neolithodes brodiei</i>	southern stone crab
PZE	<i>Paralomis zelandica</i>	
PBA	<i>Pasiphaea barnardi</i>	
PED	<i>Plesiopenaeus edwardsianus</i>	scarlet prawn
Cephalopods		
VSQ	<i>Histioteuthis</i> spp.	violet squid
MIQ	<i>Moroteuthis ingens</i>	warty squid
WSQ	<i>Moroteuthis</i> spp.	warty squid
NOS	<i>Nototodarus sloanii</i> ?	arrow squid
DWO	<i>Octopus</i> sp.	deepwater octopus
RSQ	<i>Ommastrephes bartrami</i>	red squid
TSQ	<i>Todarodes filippovae</i>	
Chondrichthyes		
Squalidae		
CSQ	<i>Centrophorus squamosus</i>	
CYP	<i>Centroscymnus crepidater</i>	
CYO	<i>C. owstoni</i>	smooth skinned dogfish
SND	<i>Deania calcea</i>	shovelnosed spiny dogfish
ETB	<i>Etmopterus baxteri</i>	Baxter's lantern dogfish
ETL	<i>E. lucifer</i>	Lucifer dogfish
PLS	<i>Scymnodon plunketi</i>	Plunket's shark
BSH	<i>Scymnorhinus licha</i>	seal shark
ZAS	<i>Zameus squamulosus</i>	
Scyliorhinidae		
APR	<i>Apristurus</i> spp.	catshark
Rajidae		
PSK	<i>Bathyraja shuntovi</i>	longnosed deepsea skate
BTH	<i>Pavoraja</i> spp.	bluntnosed skate
DSK	<i>Raja (Amblyraja)</i> sp.	deepwater spiny skate
Rhinochimaeridae		
LCH	<i>Harriotta raleighana</i>	longnosed chimaera
RCH	<i>Rhinochimaera pacifica</i>	widenosed chimera
Chimaeridae		
CHG	<i>Chimaera</i> sp.B	giant chimaera
CHP	<i>Chimaera</i> sp.C	purple chimaera
HYB	<i>Hydrolagus</i> sp.A	black hydrolagus
GSP	<i>Hydrolagus</i> sp.B	pale hydrolagus
HYP	<i>Hydrolagus</i> sp.C	longnosed blue hydrolagus
Teleosts		
Notocanthidae		
SBK	<i>Notacanthus sexspinis</i>	spineback eel
Nemichthyidae		
NEM	<i>Nemichthys scolopaceus</i>	slender snipe eel

Congridae		
HCO	<i>Bassanago hirsutus</i>	hairy conger
SCO	<i>B. bulbiceps</i>	swollenhead conger
Synphobranchidae		
BEE	<i>Diastobranchus capensis</i>	basketwork eel
SNE	<i>Simenchelys parasiticus</i>	snubnosed eel
Serrivomeridae		
SAW	<i>Serrivomer bertini</i>	thread eel
Bathylagidae		
DSS	<i>Bathylagus</i> sp.	deepsea smelt
Alepocephalidae		
SSM	<i>Alepocephalus australis</i>	smallscaled brown slickhead
SBI	<i>Alepocephalus</i> sp.	bigscaled brown slickhead
BSL	<i>Xenodermichthys copei</i>	black slickhead
Platyroctidae		
PER	<i>Persparsia kopua</i>	tubeshoulder
SID	Platyroctidae (family)	tubeshoulders
Photichthyidae		
PHO	<i>Photichthys argenteus</i>	lighthouse fish
Chauliodontidae		
CHA	<i>Chauliodus sloani</i>	viperfish
Astronesthidae		
AST	<i>Astronesthes</i> spp.	snaggletooth
RDE	<i>Rhadinesthes decimus</i>	snaggletooth
Melanostomiidae		
OMI	<i>Opostomias micripnus</i>	scaleless black dragonfish
Malacosteidae		
MAL	<i>Malacosteus</i> sp.	loosejaws
Idiacanthidae		
IDI	<i>Idiacanthus</i> spp.	black dragonfishes
Scopelarchidae		
SCP	<i>Scopelarchus</i> sp.	pearleyes
Alepisauridae		
ABR	<i>Alepisaurus brevirostris</i>	shortsnouted lancetfish
Myctophidae		
LAN	Myctophidae (family)	lanternfish
Moridae		
VCO	<i>Antimora rostrata</i>	violet cod
HJO	<i>Halargyreus johnsonii</i>	Johnson's cod
SMC	<i>Lepidion microcephalus</i>	smallheaded cod
LEG	<i>L. schmidti</i>	giant lepidion
RIB	<i>Mora moro</i>	ribaldo
GRC	<i>Tripteryphycis gilchristi</i>	grenadier cod

Melanonidae		
MEL	<i>Melanonus gracilis</i>	pelagic cod
Merlucciidae		
LYC	<i>Lyconus</i> sp.	blackmouth hake
HOK	<i>Macruronus novaezelandiae</i>	hoki
HAK	<i>Merluccius australis</i>	hake
Macrouridae		
CKX	<i>Caelorinchus acanthiger</i>	spottyfaced rattail
CBO	<i>C. bollonsi</i>	Bollons's rattail
CFA	<i>C. fasciatus</i>	banded rattail
CIN	<i>C. innotabilis</i>	notable rattail
CKA	<i>C. kaiyomaru</i>	Kaiyomaru rattail
CMA	<i>C. matamua</i>	Mahia rattail
COL	<i>C. oliverianus</i>	Oliver's rattail
CCR	<i>Cetonurus crassiceps</i>	globosehead rattail
CMU	<i>Coryphaenoides murrayi</i>	abyssal rattail
CSE	<i>C. serrulatus</i>	serrulate rattail
CTR	<i>C. striatura</i>	
CSU	<i>C. subserrulatus</i>	fourrayed rattail
CBA	<i>Coryphaenoides</i> sp. B	longbarbel rattail
JAV	<i>Lepidorhynchus denticulatus</i>	javelinfish
MCA	<i>Macrourus carinatus</i>	ridgescaled rattail
BJA	<i>Mesobius antipodum</i>	black javelinfish
NNA	<i>Nezumia namatahi</i>	squashfaced rattail
WHR	<i>Trachyrincus longirostris</i>	white rattail
WHX	<i>Trachyrincus</i> sp.	unicorn rattail
VNI	<i>Ventrifossa nigromaculata</i>	blackspotted rattail
Ophidiidae		
BCR	<i>Brotulotaenia crassa</i>	blue cusk eel
LIN	<i>Genypterus blacodes</i>	ling
Carapidae		
ECR	<i>Echiodon cryomargarites</i>	messmate fish
Linophrynidae		
BAF	<i>Haplphryne mollis</i>	angler fish
Trachipteridae		
DEA	<i>Trachipterus trachipterus</i>	dealfish
Trachichthyidae		
ORH	<i>Hoplostethus atlanticus</i>	orange roughy
Diretmidae		
DIS	<i>Diretmus argenteus</i>	discfish
Anoplogastridae		
ANO	<i>Anoplogaster cornuta</i>	fangtooth roughy
Berycidae		
BYS	<i>Beryx splendens</i>	alfonsino
Melamphaidae		
MPH	<i>Melamphaes</i> sp.	bigscale fish
Zeidae		
LDO	<i>Cyttus traversi</i>	lookdown dory

Oreosomatidae		
BOE	<i>Allocyttus niger</i>	black oreo
WOE	<i>A. verrucosus</i>	warty oreo
SOR	<i>Neocyttus rhomboidalis</i>	spiky oreo
SSO	<i>Pseudocyttus maculatus</i>	smooth oreo
Macrorhamphosidae		
BBE	<i>Centriscops humerosus</i>	redbanded bellowsfish
Scorpaenidae		
TRS	<i>Trachyscorpia capensis</i>	cape scorpionfish
Psychrolutidae		
COT	<i>Cottunculus nudus</i>	bonyskull toadfish
PSY	<i>Psychrolutes</i> sp.	blobfish
Bramidae		
RBM	<i>Brama brama</i>	Ray's bream
Apogonidae		
EPL	<i>Epigonus lenimen</i>	bigeyed cardinalfish
EPR	<i>E. robustus</i>	robust cardinalfish
EPT	<i>E. telescopus</i>	black cardinalfish
ROS	<i>Rosenblattia robusta</i>	
Serranidae		
SPE	<i>Helicolenus</i> sp.	sea perch
Chiasmodontidae		
CNI	<i>Chiasmodon niger</i>	black swallower
Gempylidae		
PDS	<i>Paradiplospinus gracilis</i>	false frostfish
Centrolophidae		
RUD	<i>Centrolophus niger</i>	rudderfish
RAG	<i>Icichthys australis</i>	ragfish
TUB	<i>Tubbia tasmanica</i>	
Trichiuridae		
BEN	<i>Benthodesmus</i> sp. ?	scabbard fish
Caristiidae		
CST	<i>Caristius</i> sp.	manefish
PLA	<i>Platyberyx</i> sp.	
Zoarcidae		
EPO	<i>Melanostigma gelatinosum</i>	eel pout
Nototheniidae		
NOT	<i>Paranotothenia</i> sp. ?	
Bothidae		
MAN	<i>Neoachirosetta milfordi</i>	finless flounder
Triacanthodidae		
SPK	<i>Macrorhamphosodes uradoi</i>	spikefish
Psychrolutidae		
TOP	<i>Neophrynichthys angustus</i>	pale toadfish



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