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EXECUTIVE SUMMARY

Anderson, O.F.; Dunn, M.R. (2006). Descriptive analysis of catch and effort data from New Zealand orange roughy fisheries in ORH 1, 2A, 2B, 3A, 3B, and 7B to the end of the 2003–04 fishing year.

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This report updates descriptive analyses of commercial catch and effort data for all the main orange roughy fisheries in the New Zealand EEZ, with data to the end of the 2003–04 fishing year. Data are summarised back to the start of most of the fisheries, and are analysed in detail for the most recent fishing years. The Challenger Plateau fishery (ORH 7A) is not included, as this fishery has effectively been closed since the 2000–01 fishing year.

Catch totals, patterns of catch and effort over time and space, and, in some cases, bycatch were examined for each of the fisheries. The fishing grounds included are:
Northern North Island (ORH 1)
Mid-East Coast (ORH 2A, ORH 2B, ORH 3A)
Chatham Rise (ORH 3B)
South of 46° S (southern ORH 3B)
West coast South Island (ORH 7B)

Overall, there were few changes in the distribution of catch and effort, with the established fishing grounds remaining the focus of effort. This stability was aided in part by there being no change to the TACC in 2003–04 for any QMA, and no new fishing grounds being developed during the year. Overall, about 88% of the quota was caught, compared with 96% in 2002–03. Reduced catches on the Chatham Rise, especially the northeast Rise, were mostly responsible for this decrease. The 2003–04 reported landings were 30% less than the TACC in ORH 1 and 12% less than the TACC in ORH 3B. In all other areas reported landings were slightly greater than the TACC, from 4 t in ORH 2B to 29 t in ORH 3A.

1. INTRODUCTION

Orange roughy are widespread in New Zealand waters. They occur in all areas of the upper continental slope at depths between 700 and 1500 m. They are the focus of an important deepwater fishery in New Zealand, and have been fished for over 20 years (Sullivan et al. 2005). The orange roughy fishery first developed on the Chatham Rise in 1979, followed by the location of new grounds on the Challenger Plateau, off the east coast (Wairarapa, Kaikoura, Ritchie Banks), and Cook Canyon in the mid 1980s, and Puysegur Bank, East Cape, and Bay of Plenty in the early 1990s (Clark 1995). There have been, or are currently, over 15 major fishing grounds (Figure 1). These are distributed between eight Quota Management Areas (labelled *ORH 1*, *ORH 2B*, etc., in Figure 1).

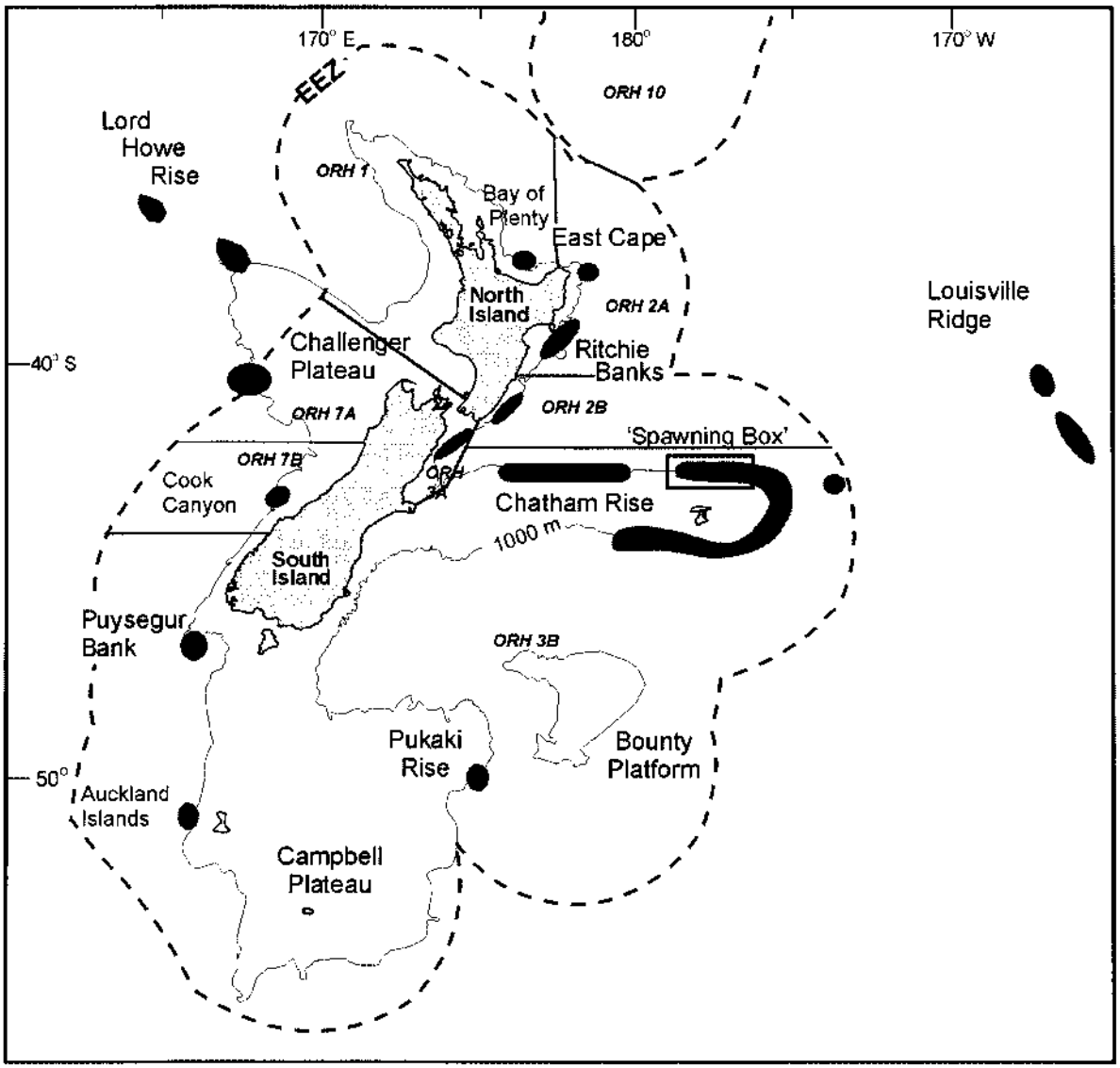

Figure 1: The New Zealand region, showing the distribution of the main orange roughy fishing grounds (grey areas), the main fishery names as mentioned in the text, and Quota Management Areas (italicised) for orange roughy.

The size of the total fishery was relatively steady at about 40 000–50 000 t during the 1980s, but started to decrease in the 1990s with reductions in Total Allowable Commercial Catches (TACCs) as some of the main stocks became fully or over-exploited (Clark et al. 2000, Clark 2001a, Francis & Clark 2005). Recent years have seen a mixture of reduced catch levels in the major established fisheries, supplemented with short-term high levels of catch from newly developed, smaller fisheries.

There is a need to carry out regular monitoring programmes and stock assessments to determine stock status and estimate sustainable yields for all orange roughy fisheries and, in order to update the stock assessment for each fishery, commercial catch and effort data should be monitored and the descriptive analysis of the commercial catch and effort data updated annually (Ministry of Fisheries 2005).

The work described in this report was carried out under Objective 1 of Ministry of Fisheries project ORH2004/02: "To update the descriptive analysis of the commercial catch and effort data from selected orange roughy fisheries with the inclusion of data up to the end of the 2003/04 fishing year. These fisheries include ORH 1, ORH 2A (North and South), ORH 2B, ORH 3A, ORH 3B (Chatham Rise and other areas), and ORH 7B." The Challenger Plateau fishery (ORH 7A) was not included in this project as the fishery has had a TACC of only 1 t since 2000–01.

This report updates Dunn et al. (2005). Although the orange roughy fishery description is regularly updated, the level of detail may vary between reports. This is in response to research efforts focusing on specific areas for stock assessment. Stock assessments were conducted in 2005 for the Northeast Chatham Rise (M. Dunn, NIWA, unpublished results), the Mid-East Coast (Sullivan et al. 2005), and Challenger Plateau (Sullivan et al. 2005).

2. REVIEW OF THE FISHERY

2.1 Data sources and methods

Estimated catch and effort data for the orange roughy fishery are recorded on either trawl catch effort processing return (TCEPR) or catch, effort and landing return (CELR) forms. The TCEPR forms give tow-by-tow information, with location and estimated catch for each trawl. The CELR forms provide daily estimated catch records with effort as the number and total duration of tows in the day. CELR forms tend to be used by smaller inshore vessels. Larger deepwater vessels (over 28 m in length) are required to complete TCEPR forms. Up-to-date data for the last two fishing years were requested from the Ministry of Fisheries catch-effort database in December 2004. TCEPR data were loaded into a relational (Empress) database at NIWA containing similar tow-by-tow data for all previous years, and CELR data were stored as an Excel spreadsheet. This report focuses on data from the more detailed TCEPR forms. Although CELR forms were widely used in earlier years, their use has declined over time, representing less than 10% of the total estimated catch since 1993–94. Where CELR data are included in any table or figure, this is indicated in the text.

Data were selected where orange roughy were either the declared target species, or were caught. TCEPR data for all years were extracted from the Empress database and comprehensively error-checked using routines developed in the statistical software package R (Ihaka & Gentleman 1996). Errors in the recorded position, depth, towing speed, and tow duration were corrected using a process of 'median imputation' which identifies, e.g., unusually long tow distances and compares the start and finish positions of the tow with median values for the other tows made by the vessel on that day. Obvious errors in the recording of target species, or due to confusion of the western with the eastern hemisphere, were corrected, and a few remaining tow positions on land were removed. All remaining tows were then assigned to a QMA and fishery or sub-area. Data for the 2003–04 fishing year may be incomplete because forms not yet supplied by fishing vessels will not have been entered into the Ministry database. Records containing errors that could not be resolved or corrected were excluded from any analyses.

The total dataset of trawls (where orange roughy were either the declared target species or were caught) totalled 8520 for 2002–03, and 7761 for 2003–04.

3. THE TOTAL ORANGE ROUGHY FISHERY

In 2003–04, over 94% of the total orange roughy landings reported to the Quota Management System (QMS) were accounted for by the tow-by-tow or daily estimates recorded on the TCEPR and CELR forms. About 97% of these estimated catches were recorded on the more detailed TCEPR forms (representing about 92% of overall reported catch; Table 1). These percentages are slightly down on the previous year, but still show good consistency between the estimated catches and reported landings. The total reported catch of orange roughy fell from 14 670 t in 2002–03 to 13 414 t in 2003–04 (a decrease of 8.5%), with about 96% of the TACC taken in 2002–03, dropping to 88% in 2003–04.

Table 1: Summary of reported landings, TACCs, and recorded catch totals from TCEPR and CELR data.

	2002–03	2003–04
Reported landings (QMS)	14 670	13 414
TACC	15 211	15 211
TCEPR estimated catch	14 101	12 360
CELR estimated catch	210	307
Total estimated catch	14 311	12 667
Estimated catch/reported landings (%)	97.6	94.4

The TACCs for 2003–04 remained unchanged from the previous year in all areas. The 2003–04 TACC was undercaught by 30% in ORH 1, and by 12% in ORH 3B (Table 2). In all other areas the TACC was slightly exceeded, from 4 t in ORH 2B to 29 t in ORH 3A. The TACC was also exceeded in ORH 2A, ORH 2B, and ORH 3A in 2002–03.

Table 2: Annual reported landings (t) and TACCs (t) of orange roughy from the EEZ.

	2002–03		2003–04	
Quota Management Area	TACC	Landings	TACC	Landings
ORH 1	1 400	1 123	1 400	986
ORH 2A	680	782	680	703
ORH 2B	99	105	99	103
ORH 3A	221	235	221	250
ORH 3B	12 700	12 333	12 700	11 254
ORH 7A	1	4	1	<1
ORH 7B	110	90	110	119

The percentage of orange roughy caught in different target fisheries was very similar between 2002–03 and 2003–04, with 84–86% of the effort in the orange roughy target fisheries (Table 3). Changes in the percentage of tows where orange roughy were caught when targeting other species were small (about 1% or less). New Zealand domestic vessels remain dominant in the orange roughy fishery, with their share of fishing effort remaining at the same level between 2002–03 and 2003–04 (Table 4). There was a drop in the effort by Australian and Panamanian registered vessels in 2003–04 compared with the previous year, with the introduction of Ukranian registered vessels in 2003–04 keeping the foreign component of the fishing effort at a steady level.

Table 3: Summary of number of trawls in the orange roughy fishery by target species.

	2002–03		2003–04	
	No. tows	% tows	No. tows	% tows
Orange roughy	4 582	84	4 492	86
Oreos (unspecified)	245	4.5	225	4.3
Smooth oreos	134	2.5	122	2.3
Black oreo	5	0.1	9	0.2
Cardinalfish	206	3.8	137	2.6
Alfonsino and long-finned beryx	35	0.6	14	0.3
Hoki	239	4.4	248	4.7

Table 4: Summary of number of trawls in the orange roughy fishery by vessel nationality.

	2002–03		2003–04	
	No. tows	% tows	No. tows	% tows
Domestic	5307	97.4	5113	97.4
Australia	110	2.0	66	1.3
Panama	31	0.6	8	0.2
Ukraine	0	0	63	1.2
Cyprus	3	0.1	0	0

4. NORTHERN NORTH ISLAND FISHERIES (ORH 1)

The coastline of ORH 1 extends from north of Wellington on the west coast, north around to the eastern Bay of Plenty on the east coast. There was exploratory fishing in this area during the early to mid 1980s, with the commercial fishery first developing in the western Bay of Plenty after 1994. Detailed analyses for this area were presented by Clark (2001b), and stock assessments for some of the ORH1 sub-areas by Sullivan et al. (2005). The ORH 1 stock was reintroduced into the Adaptive Management Programme (AMP) in 2001, under which decision rules based upon catch per unit effort (CPUE) were put in place to restrict or maintain catches, which may include the use of specific feature catch limits (Sullivan et al. 2005). This programme is scheduled to run for five years, ending on 30 September 2006. The only stock assessment for this fishery was conducted in 2001, and only for the Mercury-Colville box (Sullivan et al. 2005).

4.1 Total catch

The TACC was reduced in 2000–01 following the conclusion of the Adaptive Management Programme (AMP) initiated for the Mercury-Colville box in 1995 (Table 5). In 2001–02, under the reintroduced AMP programme, the TACC increased to 1400 t, and the total catch was the highest recorded under TACC in ORH 1. In the two most recent years the TACC has remained the same, but catches dropped by about 13% in 2002–03 and then by a further 12% in 2003–04. The total of the estimated catches reported on TCEPRs was 1222 t in 2001–02, 1013 t in 2002–03, and 903 in 2003–04 (94.4%, 90.2%, and 91.6% of reported catches respectively).

Table 5: Reported catches (t) and TACCs (t) for ORH 1 from 1995–96 to 2003–04. The catches in parentheses indicate combined exploratory (under special permit) and TACC catches.

Fishing year	Reported catches	TACC
1995–96	965	1 190
1996–97	1 021	1 190
1997–98	511	1 190
1998–99	845 (1 543)	1 190
1999–00	771 (1 476)	1 190
2000–01	858	800
2001–02	1 294	1 400
2002–03	1 123	1 400
2003–04	986	1 400

4.2 Distribution of catch and effort

Following previous analyses, eight subareas have been defined:

- **West Norfolk.** The area within the boundary of 34.3°–35.5° S and 168.4°–170.5° E.
- **Tauroa.** The area within the boundary of 34.3°–35.2° S and 171°–172.5° E.
- **Manukau**. The area within the boundary of 35.5°–36.5° S and 172.5°–174° E.
- **Northland**. The area within the boundary of 33.5°–34.7° S and 173.8°–175.5° E.
- **North Colville**. The area within the boundary of 34°–35.67° S and 177°–178° E.
- **Mercury-Colville**. The area within the boundary of 36.11°–36.67° S and 176.5°–177.1° E.
- **White Island**. The area within the boundary of 36.7°–37.33° S and 177°–177.6° E.
- **Aldermen**. The area within the boundary of 36.8°–37.15° S and 176.4°–177° E.

The patterns of catch and effort in 2002–03 and 2003–04 were generally similar, with most of the fishing taking place within the main recognised fishing grounds. However, compared to 2002–03, the spread of catches in the western half of the West Norfolk fishery in 2003–04 was shifted slightly northwest, and some larger catches were made in North Colville (Figure 2). The occurrence of large catches (50–60 t) recorded in 2000–01 and 2001–02 in several areas (Clark et al. 2003) has reduced slightly in the last two years, although the largest catch in 2002–03 was 55 t in Manukau in July, and the largest catch in 2003–04 was 45 t in North Colville in June.

Following the exploratory development of the fishing grounds through the mid–late 1990s, large annual catches have been reported regularly from Tauroa Knoll, the West Norfolk Ridge, and the North Colville Ridge. The large annual catches reported in the late 1990s from the Bay of Plenty fisheries, in particular the Mercury-Colville box and White Island, have not occurred in the last two fishing years, but this has been offset by the development of the Manukau fishery over the last three years (Table 6).

The Mercury-Colville Box was effectively closed to orange roughy fishing in 2000–01, and although catches and effort increased from 2000–01 to 2001–02, beyond the allowed 50 t allowable bycatch, they dropped to 15 t in 2002–03 and 11 t in 2003–04 (Table 6). Catches have steadily declined in White Island, reaching a low in 2002–03, but effort and catch increased in this area in 2003–04. Catches and effort remain low in the Aldermen Islands area.

After peaking in 2001–02, orange roughy catch decreased on the West Norfolk Ridge, and while this area received easily the most target and non-target effort in 2003–04, estimated catch was considerably less than in the other western ORH 1 fisheries, Tauroa Knoll and Manukau (Table 6). The largest total catch in 2003–04 came from Tauroa Knoll. The 229 t caught there was 20 t more than in the previous year, despite considerably less effort. Catches and effort have continued to increase in Manukau, and some large catches have been taken in the area between Manukau and Tauroa. Effort and catch dropped sharply on the north Colville Ridge and in Northland. The area around the Aotea seamount remains closed to fishing.

The timing of effort has varied from year to year, and in the earlier years of the fishery was generally at the highest level in March and June or July (Clark et al. 2003). In the last three years, June and July have continued to be important months in this fishery, but catch and effort in March has been more variable, with high levels in 2002–03 and low levels in 2001–02 and 2003–04 (Figure 3). Moderate levels of effort in October in the last two years have also produced some good catches. The total effort in the main fishing areas fluctuated slightly between 2001–02 and 2003–04, from 520 to 598 to 535 tows, and the fraction of tows outside of these areas has also fluctuated slightly, from 8% to 17% to 11%.

4.3 Catch rates

In 2002–03, the highest mean catch rate (t/tow) was taken in Manukau, followed by Tauroa, and the lowest in the three Bay of Plenty fisheries (Mercury-Colville, White Island, and Aldermen) (Table 6). In 2003–04, the highest catch rates were in Tauroa, followed by North Colville then Manukau. The lowest catch rates were again in the Bay of Plenty fisheries, although they were more than double the catch rates of the previous year in each fishery. Catch rates decreased only in the West Norfolk, Manukau, and Northland areas.

In 2002–03, occasional high catch rates (10 t or more) were taken in most subareas, except for the Bay of Plenty (Figure 4). The same was true for 2003–04, although there were a few high catches in White Island in July. Fishing was more spread out over the year in West Norfolk in 2003–04 than in 2002–03, and the high catch rates in January in this fishery were replaced with high catch rates in July. In Northland and North Colville, the intensive fishing effort in March of the 2002–03 fishing year was not repeated in 2003–04, and vessels were relatively inactive in this month in all areas. Fishing was concentrated into July in Aldermen, but was well spread out in the adjacent White Island and Mercury-Colville fisheries (Figure 4).

Catch rates for ORH 1 as a whole peaked in June and July in each of the last three years, with peaks also occurring in January or February in each year. In the last two years, catch rates were highest in October, with an increasing amount of catch coming from this month (see Figure 3).

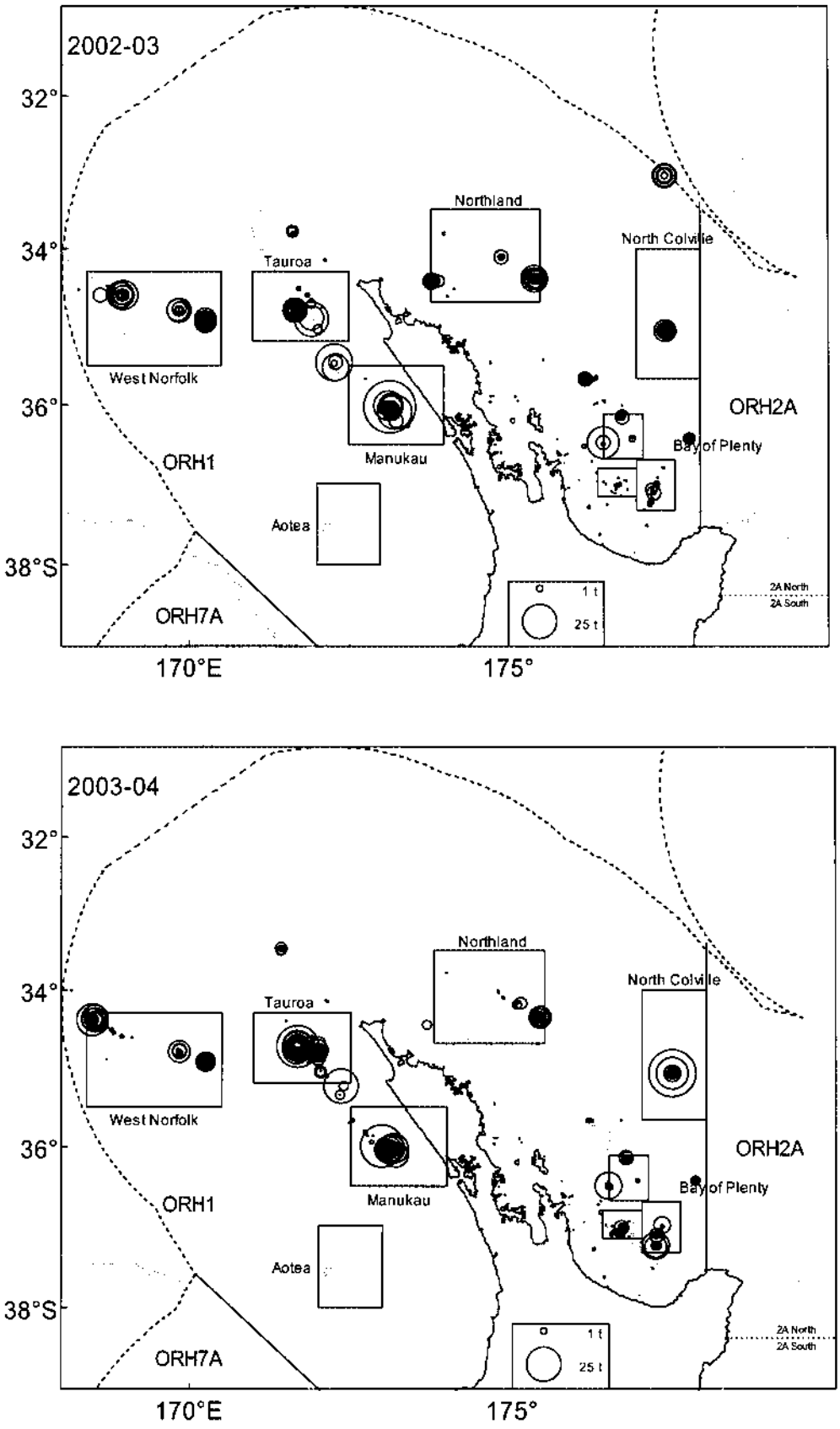

Figure 2: Distribution of trawls and orange roughy catch rate (t/tow) in ORH 1 for 2002–03 and 2003–04 (max. = 55 t). Bay of Plenty boxes are: Mercury-Colville (northwest), Aldermen (southwest), and White Island (southeast).

Table 6: Summary of orange roughy catch and effort data for subareas within ORH 1 during fishing years 1997–98 to 2003–04 (subareas are marked on Figure 2). –, insufficient data. Catch rate (ORH t/tow) is calculated as total catch/total number of tows, where there were 2 or more vessels, and 10 or more tows, per year.

	1997–98	1998–99	1999–2000	2000–2001	2001–02	2002–03	2003–04
West Norfolk							
No. vessels	1	1	1	2	2	2	3
No. tows	2	4	33	81	169	113	160
No. ORH target	2	4	27	59	156	73	104
Catch ORH (t)	0.0	0.1	111.7	167.6	356.9	219.1	153.8
ORH t/tow	–	–	–	2.1	2.1	1.9	1.0
Tauroa							
No. vessels	3	3	4	2	2	4	6
No. tows	25	72	144	17	37	78	58
No. ORH target	25	72	144	4	37	78	57
Catch ORH (t)	5.7	582.8	516.5	142.8	175.8	209.0	228.8
ORH t/tow	0.2	8.1	3.6	8.4	4.8	2.7	3.9
Manukau							
No. vessels	0	0	0	0	2	3	4
No. tows	0	0	0	0	44	52	81
No. ORH target	0	0	0	0	44	52	81
Catch ORH (t)	–	–	–	–	114.7	185.3	220.0
ORH t/tow	–	–	–	–	2.6	3.6	2.7
Northland							
No. vessels	1	2	2	1	2	4	3
No. tows	1	24	20	4	52	96	51
No. ORH target	1	24	20	4	52	94	36
Catch ORH (t)	0.0	37.0	6.7	53.5	46.8	104.5	48.8
ORH t/tow	–	1.5	0.3	–	0.9	1.1	1.0
N. Colville							
No. vessels	1	1	1	1	2	3	2
No. tows	4	12	65	15	72	77	26
No. ORH target	4	11	41	9	62	54	15
Catch ORH (t)	0.0	130.2	119.8	106.1	217.2	109.2	89.7
ORH t/tow	–	–	–	–	3.0	1.4	3.4
Mercury-Colville							
No. vessels	6	4	4	3	2	6	4
No. tows	603	253	142	36	63	65	24
No. ORH target	579	236	91	2	26	31	9
Catch ORH (t)	266.5	140.4	210.9	30.0	107.2	14.8	11.0
ORH t/tow	0.4	0.6	1.5	0.8	1.7	0.2	0.5
White Island							
No. vessels	6	5	4	4	3	8	4
No. tows	249	474	293	57	70	98	106
No. ORH target	222	402	253	30	49	74	88
Catch ORH (t)	63.5	611.8	294.9	183.5	130.4	18.1	66.0
ORH t/tow	0.3	1.3	1.0	3.2	1.9	0.2	0.6
Aldermen							
No. vessels	6	4	2	1	2	4	3
No. tows	119	33	41	3	13	19	29
No. ORH target	117	32	41	1	13	19	28
Catch ORH (t)	136.7	23.8	34.0	75.0	44.1	1.7	16.1
ORH t/tow	1.1	0.7	0.8	–	3.4	0.1	0.6

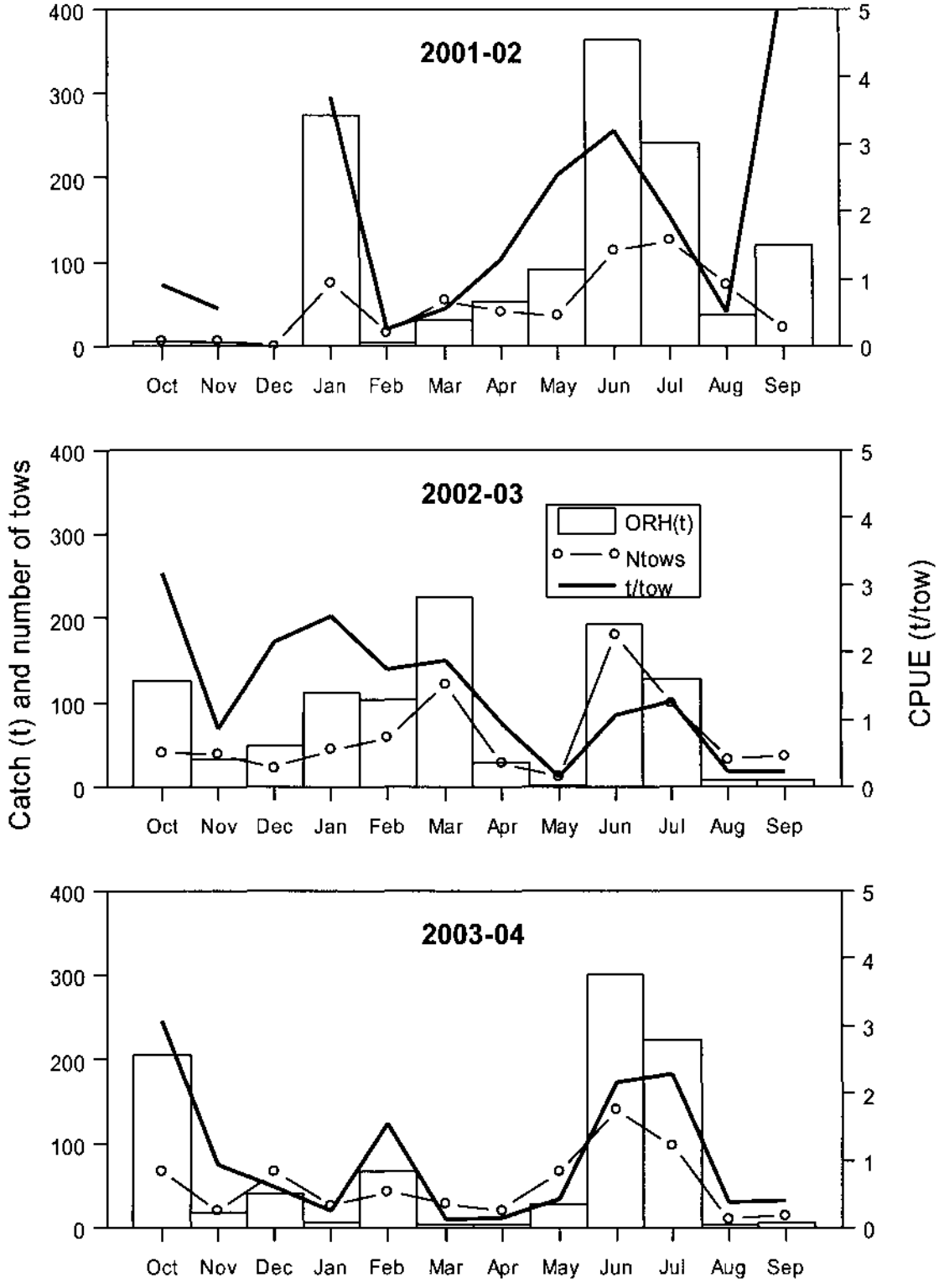

Figure 3: Monthly distribution of total catch and effort in ORH 1 for 2001–02 to 2003–04.

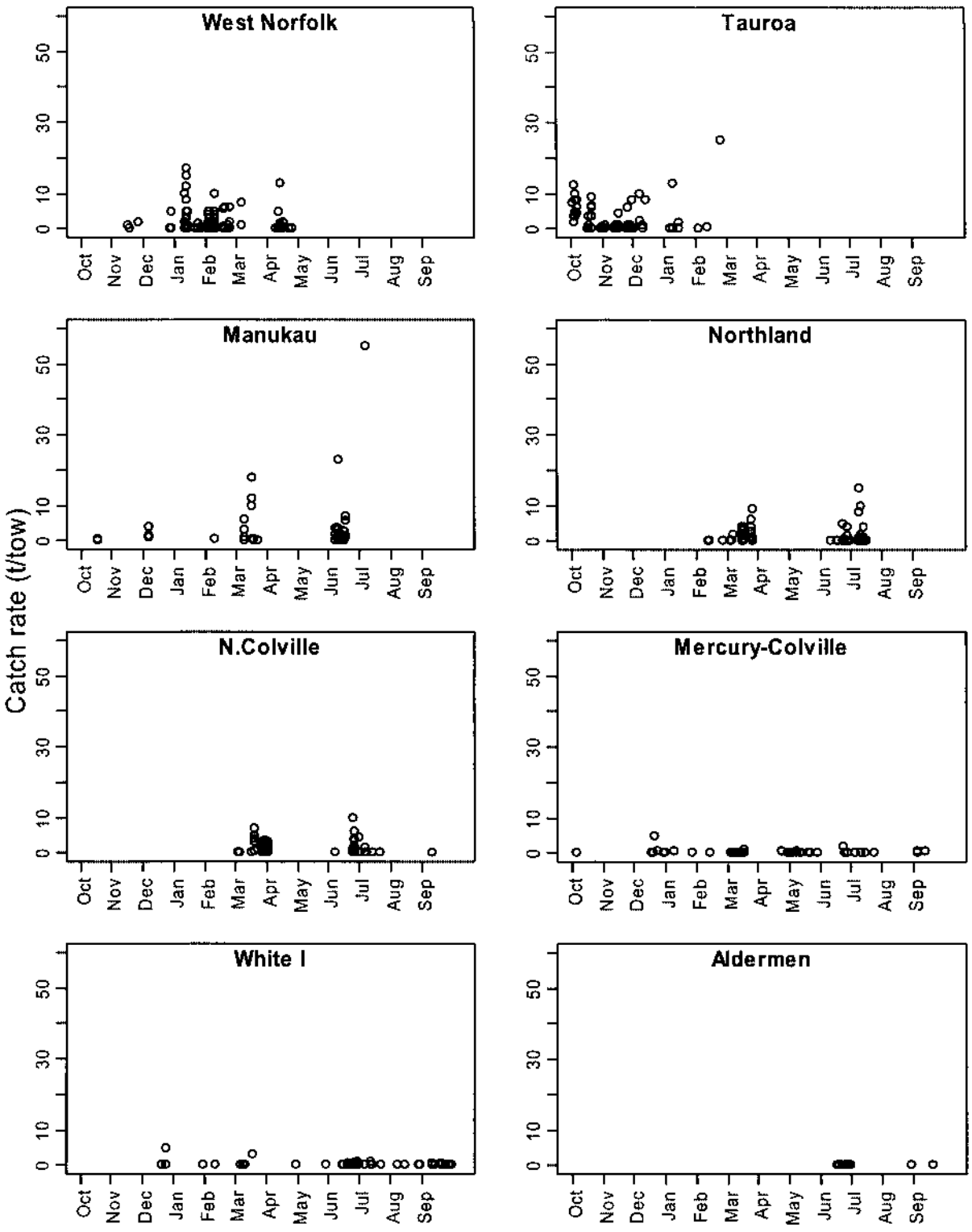

Figure 4: Catch rate profiles (t/tow) of orange roughy in ORH 1 by subarea, 2002–03.

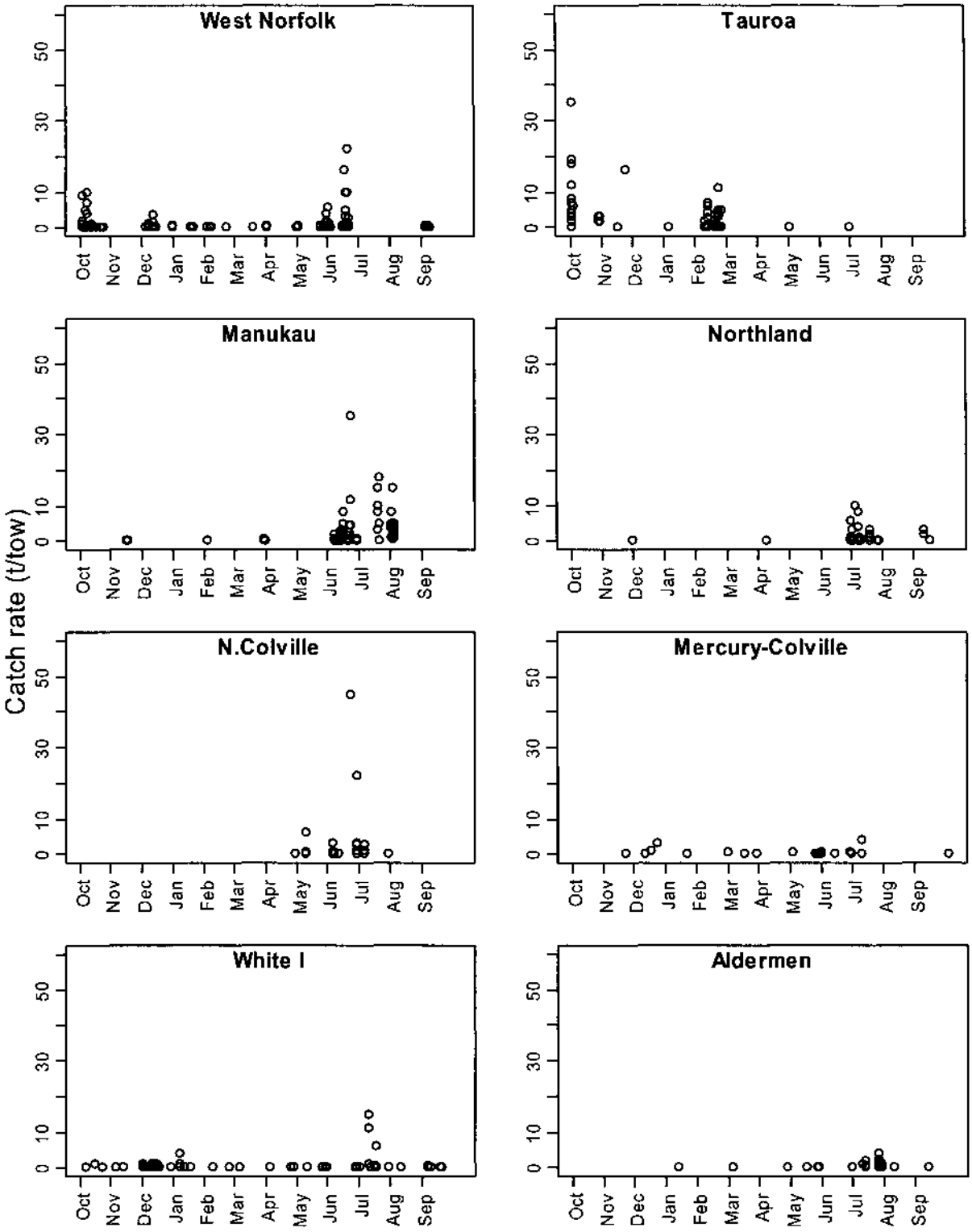

Figure 4 (cont): Catch rate profiles (t/tow) of orange roughy in ORH 1 by subarea, 2003–04.

5. MID-EAST COAST AND EAST CAPE FISHERIES (ORH 2A, ORH 2B, and ORH 3A)

The fisheries for orange roughy in ORH 2A South (the portion of ORH 2A south of 38° 23′ S), ORH 2B (Wairarapa), and ORH 3A (Kaikoura) form what has been known since 1995 as the Mid-East Coast (MEC) stock. The northern part of ORH 2A (ORH 2A North) is referred to as the East Cape (EC) stock. The stock boundaries are based upon knowledge of spawning locations, and on allozyme studies (Anderson 2002).

Before the spawning fishery in ORH 2A North developed, the fisheries were assessed together as part of the "Cape Runaway to Banks Peninsula" stock (ORH 2A, 2B, 3A). However, since the 1994–95 fishing year, an agreement has been in place between quota holders and the Minister of Fisheries that ORH 2A be split into two, with separate catch limits for ORH 2A North (EC) and ORH 2A South (part of MEC). In the 1996–97 fishing year, a further agreement split the EC fishery itself, with separate catch limits set for the East Cape hills and an exploratory area comprising the remainder of ORH 2A North, north of 37° S. Following a large reduction in the catch limit for the EC fishery, this agreement lapsed in 2000–01.

This report examines catch and effort of orange roughy in each QMA or subarea separately, and in the EC and MEC stocks as a whole. The most recent stock assessment for the MEC was conducted in 2004 (Dunn 2005), and for the EC stock in 2003 (Anderson 2003).

5.1 Total catch

Annual landings in the MEC fishery have been in decline since 1994–95, following a reduction in the agreed TACC to 1500 t in 2000–01, and to 800 t in 2002–03 (Table 7). Reported landings have exceeded the agreed TACC in seven of the last eight fishing years.

Table 7: Reported landings (t) and catch limits/TACCs (t) by QMA for the MEC fishstock for the fishing years 1981–82 to 2003–2004.

	ORH 2A (South)		ORH 2B		ORH 3A		MEC ALL	
Fishing year	Landings	Catch limit	Landings	TACC	Landings	TACC	Landings	TACC
1981–82*	–	–	554	–	–	–	554	–
1982–83*	–	–	3 510	–	253	–	3 763	–
1983–84†	162	–	6 685	–	554	–	7 401	–
1984–85†	1 858	–	3 310	3 500	3 266	§	8 434	–
1985–86†	2 778	4 576	867	1 053	4 326	2 689	7 971	8 318
1986–87‡	4 934	5 500	963	1 053	2 555	2 689	8 452	9 242
1987–88‡	6 203	5 500	982	1 053	2 510	2 689	9 695	9 242
1988–89‡	5 710	6 060	1 236	1 367	2 431	2 839	9 377	10 266
1989–90‡	6 239	6 106	1 400	1 367	2 878	2 879	10 517	10 352
1990–91‡	6 051	6 106	1 384	1 367	2 553	2 879	9 988	10 352
1991–92‡	6 329	6 286	1 327	1 367	2 443	2 879	10 099	10 532
1992–93‡	5 807	6 386	1 080	1 367	2 135	2 879	9 022	10 632
1993–94‡	3 173	6 666	1 259	1 367	2 131	2 300	6 563	10 333
1994–95‡	3 281	4 000	754	820	1 686	1 840	5 721	6 660
1995–96‡	1 033	1 261	245	259	612	580	1 890	2 100
1996–97‡	1 270	1 261	272	259	580	580	2 122	2 100
1997–98‡	#1 416	1 261	254	259	570	580	2 240	2 100
1998–99‡	#1 434	1 261	257	259	582	580	2 273	2 100
1999–00‡	#1 666	1 261	234	259	617	580	2 517	2 100
2000–01‡	#1 083	900	190	185	479	415	1 752	1 500
2001–02φ	#901	900	180	185	400	415	1 480	1 500
2002–03	#546	480	105	99	235	221	886	800
2003–04	#533	480	103	99	250	221	886	800

* MAF data., † FSU data., ‡QMS data., φMHR data, §Included in QMA 3B TACC., #Pro-rated from ORMC figures for ORH 2AN and ORH 2AS, to QMS data for ORH 2A.

Up until 1999–2000, annual landings in the EC fishery ranged from 1500 to 3400 t, with very little of the catch coming from outside the East Cape hills area. A sharp decrease in the catch limit in 2000–01, from 2500 t to 200 t, has restricted landings from this fishery to low levels in the past four years (Table 8). In direct contrast to ORH 2A South, reported landings in ORH 2A North have been less than the agreed catch limit in seven of the last eight years.

Table 8: Total landings for the East Cape hills and exploratory areas of the EC stock. Total landings data from Annala et al. (2000) (1993–94 to 1998–99) and from data supplied by the Orange Roughy Management Company Limited, pro-rated to QMS data for ORH 2A, for 1999–2000 to 2003–04. Catch limits in parentheses. NA, no area split.

	Total landings (t)		
Fishing year	All EC	East Cape hills	Exploratory area
1993–94	3 437 (none)	–	–
1994–95	2 921 (3 000)	–	–
1995–96	3 235 (3 000)	–	–
1996–97	2 491 (3 000)	2 453 (2 500)	38 (500)
1997–98	2 411 (3 000)	2 394 (2 500)	17 (500)
1998–99	1 901 (2 500)	1 900 (2 000)	1 (500)
1999–00	1 456 (2 500)	1 450 (2 000)	6 (500)
2000–01	302 (200)	302 (NA)	0 (NA)
2001–02	186 (200)	–	–
2002–03	173 (200)	–	–
2003–04	170 (200)	–	–

5.2 Distribution of catch and effort

Since 1993–94, TCEPR records for both EC and MEC have provided data covering between 75% and 100% of the total landings (this figure may exceed 100% if catch-effort reporting compliance is high and catch sizes are overestimated) (Tables 9 & 10). In the MEC stock, effort (number of vessel days) has shown considerable variation (Table 9). The highest effort levels were during the early 1990s, when landings were at their peak, followed by a general reduction in subsequent years, with effort dropping since 1998–99. Reported effort declined between 2002–03 and 2003–04, and was the lowest since 1988–89.

In the EC stock, effort dropped considerably in 2000–01, in line with the TACC reduction, and has continued to drop since. The number of vessel days for 2003–04 was the lowest recorded since the start of the fishery. Catch has also decreased, to between 130 and 160 t over the last three fishing years (Table 10).

Table 9: Vessel-days and estimated catch (t) by data type for the MEC stock for the fishing years 1982–83 to 2003–2004. The figure for total estimated catch as percentage of landings may exceed 100% if catch-effort reporting compliance is high and catch sizes are overestimated.

Fishing year	Vessel days	Total estimated catch	Total estimated as % of landings	Estimated CELR catch	Estimated TCEPR catch	Estimated TCEPR as % of landings
1982–83	94	1 331	35	0	1 331	35
1983–84	544	6 518	88	747	5 771	78
1984–85	1 256	7 818	93	2 211	5 607	66
1985–86	1 093	7 458	94	2 502	4 956	62
1986–87	868	5 107	60	2 522	2 585	31
1987–88	837	7 193	74	2 145	5 048	52
1988–89	151	1 590	17	197	1 393	15
1989–90	991	8 391	80	3 352	5 039	48
1990–91	1 009	7 653	77	2 348	5 305	53
1991–92	1 319	8 368	83	1 621	6 747	67
1992–93	1 573	7 801	86	1 282	6 519	72
1993–94	1 625	6 430	98	507	5 923	90
1994–95	1 436	4 844	85	614	4 230	75
1995–96	568	1 637	87	105	1 532	81
1996–97	728	2 012	95	131	1 881	89
1997–98	847	2 214	100	170	2 044	92
1998–99	1 124	2 262	105	252	2 010	93
1999–00	877	2 395	98	233	2 162	88
2000–01	488	1 645	94	84	1 561	89
2001–02	330	1 471	99	140	1 331	90
2002–03	297	846	95	1	845	95
2003–04	254	963	109	8	955	108

Table 10: Vessel-days and estimated catch (t) by data type for the EC stock for the fishing years 1993–94 to 2003–2004. The figure for total estimated catch as percentage of landings may exceed 100% if catch-effort reporting compliance is high and catch sizes are overestimated.

Fishing year	Vessel days	Total estimated catch	Total estimated as % of landings	Estimated CELR catch	Estimated TCEPR catch	Estimated TCEPR as % of landings
1993–94	*256	3 281	95	407	2 874	84
1994–95	427	3 148	108	353	2 795	96
1995–96	385	3 155	98	290	2 865	89
1996–97	308	2 170	87	243	1 927	77
1997–98	426	1 995	83	125	1 870	78
1998–99	358	1 775	93	74	1 701	89
1999–00	286	1 430	94	94	1 336	88
2000–01	71	291	97	0	291	97
2001–02	51	158	85	0	158	85
2002–03	55	129	75	0	129	75
2003–04	44	162	95	0	162	95

* Estimated

Over the last five years, the spatial distribution of effort in the East Cape fishery has remained fairly constant, with the focus on the East Cape Hills (Figure 5). There has been no fishing in the (former) exploratory area of ORH 2A North during the past three years.

In the Mid-East Coast fishery, the distribution of effort has remained fairly constant from year to year, with tow positions tracking the 1000 m contour along almost the entire extent of the three QMAs

(Figure 5). There is, however, a section of mostly unfished ground centred near the boundary of ORH 2A and ORH 2B which has provided a natural separation between the two QMAs. The last five fishing years have seen an increase in fishing effort in the northern half of this previously unfished section (the southern end of 2A South), reducing its extent. In 2002–03, there was also a decline in the catches from the fishery at Tuaheni High (the focus of catches in the northern part of 2A South) and very little effort and catch in any part of the northern half of ORH 2A South in 2003–04 (Figure 5). The Ritchie Bank and Rockgarden areas in 2A South continue to provide the focus of the MEC fishery, with the highest concentration of large catches shown for this area. The distribution of fishing effort has been more continuous around the boundary between the ORH 2B and ORH 3A fisheries, although fishing effort has been typically very light in this area, in particular in the southern parts of ORH 2B. In ORH 3A, large catches were made over a small area on the northwestern end of the Chatham Rise in both 2002–03 and 2003–04.

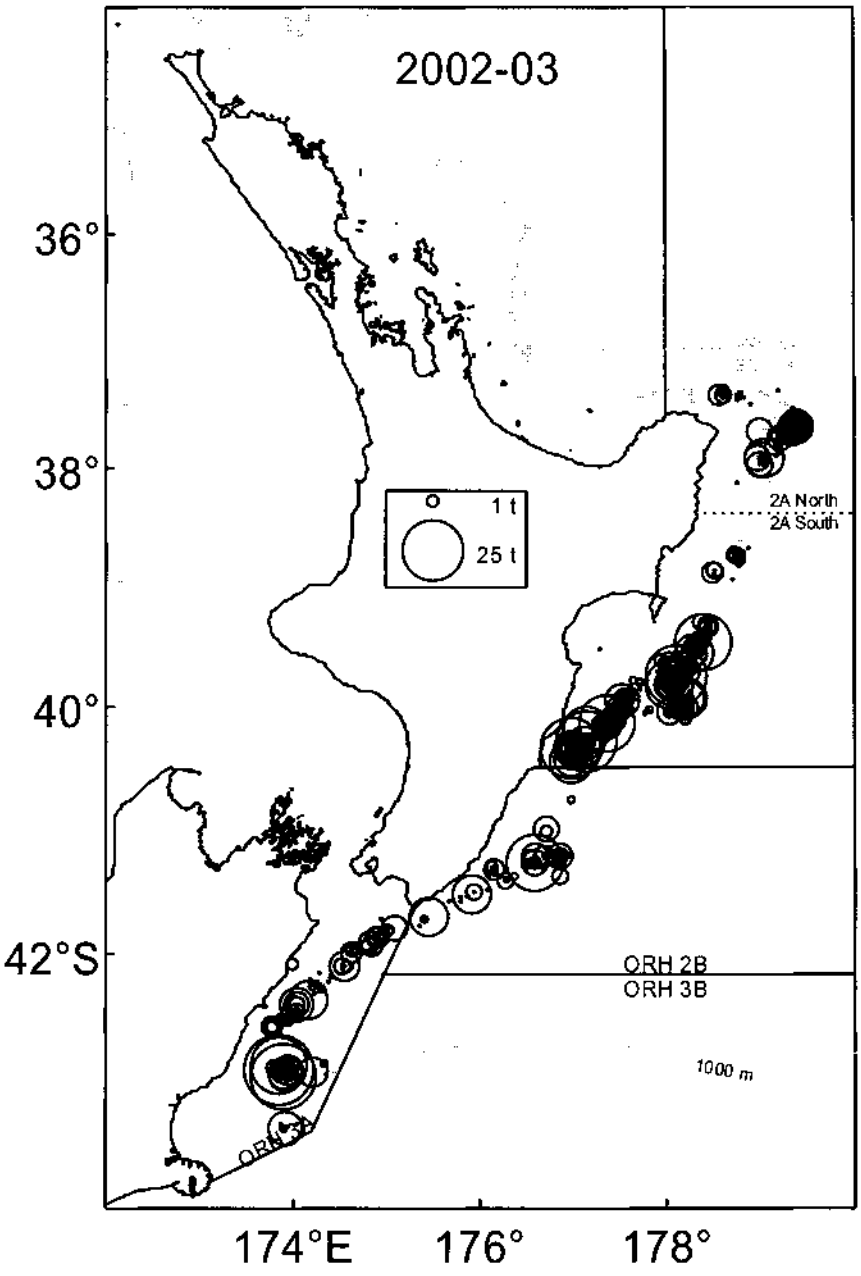

Figure 5: Catch (t) per tow of orange roughy in the EC and MEC fish stocks for the 2002–03 fishing year (*continued over*).

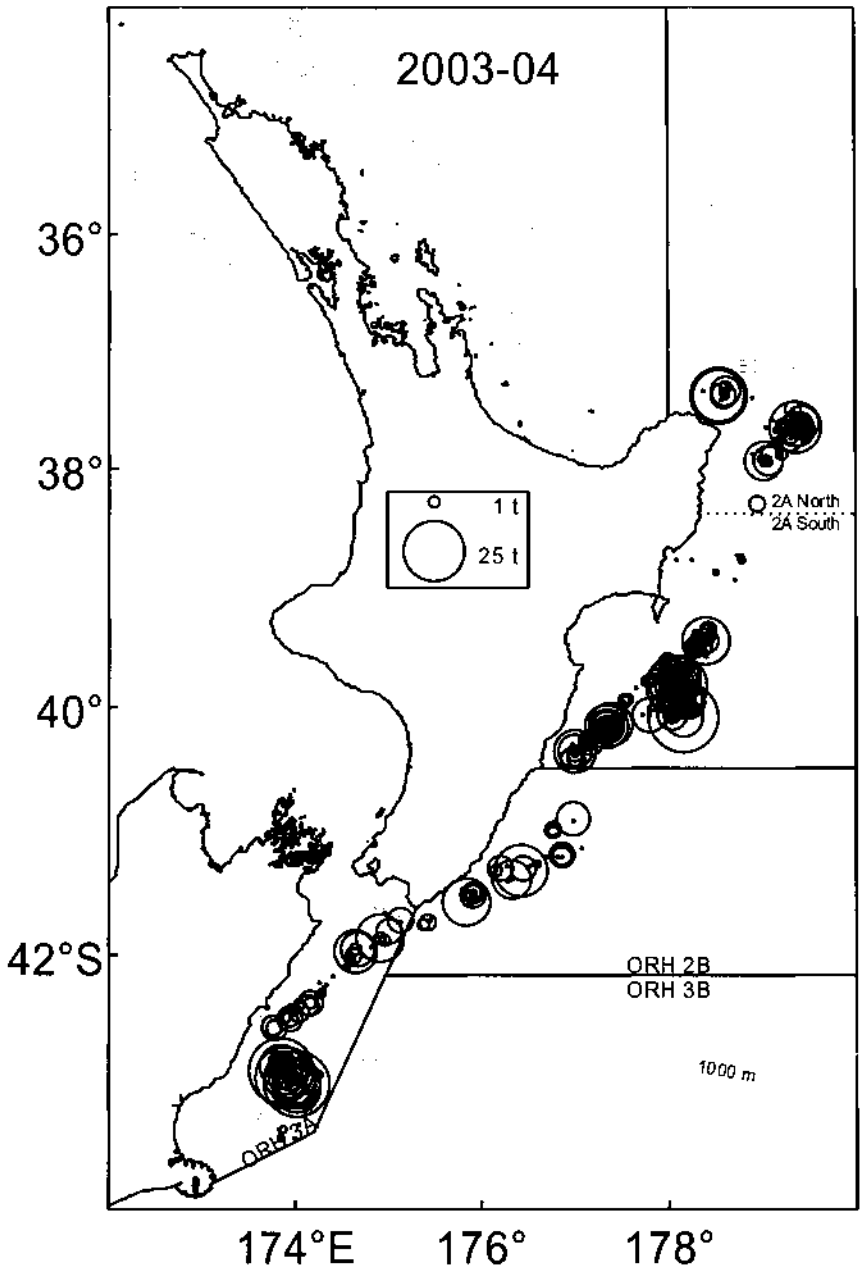

Figure 5 (cont.): Catch (t) per tow of orange roughy in the EC and MEC fish stocks for the 2003–04 fishing year.

Effort in the EC stock has been spread over all months in most years, but has been generally unpredictable over the first six months of the fishing year, followed by an increase around April to June, and a subsequent decline (Table 11). In 2001–02, there was a change to more fishing earlier in the year, especially in January, February, and April, followed by no fishing at all after June. This pattern persisted into 2002–03 and 2003–04, with more than 80% of the effort in 2003–04 coming between February and May.

Table 11: Percent of tows by month for the EC stock for the fishing years 1993–94 to 2003–2004.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total tows
1993–94	4	0	10	3	9	12	13	12	15	15	2	4	538
1994–95	5	4	8	12	14	9	15	29	2	0	1	0	1226
1995–96	11	9	9	11	8	11	12	19	7	2	1	2	1043
1996–97	12	17	11	3	5	8	7	15	10	6	2	3	851
1997–98	8	3	4	2	7	11	10	14	27	4	1	9	1638
1998–99	3	3	2	5	3	6	7	18	35	9	4	6	1121
1999–00	8	4	1	3	6	1	3	13	29	14	8	10	757
2000–01	5	12	0	0	4	7	5	34	32	2	0	0	193
2001–02	7	6	0	12	21	2	19	22	11	0	0	0	165
2002–03	1	0	5	2	35	0	24	17	14	1	0	0	136
2003–04	3	0	3	4	12	26	22	21	1	0	0	9	117

Within the MEC stock, effort in ORH 2A South has declined considerably over the last five years, following a reduction in the catch limit, reaching a level of about 350–400 tows/year over the last three fishing years (Table 12). Fishing has taken place in most months of most years, and although effort has generally been greatest around May and June, and low after June, seasonal fishing patterns have been variable from year to year. As seen in the EC fishery, effort was concentrated strongly in the February to June period in 2003–04 (Table 12).

Table 12: Percent of tows by month for ORH 2A South for the fishing years 1993–94 to 2003–2004.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total tows
1993–94	3	6	7	14	8	9	16	11	23	3	1	1	1622
1994–95	3	8	0	3	1	3	3	8	38	15	6	12	1724
1995–96	2	5	5	4	3	10	14	18	18	12	7	2	492
1996–97	6	6	2	7	4	3	6	30	18	8	1	8	561
1997–98	21	13	2	3	18	15	9	8	5	0	0	6	1131
1998–99	7	5	3	21	12	5	12	12	10	4	3	5	1645
1999–00	16	7	3	8	7	5	7	12	12	12	4	6	1424
2000–01	6	8	2	8	4	12	12	20	24	2	0	1	703
2001–02	21	8	0	13	4	2	12	12	22	1	1	4	405
2002–03	6	5	7	6	11	3	12	29	14	3	2	2	357
2003–04	8	1	5	8	12	5	14	23	18	0	0	5	358

In the central area of the MEC (ORH 2B), most of the fishing has historically taken place between September and May, with vessels generally absent from this fishery during June and July, the main spawning period of the larger fisheries (Table 13). In 2001–02, more effort was expended in the last four months of the fishing year than in any year since at least 1993–94, but effort declined during this period in 2002–03, and in 2003–04 there was no fishing in these months. In 2003–04, 40% of the effort took place in the first month of the fishing year, with the remainder spread out over the following seven months (Table 13).

Table 13: Percent of tows by month for ORH 2B for the fishing years 1993–94 to 2003–2004.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total tows
1993–94	8	9	7	16	20	11	14	5	3	1	2	3	832
1994–95	14	9	8	15	5	11	7	12	3	1	4	11	785
1995–96	15	6	4	14	6	11	18	8	4	7	3	4	323
1996–97	15	12	13	10	9	6	9	15	0	2	0	10	251
1997–98	19	11	4	23	17	12	11	2	0	0	1	0	275
1998–99	13	12	8	22	18	10	11	3	0	0	0	3	252
1999–00	14	12	5	6	19	15	8	6	3	0	5	7	240
2000–01	17	21	4	15	10	1	5	9	3	0	0	15	195
2001–02	12	22	7	10	8	3	9	2	7	10	2	9	91
2002–03	17	17	9	9	3	11	13	11	3	2	2	3	127
2003–04	40	9	9	11	7	14	4	7	0	0	0	0	57

In the southern area of the MEC (ORH 3A), the fishing pattern has been similar to that in ORH 2B, with most fishing taking place before June in each year (Table 14). Before 2001–02, the effort in this fishery had been contracting steadily into the early part of the fishing year (about 60% of effort between October and December), but in 2001–02 the effort was spread more evenly through the year. In 2002–03 and 2003–04, effort was again focused early in the fishing year, with 58% and 63% respectively coming between October and January (Table 14).

Table 14: Percent of tows by month for ORH 3A for the fishing years 1993–94 to 2003–2004.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total tows
1993–94	8	5	2	10	10	10	10	14	6	2	7	16	1 362
1994–95	15	11	11	8	9	13	9	6	2	1	6	10	880
1995–96	13	7	13	21	7	16	10	5	2	1	4	0	477
1996–97	21	19	6	4	3	15	19	4	5	1	1	4	511
1997–98	18	13	19	22	8	5	6	6	0	2	0	1	476
1998–99	35	8	19	12	8	3	9	4	2	0	0	1	407
1999–00	30	14	11	10	14	6	3	5	2	2	0	3	442
2000–01	16	12	25	22	5	5	4	2	6	0	0	2	255
2001–02	24	5	7	13	5	3	7	5	17	0	7	6	165
2002–03	14	20	16	8	5	7	9	16	2	1	0	1	152
2003–04	24	8	10	21	8	11	7	8	1	0	2	1	132

5.3 Catch rates

5.3.1 Seasonal catch rates

The highest levels of effort, and unstandardised catch rates (t/tow), for the MEC fishery have typically been during the spawning season, in June and July (Clark et al. 2003), but this trend has become less clear in the last two years. Although there were a few high catch rates (over 10 t/tow) recorded in June and July in ORH 2A South in both 2002–03 and 2003–04, these were no greater than catch rates recorded in other months, particularly the October–December period in 2002–03 and October and January in 2003–04 (Figure 6). High catch rates were also recorded at various times of the year in ORH 2B and ORH 3A in these two years, but always before June. Effort was spread over much of the year in each of the three regions of the MEC, although there was a tapering off after June in each area in 2002–03, and virtually no effort in July and August, and only a few tows in September, in 2003–04.

High catch rates (over 10 t/tow) were rare in the EC fishery in both 2002–03 and 2003–04, with only a few such catches recorded in January 2003 and in October, January, and July in 2004 (Figure 6). The effort was concentrated in February and April–June in 2002–03 and in March–May in 2003–04, with the spawning period left virtually unfished in 2003–04. The reduction of clear seasonal spikes, and homogenisation of catch rates over recent years in the EC fishery (Clark et al. 2003) has continued into 2003–04, with occasional relatively high catch rates taken at various times of the year.

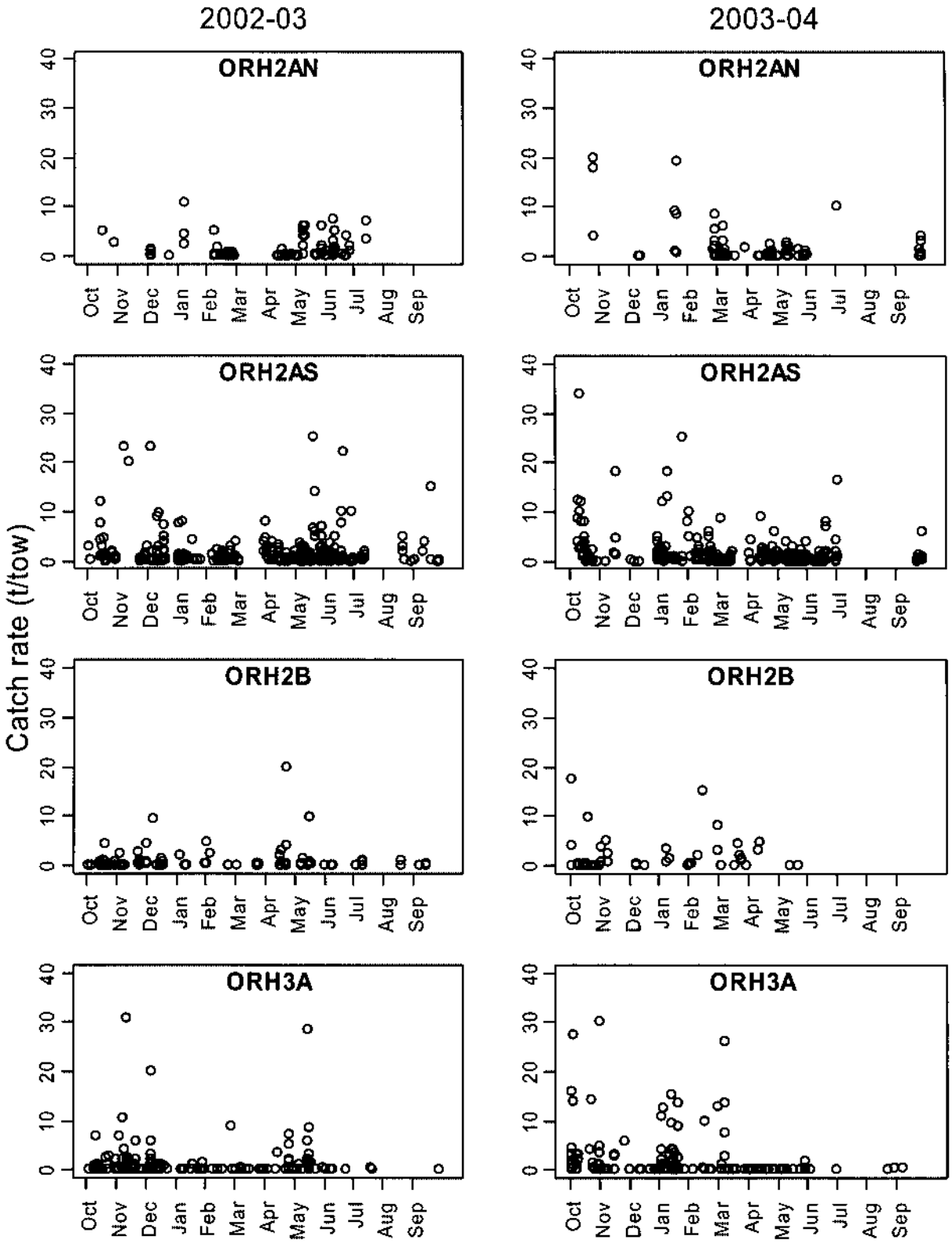

Figure 6: Unstandardised daily catch rate profiles (t/tow) of orange roughy in the MEC and EC stocks for 2002–03 and 2003–04. ORH2AN = ORH 2A North; ORH2AS = ORH 2A South.

5.3.2 Annual catch rates

Within the MEC stock, unstandardised annual catch rates peaked in the early 1990s, and then declined (Figure 7). There was an increase in the catch rate in 2001–02 (both in t/tow and t/h) to a level higher than that recorded in any of the previous eight years. In 2002–03, the catch rate dropped but increased again in 2003–04, driven mostly by better catch rates in ORH 2B and ORH 3A. Catch rates were higher in ORH 2A South than in the other two QMAs in all years until 1996–97. Catch rates in ORH 3A have increased steadily since that time, and were greater than in the other two QMAs until 2003–04. Catch rates in ORH 2B have also been increasing in recent years and there was a big increase in the annual catch rate in 2003–04 to just over 2 t per hour, the highest of the three QMAs (Figure 7).

The catch rates for the EC stock are described here using the three basic subareas defined by Anderson (2000): MAIN, the main spawning hill feature due east of East Cape which was first and almost exclusively fished in the first year of the fishery, and fished heavily in every year since; NORTH, the northwest quadrant of the fishery containing a distinct hill feature fished consistently since the 1995–96 fishing year; OTHER, all other areas, but mostly comprising a series of about 10 seamounts running generally north-south to the west of the MAIN hill feature.

The overall EC catch rates have shown a decline since the start of the fishery, and a small increase in the last two fishing years (Figure 8). Catch rates were initially highest in MAIN, followed by NORTH, and then by OTHER, but since the late 1990s all areas have shown broadly similar catch rates. Following a decline in catch rates in all areas between 1995–96 and 1997–98, catch rates increased in OTHER to 2000–01, but with a sharp decline in 2001–02. Catch rates in MAIN have fluctuated, decreasing in catch per hour but remaining steady in catch per tow over the last two years. Catch rates in area NORTH have been variable over the last four years, but increased dramatically in 2003–04, with the 23 tows in this area producing more than 50 t of orange roughy.

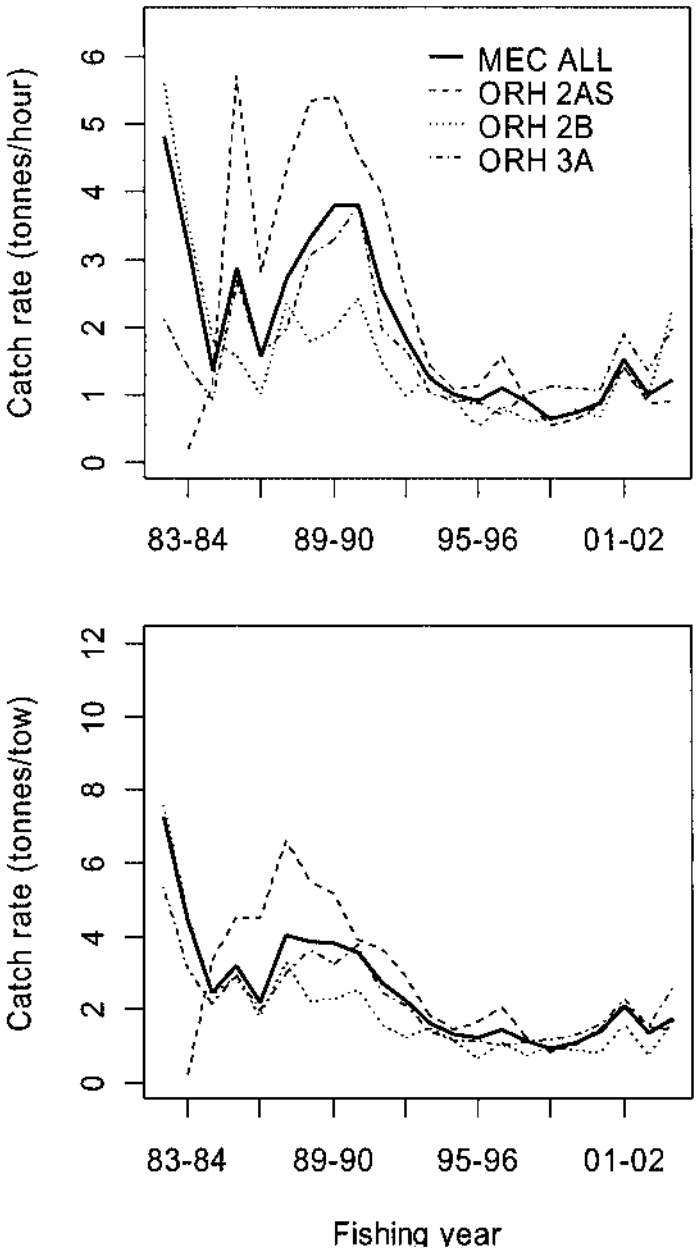

Figure 7: Unstandardised catch rates of orange roughy in the MEC stock and subareas for 1982–83 to 2003–2004. ORH2AS = ORH 2A South.

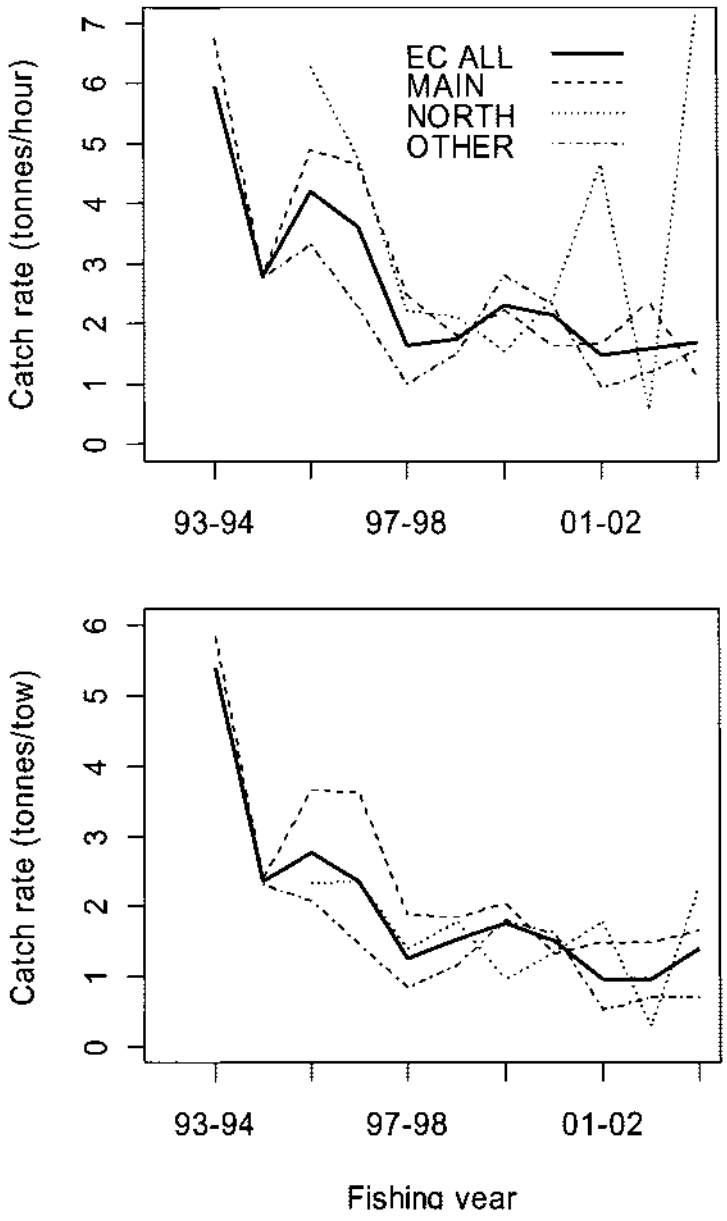

Figure 8: Unstandardised catch rates of orange roughy in the EC stock and subareas for 1993–94 to 2003–2004.

6. CHATHAM RISE AND SOUTHERN FISHERIES (ORH 3B)

Quota management area ORH 3B extends from the northern edge of the Chatham Rise, off the east coast of the South Island, south and west to encompass most of the southern region of the EEZ (Figure 9). The area has been subdivided at 46° S for some years now, which separates the Chatham Rise from areas to the south. Although further subdivisions have taken place, the QMA is generally treated as these two large areas. In this section, we first present combined total ORH 3B information, then analyse the Chatham Rise, the northeast Chatham Rise, and the southern region (plus Arrow Plateau) as discrete management areas. The northeast Rise has a specific analysis in this report because it was completed for a stock assessment of this area in 2004–05 (M. Dunn, NIWA, unpublished results).

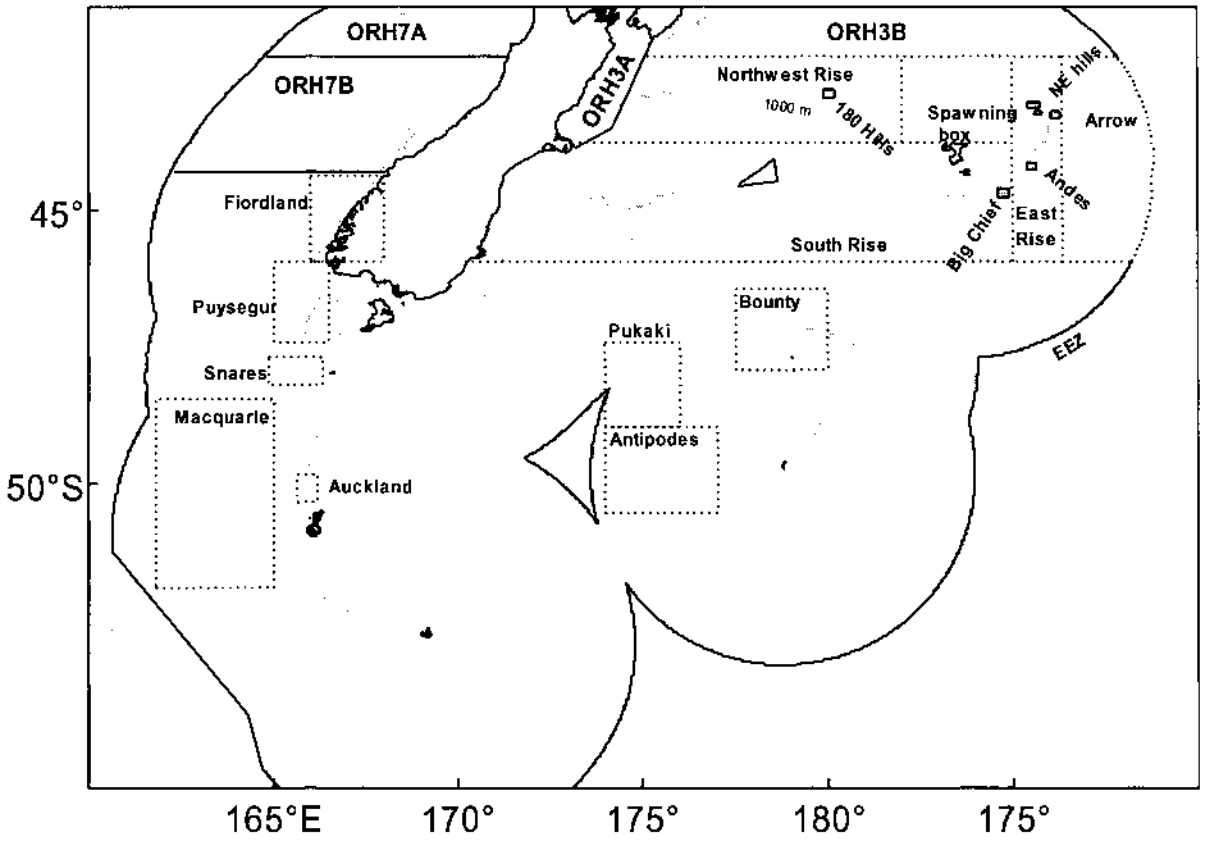

Figure 9: Map of locations of fisheries within ORH 3B, with shaded areas indicating the hill areas described in Table 18.

6.1 Overall total catch

Total catch in ORH 3B during 2003–04 was 11 254 t (Table 15), which represented 89% of the quota. This represents a decrease of about 1100 t from the recent peak in landings recorded in 2002–03 and is similar to the reported catch of 2001–02. The 2004–05 catch is about one third of the catch reported in the best years of the fishery (1982–83, 1983–84, and 1988–89).

Table 15: Annual reported catches and TACs of orange roughy from ORH 3B. (Catches from 1978–79 to 1985–86 are from Robertson & Mace (1988)) and from 1986–87 to 2003–04 from Fisheries Statistics Unit and Quota Monitoring System data).

Fishing year	Reported catch (t)	TAC (t)
1979–80†	11 800	–
1980–81†	31 100	–
1981–82†	28 200	23 000
1982–83*	32 605	23 000
1983–84*	32 535	30 000
1984–85‡	29 340	30 000
1985–86‡	30 075	29 865
1986–87‡	30 689	38 065
1987–88‡	24 214	38 065
1988–89‡	32 785	38 300
1989–90‡	31 669	32 787
1990–91‡	21 521	23 787
1991–92‡	23 269	23 787
1992–93‡	20 048	21 300
1993–94‡	16 960	21 300
1994–95‡	11 891	14 000
1995–96‡	12 501	12 700
1996–97‡	9 278	12 700
1997–98‡	9 638	12 700
1998–99‡	9 372	12 700
1999–00‡	8 663	12 700
2000–01	9 274	12 700
2001–02	11 324	12 700
2002–03	12 333	12 700
2003–04	11 254	12 700

† Catches for 1979–80 to 1981–82 are for an April–March fishing year.

* Catches for 1982–83 and 1983–84 are 15 month totals to accommodate the change over from an April–March fishing year to an October–September fishing year. The TAC for the interim season, March to September 1983, was 16 125 t.

‡ Catches from 1984–85 onwards are for a October–September fishing year.

In 1993, ORH 3B was divided into 'quasi' quota areas under an informal agreement between the Minister of Fisheries and the Orange Roughy Management Company. In 2003–04, the overall TACC and allocation between quota areas was unchanged, with 10 400 t allocated to the Chatham Rise, split into three areas (Table 16). The area quotas were slightly exceeded for the northwest Rise in 2001–02 and 2002–03, and slightly undercaught in 2003–04. Catches were under the area limits in all areas in 2003–04, particularly so in the Spawning Box and in the exploratory areas of the sub-Antarctic and Arrow Plateau.

Table 16: Changes in catch (rounded to the nearest 50 t) and quota for MFish–ORMC subareas on the Chatham Rise (data from TCEPR + CELR estimates).

		2001–02	2002–03	2003–04
Area	Quota	Catch	Catch	Catch
Northwest Rise	2 000	2 100	2 200	1 950
Spawning Box, East Rise	7 000	6 500	7 100	6 350
South Rise	1 400	1 100	1 500	1 250
Puysegur	0	50	0	0
Subantarctic	1 300	1 200	1 100	750
Arrow Plateau	1 000	100	200	150

6.2 Chatham Rise fisheries

Commercial fisheries for orange roughy started on the Chatham Rise in the late 1970s, and the area continues to support the largest orange roughy fisheries in New Zealand waters. Initial catches were largely taken from the northern slopes of the Chatham Rise, in particular the area where large spawning plumes of orange roughy occurred between June and August. The importance of other fisheries on both spawning and non-spawning aggregations of orange roughy increased as this fishery declined in the 1990s. The north-west stock and southern stocks were last assessed in 2004 (A. McKenzie, NIWA, unpublished results; Anderson, 2005), and the north-east stock, including the spawning box, was last assessed in 2005 (M. Dunn, NIWA, unpublished results).

6.2.1 Total catch

In the first few years of the fishery, catches have come mostly from the Spawning Box (Table 17). Landings from the western part of the northwest Rise and the South Rise grew rapidly during the early 1980s, and these three areas were responsible for the majority of the landings for several years. Catches from the east Rise also grew during the 1980s, reaching a peak of 12 000 t (51% of the ORH3B catch) in 1991–92. Non-Chatham Rise catches increased rapidly with the discovery of the Puysegur fishery in the early 1990s and accounted for 30–40% of the ORH 3B catch for several years. The relative contribution from each area has become more stable over time as each fishery has become fully developed, and the fishing down phase completed, with the northwest Rise, east Rise, and Spawning Box contributing more or less equally (about 20–30%), and the South Rise and Non-Chatham areas each contributing about 10% (Table 17).

Table 17: ORH 3B catches by fishing year and area (Figure 10), to the nearest 100 t, and by percentage (to the nearest percent) of the total ORH 3B catch. All years are from 1 October–30 September.

	Northwest		South		Spawning Box		East		Non–Chatham	
Fishing year	t	%	t	%	t	%	t	%	t	%
1978–79	0	0	0	0	11 500	98	300	2	0	0
1979–80	1 200	4	800	3	27 900	90	1 200	4	0	0
1980–81	8 400	30	3 700	13	16 000	57	100	0	0	0
1981–82	7 000	28	500	2	16 600	67	800	3	0	0
1982–83	5 400	35	4 800	31	4 600	30	600	4	0	0
1983–84	3 300	13	5 100	21	15 000	61	1 500	6	0	0
1984–85	1 800	6	7 900	27	18 400	63	1 100	4	0	0
1985–86	3 700	12	5 300	18	17 000	56	4 100	13	0	0
1986–87	3 200	10	4 900	16	20 200	66	2 400	8	0	0
1987–88	1 600	7	6 800	28	13 500	56	2 300	10	0	0
1988–89	3 800	12	9 200	28	16 700	51	3 100	9	0	0
1989–90	3 300	10	11 000	35	16 200	51	1 100	3	200	1
1990–91	1 500	7	6 900	32	6 100	28	6 100	29	900	4
1991–92	300	1	2 200	9	1 000	4	12 000	51	7 800	34
1992–93	3 800	19	5 400	27	100	0	4 700	23	6 100	30
1993–94	3 500	21	5 100	30	0	0	4 900	29	3 500	20
1994–95	2 400	20	1 600	13	500	5	3 500	30	3 800	32
1995–96	2 400	19	1 300	10	1 600	13	2 200	17	5 000	40
1996–97	2 200	24	1 400	15	1700	19	1 900	21	1 900	21
1997–98	2 300	23	1 700	17	2 400	24	2 200	22	1 600	16
1998–99	2 700	28	1 200	13	1 100	11	2 500	27	1 900	21
1999–00	2 100	24	1 100	13	1 500	17	3 100	36	800	9
2000–01	2 500	27	1 650	18	1 200	13	2 200	24	1 500	17
2001–02	2 100	19	1 100	10	3 000	28	3 400	31	1 200	11
2002–03	2 200	19	1 500	12	3 200	27	3 900	33	1 300	7
2003–04	1 950	19	1 250	12	3 950	38	2 400	23	950	9

6.2.2 Distribution of catch and effort

The main areas of the Chatham Rise can be divided, and examined as individual features or groups of spatially related features. Of these, the 180 Hills, the NE hills and Andes, Big Chief and the Spawning Box (see Figure 9) have contributed the largest proportion of the total catch of the Chatham Rise (Table 18). Of the four main seamount complexes outside of the Spawning Box, catches from the Andes have generally been highest, and have fluctuated between about 700 t and 2200 t since 1994–95.

The main fishing areas of the Chatham Rise, with trawl positions and catch sizes, are shown for the two most recent fishing years in Figure 10. The distribution of catches and effort was similar in 2002–03 and 2003–04, although fishing was more spread out over the Spawning Box and over the eastern areas of the northwest Rise in 2003–04. Targeted orange roughy fishing effort has been greatest in the Andes in recent years, followed by the Spawning Box and Big Chief. Effort in the Andes decreased in 2003–04 after rapidly increasing effort over the previous three years. Effort has been increasing in the Spawning Box and Big Chief since 1999–2000, while decreasing in the 180 hills. Effort has remained relatively constant in the NE hills over the last four years (Table 18).

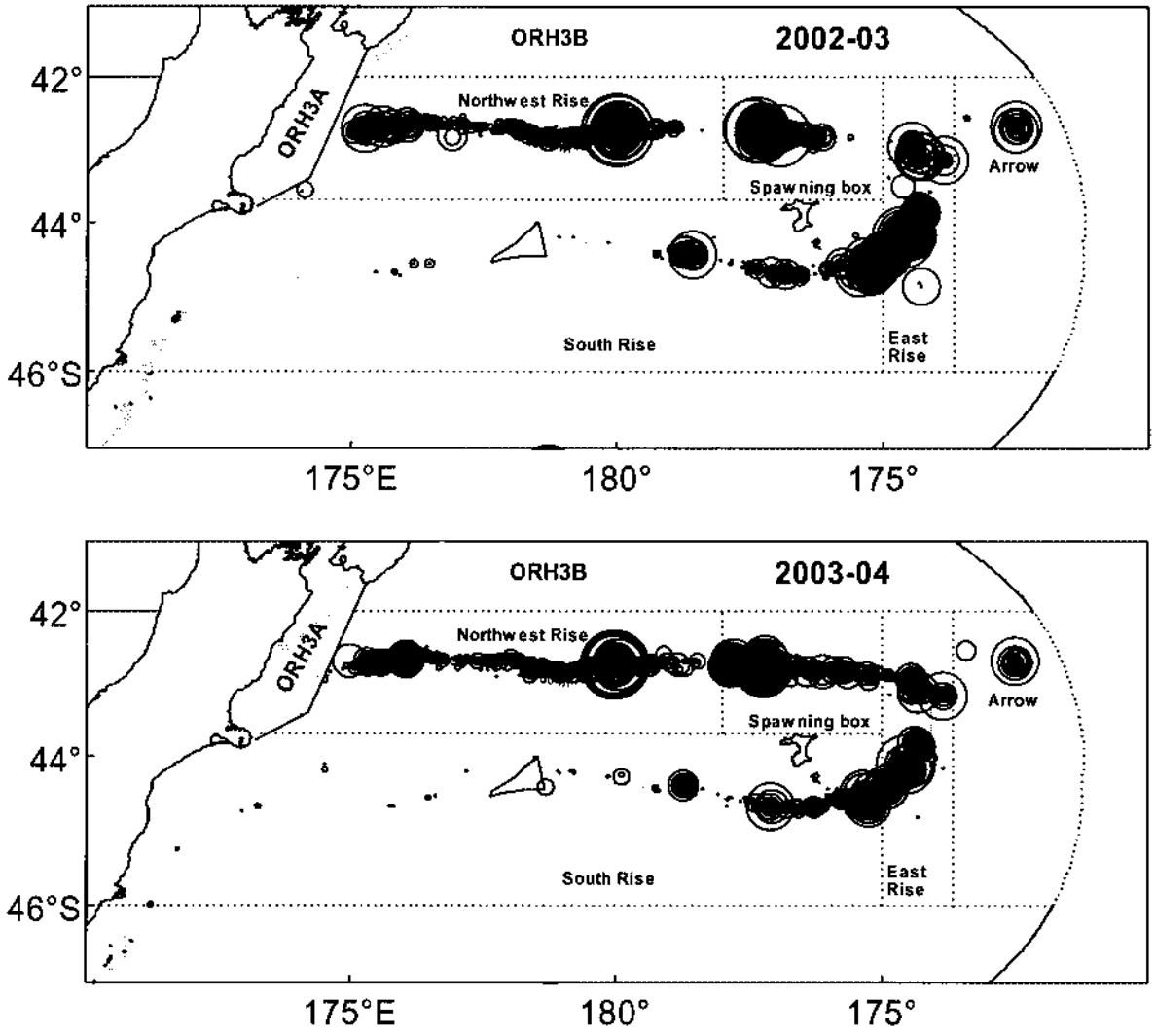

Figure 10: Distribution of unstandardised catch rates (t per tow) for orange roughy targeted or caught in the Chatham Rise area during 2002–03 and 2003–04 (circle area proportional to catch rate, maximum = 90 t).

6.2.3 Catch rates

The pattern of unstandardised catch rates at the different fishing locations in 2003–04 was similar to that in previous years, with the highest catch rates in the Spawning Box and NE hills (Table 18). Catch rates in the 180 Hills (the "Graveyard" hills) have been steadily increasing over the last four years. Catch rates in Andes, NE hills, Big Chief, and the Spawning Box were all lower in 2003–04 than in recent years.

Unstandardised catch rate profiles show a consistent pattern of catch rates (t/tow) between the last two fishing years in all four Chatham Rise fisheries (Figure 11). In each fishery the catch is well spread out over the year, with peak catches recorded in northwest Chatham and the Spawning Box in June and July. In the east and south Chatham Rise large catches are spread out more over the year, but effort is infrequent during the orange roughy spawning period.

6.2.4 Bycatch fraction

The bycatch fraction (of oreos relative to orange roughy) by area in 2003–04 decreased from previous years in the 180 Hills, increased in the NE hills and Andes, and remained much the same in the Big Chief and Spawning Box fisheries (Table 18). In 2003–04, as in other recent years, the highest by-catch fraction in the Chatham Rise fisheries was taken in Big Chief and the lowest in the Spawning Box.

Table 18: Summary statistics from the main Chatham Rise fishing locations. Note: catches are unadjusted (i.e., not scaled to the QMR total). Catch per tow and bycatch fraction are only calculated where the number of tows is greater than 10 (–, not calculated).

Area & Fishing year	Number of tows targeting ORH	Number of tows targeting OEO	Catch of ORH (ORH target)	Catch of OEO (ORH target)	ORH catch per tow (t)	*Bycatch fraction
180 Hills (northwest Rise)						
1992–93	297	0	3298	384	11.1	0.12
1993–94	363	0	2177	276	6.0	0.13
1994–95	363	4	1512	142	4.1	0.09
1995–96	355	1	1790	140	5.0	0.08
1996–97	243	4	874	94	3.5	0.11
1997–98	305	0	829	66	2.7	0.08
1998–99	186	1	933	88	5.0	0.09
1999–00	239	6	630	99	2.6	0.16
2000–01	301	0	1014	101	3.4	0.10
2001–02	206	0	729	38	3.5	0.05
2002–03	253	0	1080	54	4.3	0.05
2003–04	126	1	744	14	5.8	0.02
Smiths City and neighbours (NE hills) (east Rise)						
1990–91	633	9	4890	789	7.7	0.16
1991–92	222	0	1272	96	5.7	0.08
1992–93	84	0	598	47	7.1	0.08
1993–94	109	1	564	110	5.6	0.20
1994–95	345	0	1136	223	3.3	0.20
1995–96	145	0	405	117	2.8	0.29
1996–97	164	2	720	181	4.3	0.25
1997–98	146	0	396	75	2.7	0.19
1998–99	272	0	809	122	3.0	0.15
1999–00	210	0	675	103	3.2	0.15
2000–01	191	0	650	141	3.4	0.22
2001–02	167	0	492	57	2.9	0.12
2002–03	124	0	404	31	3.3	0.08
2003–04	160	0	364	97	2.3	0.27
Andes (east Rise)						
1991–92	724	14	7084	2424	9.7	0.34
1992–93	345	10	2943	748	8.7	0.25
1993–94	605	5	3323	1028	5.5	0.31
1994–95	573	0	1648	517	2.8	0.31
1995–96	418	0	1121	362	2.7	0.32
1996–97	260	4	729	509	2.8	0.70
1997–98	476	0	1138	455	2.4	0.40
1998–99	448	4	1257	433	2.8	0.34
1999–00	529	1	1986	655	3.7	0.33
2000–01	354	0	977	296	2.7	0.30
2001–02	546	0	2038	566	3.7	0.28
2002–03	872	3	2231	861	2.6	0.39
2003–04	677	8	1169	593	1.7	0.51

* catch of orcos (OEO) divided by catch of orange roughy (ORH) from tows targeting orange roughy (ORH).

Table 18 —*Continued*. Summary statistics from the main Chatham Rise fishing locations. Note: catches are unadjusted (i.e., not scaled to the QMR total). Catch per tow and bycatch fraction are only calculated where the number of tows is greater than 10 (–, not calculated).

Area & Fishing year	Number of tows targeting ORH	Number of tows targeting OEO	Catch of ORH (ORH target)	Catch of OEO (ORH target)	ORH catch per tow (t)	*Bycatch fraction
Big Chief (south Rise)						
1988–89	199	0	1014	132	5.1	0.13
1989–90	529	35	2825	469	5.3	0.17
1990–91	453	91	3153	642	6.9	0.20
1991–92	138	8	821	352	5.9	0.43
1992–93	703	0	3308	2083	4.7	0.63
1993–94	698	0	2353	1659	3.4	0.71
1994–95	242	0	513	401	2.1	0.78
1995–96	151	2	577	209	3.8	0.36
1996–97	195	1	557	394	2.8	0.71
1997–98	285	0	952	621	3.3	0.65
1998–99	215	1	562	461	2.6	0.82
1999–00	123	2	379	531	3.1	1.40
2000–01	213	1	1017	753	4.8	0.74
2001–02	234	6	658	559	2.8	0.85
2002–03	276	13	655	605	2.4	0.92
2003–04	300	31	574	534	1.9	0.93
Spawning Box						
1986–87	1631	0	19956	36	12.2	0.00
1987–88	1319	1	13681	14	10.4	0.00
1988–89	1410	0	13634	14	9.7	0.00
1989–90	1001	0	11792	51	11.8	0.00
1990–91	446	0	5653	124	12.7	0.02
1991–92	139	0	948	8	6.8	0.01
1992–93	2	0	54	0	–	–
1993–94	0	0	0	0	–	–
1994–95	111	0	492	0	4.4	0.00
1995–96	153	0	1492	35	9.8	0.02
1996–97	226	0	1519	15	6.7	0.01
1997–98	262	0	2207	41	8.4	0.02
1998–99	206	0	970	38	4.7	0.04
1999–00	144	0	1422	36	9.9	0.03
2000–01	177	0	1202	45	6.8	0.04
2001–02	373	0	3065	45	8.2	0.01
2002–03	378	0	3145	16	8.3	0.01
2003–04	593	0	3956	103	6.7	0.03

* catch of oreos (OEO) divided by catch of orange roughy (ORH) from tows targeting orange roughy (ORH).

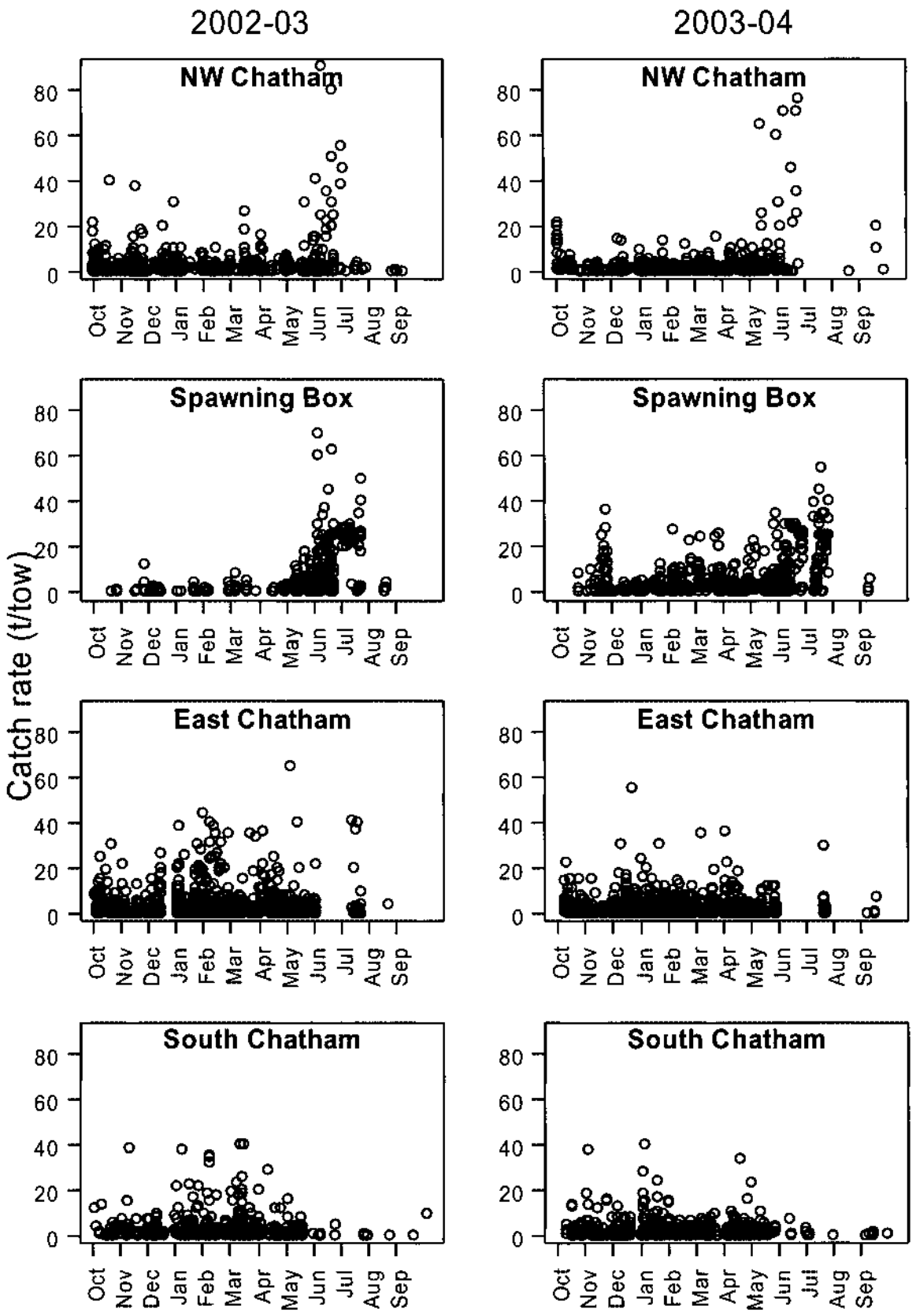

Figure 11: Unstandardised catch rate profiles (t/tow) of orange roughy in the Chatham Rise (ORH 3B) fisheries for 2002–03 and 2003–04.

6.2.5 Northeast Rise

The northeast Chatham Rise (NECR) is the area from the Spawning Box extending eastwards to the NE Hills, and then south to the Andes complex (Figure 12). This area, and the Spawning Box in particular, has been the site of the largest orange roughy fisheries in New Zealand. The NECR has been treated as a single stock for assessment purposes (Dunn 2005).

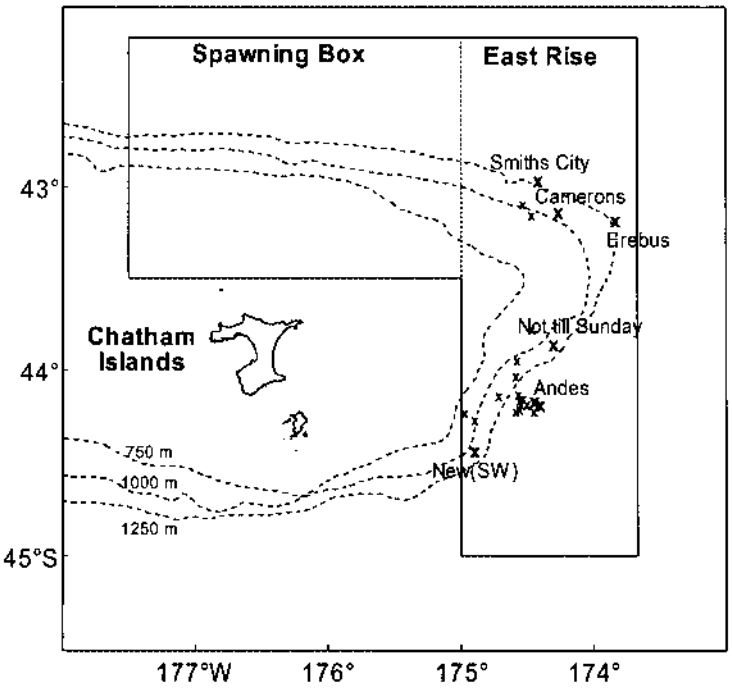

Figure 12: The northeast Chatham Rise area, with the position of known features marked as crosses.

The fisheries have been described in detail, most recently by Coburn & Doonan (1994, 1997). The fishery was initially focused on pre-spawning aggregations on flat areas of the Spawning Box, but then quickly spread to other flat areas of the northeast Rise and then the eastern Rise. It is believed that these latter fisheries were following an outward migration of post-spawning orange roughy from the Spawning Box. Most of the fishing effort at this time was in June and July. Coburn & Doonan (1994) concluded catch per unit effort did not index abundance because of the aggregation behaviour, and because of the suspected spawning migrations. This pattern of fishing continued until the early 1990s. In 1992–93 there was a voluntary closure of the Spawning Box, and around this time the fishing fleet redirected effort from flat fishing to largely hill fishing, primarily on the NE hills, Not Till Sunday, and the Andes complex. This was associated with a switch from seasonal to year round effort, and a replacement of foreign by domestic vessels. Fishing recommenced in the Spawning Box in 1994–95, but the hill fisheries were maintained and have subsequently provided most of the catch.

6.2.5.1 Distribution of catch and effort

For the following analyses, subareas or features were defined as follows:

- **Spawning Box.** The area of largely flat seabed within the limits 42.17°–43.5° S and 177.5°–175° W. Note that the analyses in this section use the 'research' rather than the 'management' definition of the western boundary, the latter being at 178°.
- **Smiths City**. The area extending 2 nautical miles around the hill at 42.96° S and 174.42° W.
- **Camerons**. The area extending 2 nautical miles around the hill at 43.133° S and 174.263° W.
- **Erebus**. The area extending 2 nautical miles around the hill at 43.178° S and 173.84° W.

- **Andes**. The area of hills within the limits 174.3–174.6°W and 44.3–44° S. Hills in the Andes complex are close together, and it is therefore difficult to allocate tows to specific hills.
- **Not till Sunday**. The area extending 2 nautical miles around the hill at 43.854° S and 174.3° W.
- **New(SW)**. The area extending 2 nautical miles around 44.43° S and 174.89° W. This area, to the west and south of the Andes, is believed to contain a ridgeline but has not been formally described. It is believed to be in the vicinity of features known as Cooks, Mangrove, and the Middle Ground.

These areas or features include most of the main current fisheries. It is in no way a comprehensive list of areas fished for orange roughy on the NECR. About 30 features are known to have been or are currently being fished for orange roughy.

6.2.5.2 Overall pattern

The patterns of catch and effort in 2002–03 and 2003–04 were generally similar (Figure 13). The fishery is still dominated by short tows (30 minutes or less) focused on hills, particularly the NE hills, Not till Sunday and the Andes, and also the spawning plume at the western end of the Spawning Box. There is a relatively new fishery in the south of the eastern Rise, just east of 175° W, which for of this analysis has been called New(SW). Longer tows (over 30 minutes) generally take place on flat areas around the Andes, and in the Spawning Box extending east from the spawning plume. In 2003–04 the Spawning Box fishery extended further along the eastern Rise, as far as the NE hills.

Large catches of more than 10 t/tow have continued to be taken in most areas, although on Smiths City, Erebus, and Not till Sunday the incidence of large catches has decreased (Figure 14). Conversely, in New(SW) the incidence of large catches has increased with the development of this fishery. The Andes continue to provide occasional large catches.

The number of tows has been relatively high or increasing in recent years in the Spawning Box, Not till Sunday, New(SW), and the Andes (Tables 18 & 19). Conversely, effort has been relatively low on the NE hills (Table 19). The seasonal distribution of effort has not changed appreciably over the last three years, with the hills receiving most effort between October and May and generally peaking in summer, but with the NE hills also receiving some effort in July (Figure 15). Most effort has been between December and May in the last two years on New(SW), and effort in the Spawning Box has continued a familiar pattern, with effort throughout the year but focused in May, June, and July (Figure 16).

6.2.5.3 Catch rates

In 2003–03 the highest mean catch rate (t/tow) was taken in the Spawning Box, followed by Camerons and New(SW), with the lowest at the Andes and Smiths City (Tables 18 & 20). In 2003–04 the catch rates were lower in all areas, but highest in the Spawning Box, Erebus, and Camerons, and lowest again at the Andes and Smiths City.

Most areas now show clear trends in catch rates, or are continuing to decline (Tables 18 & 20). Catch rates have been higher in recent years only on Camerons. Most areas show a characteristic pattern of high catch rates in the first few years, followed by a rapid decline, and this is also apparent for the relatively new fishery New(SW).

High catch rates (over 10 t/tow) have occasionally but unpredictably been made on most hills between October and May, but have been relatively common in the Spawning Box in June and July (see Figures 11 & 14).

Table 19: Summary of orange roughy effort (tows) for selected subareas or features within the northeast Chatham Rise during fishing years 1989–90 to 2003–04.

			NE hills		
Fishing year	Smiths City	Camerons	Erebus	Not till Sunday	New(SW)
1989–90	0	0	0	0	0
1990–91	694	110	402	0	0
1991–92	312	42	72	162	0
1992–93	70	60	26	49	0
1993–94	104	82	28	80	0
1994–95	278	154	228	113	0
1995–96	112	64	106	79	0
1996–97	108	74	132	57	0
1997–98	112	58	92	101	1
1998–99	216	122	158	90	0
1999–2000	172	86	130	55	0
2000–01	172	78	106	49	15
2001–02	146	54	122	91	23
2002–03	118	64	58	138	49
2003–04	136	68	90	102	114

Table 20: Summary of orange roughy unstandardised catch per unit effort (t/tow) for subareas or features within the northeast Chatham Rise during fishing years 1989–90 to 2003–04. "–" no effort

			NE hills		
Fishing year	Smiths City	Camerons	Erebus	Not till Sunday	New(SW)
1989–90	–	–	–	–	–
1990–91	9.4	6.3	5.1	–	–
1991–92	6.4	1.3	5.0	7.3	–
1992–93	6.7	8.6	6.1	8.7	–
1993–94	5.3	4.2	11.3	4.6	–
1994–95	3.1	1.9	4.2	2.5	–
1995–96	3.0	1.8	3.2	3.1	–
1996–97	3.9	4.8	4.7	3.1	–
1997–98	3.1	1.8	3.4	1.5	0.0
1998–99	3.6	2.0	3.2	1.8	–
1999–2000	3.8	3.4	2.9	3.5	–
2000–01	4.0	3.9	2.4	2.9	13.1
2001–02	2.2	1.8	4.6	4.7	4.3
2002–03	2.3	5.6	3.0	3.0	5.0
2003–04	1.9	2.6	2.8	2.1	3.1

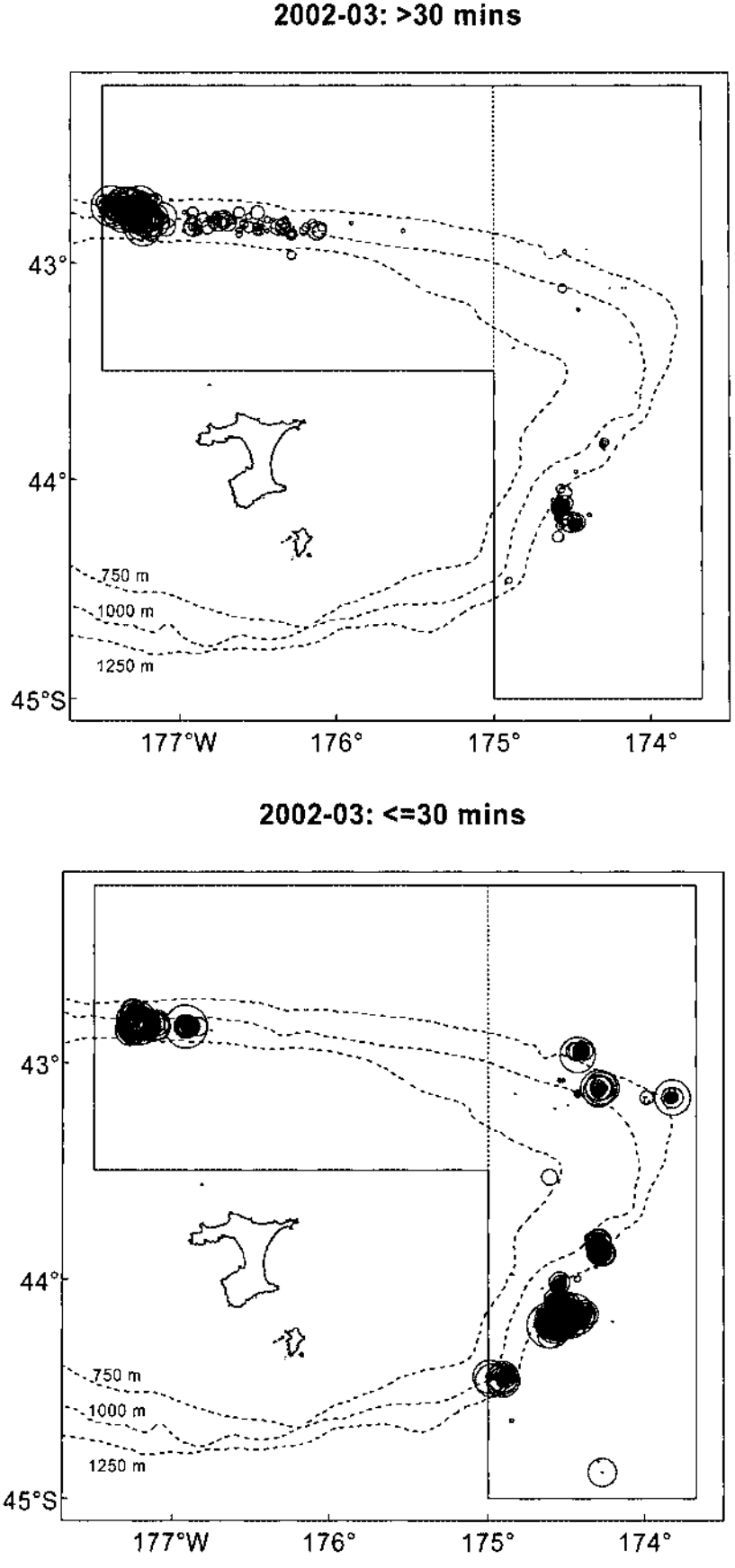

Figure 13: Distribution of trawls and orange roughy catch rate (t/tow) by tow duration in the NECR for 2002–03. Circle size proportional to catch rate (max. for >30 min tows = 70 t; max. for <=30 min. tows = 65 t).

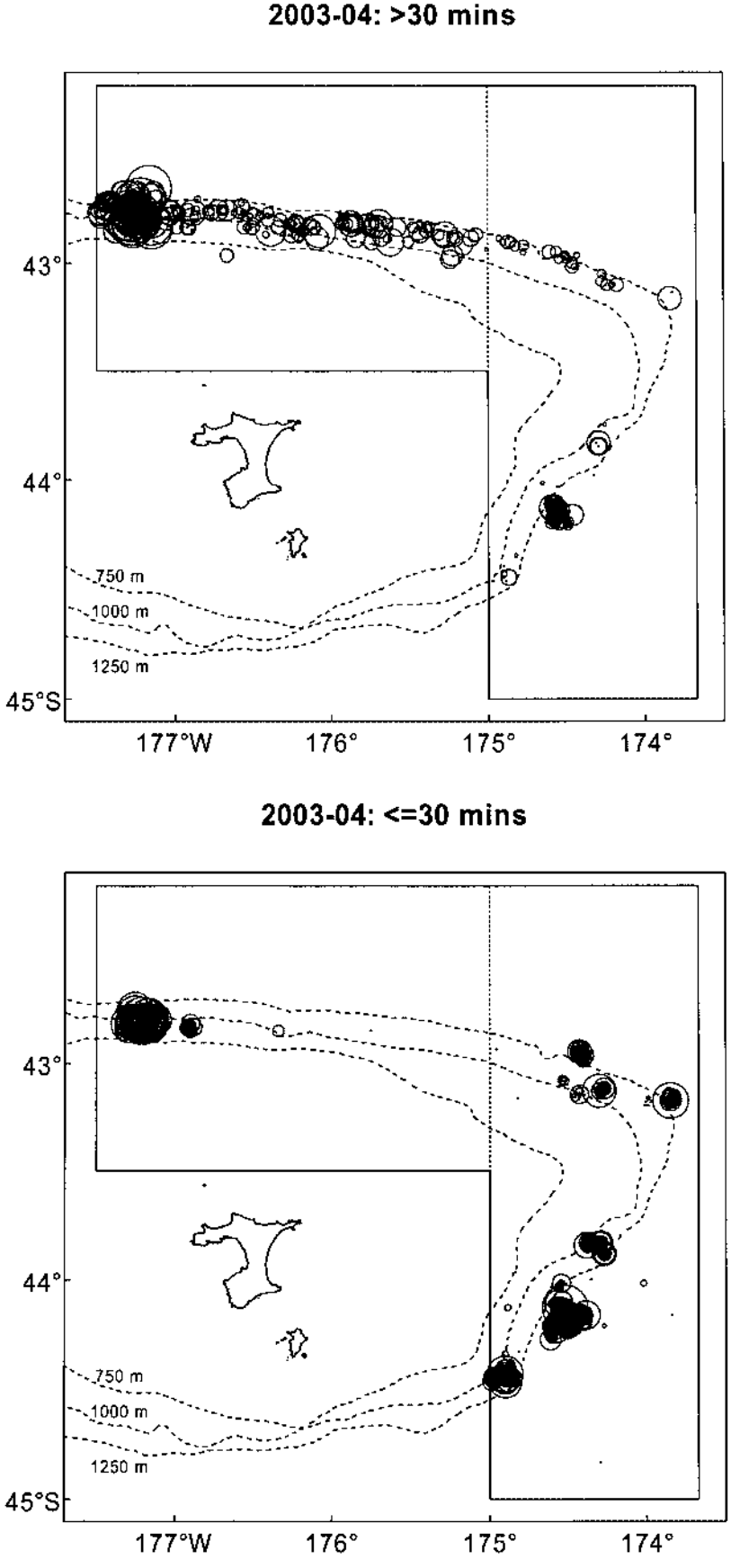

Figure 13 (cont.): Distribution of trawls and orange roughy catch rate (t/tow) by tow duration in the NECR for 2003–04. Circle size proportional to catch rate (max. for >30 min tows = 32 t; max. for <=30 min. tows = 55 t).

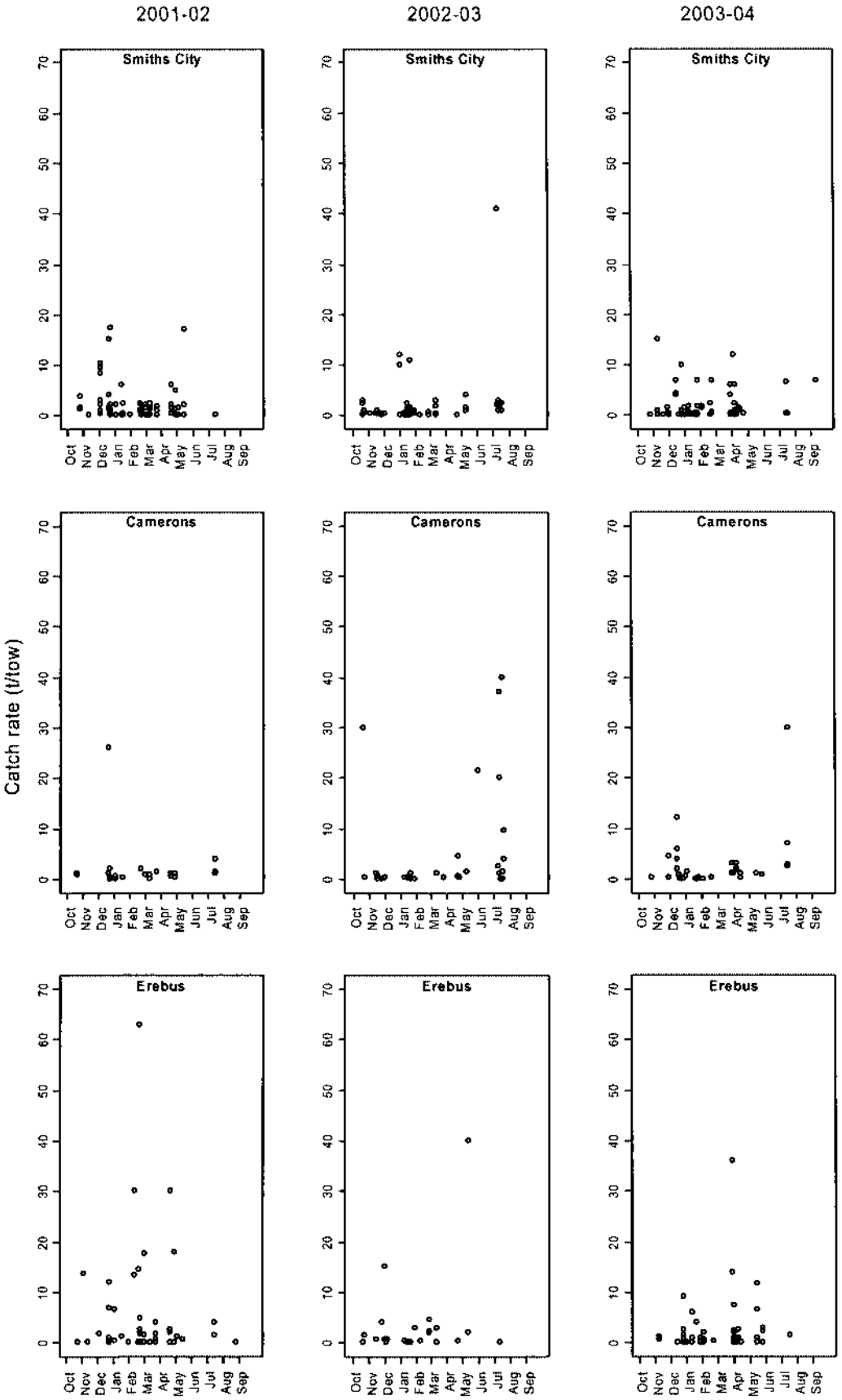

Figure 14: Unstandardised catch rate profiles (t/tow) of orange roughy in NECR by subarea or feature, 2001–02 to 2003–04, for tows <=30 minutes in duration.

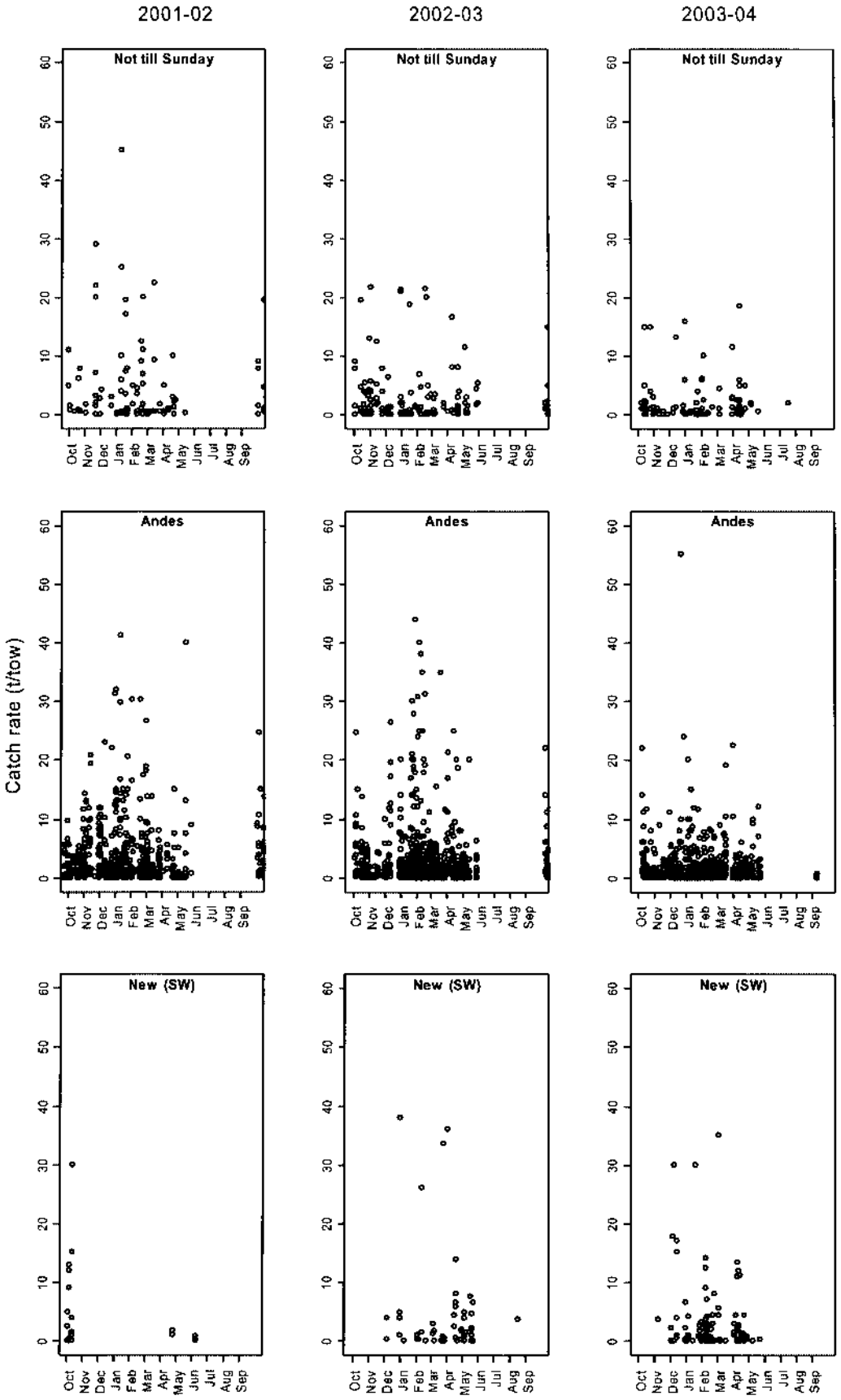

Figure 14 (cont.): Unstandardised catch rate profiles (t/tow) of orange roughy in NECR by subarea or feature, 2001–02 to 2003–04, for tows <=30 minutes in duration.

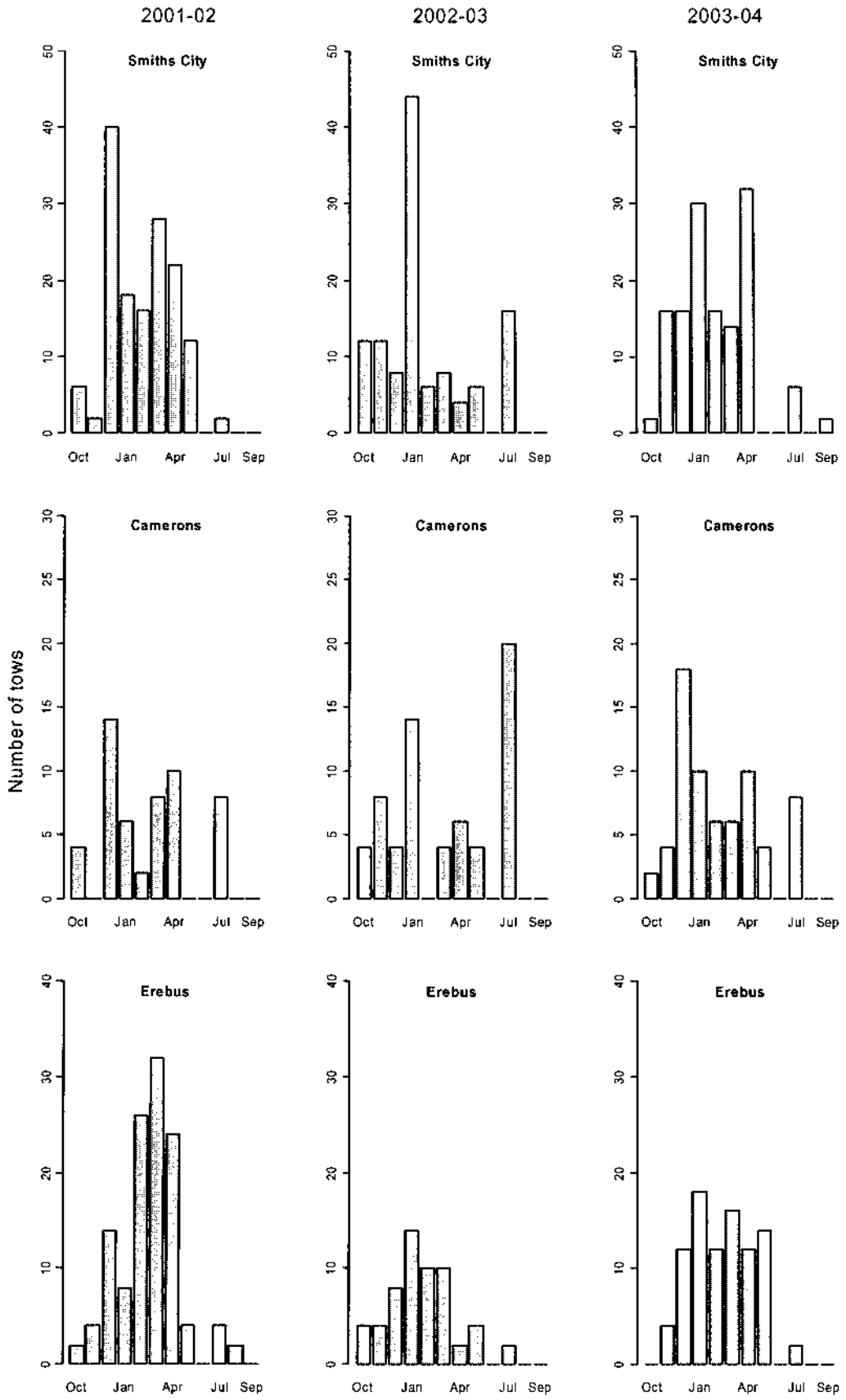

Figure 15: Monthly effort (tows) targeting orange roughy in the NECR by subarea or feature, 2001–02 to 2003–04, for tows <=30 minutes in duration.

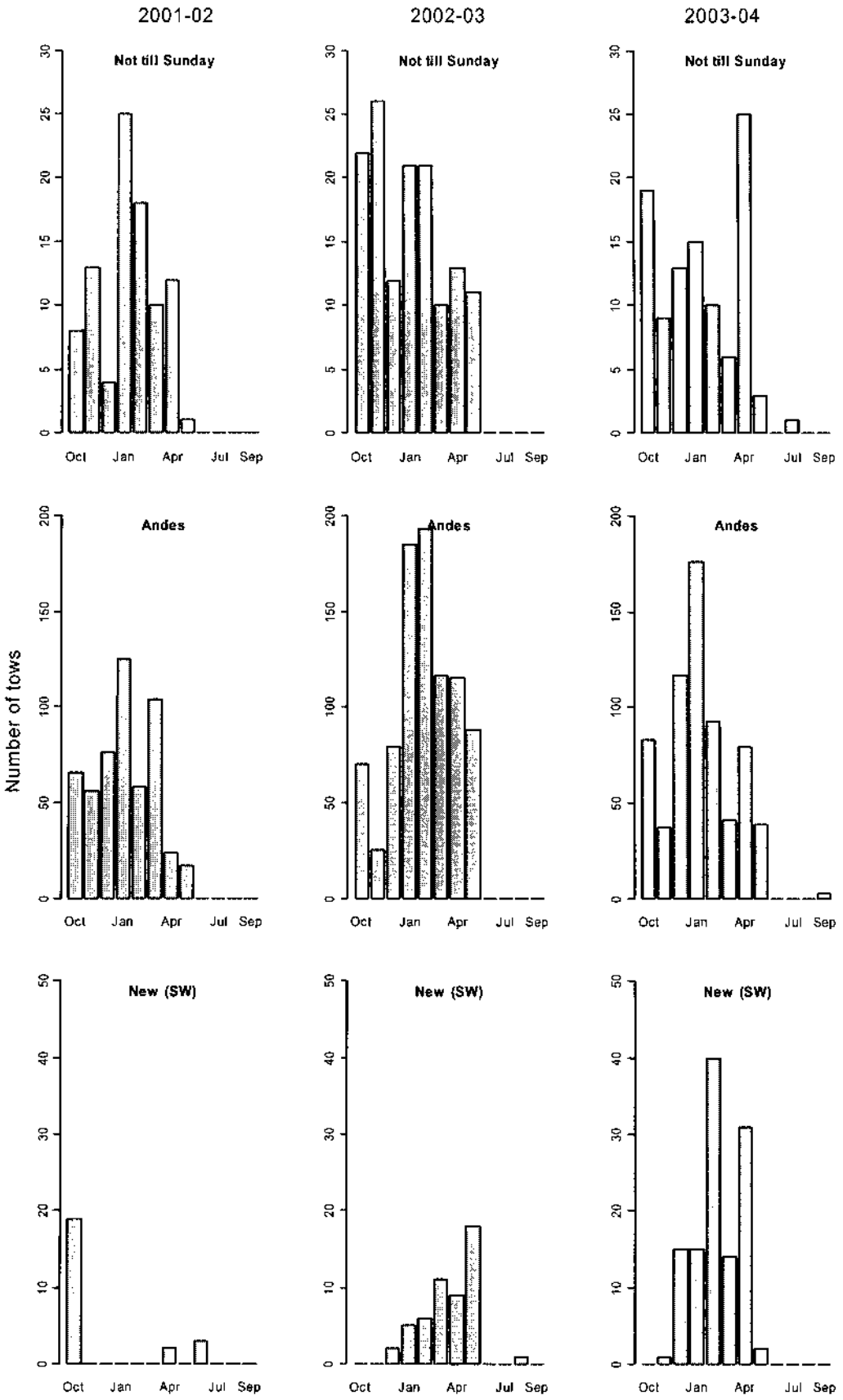

Figure 15 (cont.): Monthly effort (tows) targeting orange roughy in the NECR by subarea or feature, 2001–02 to 2003–04, for tows <=30 minutes in duration.

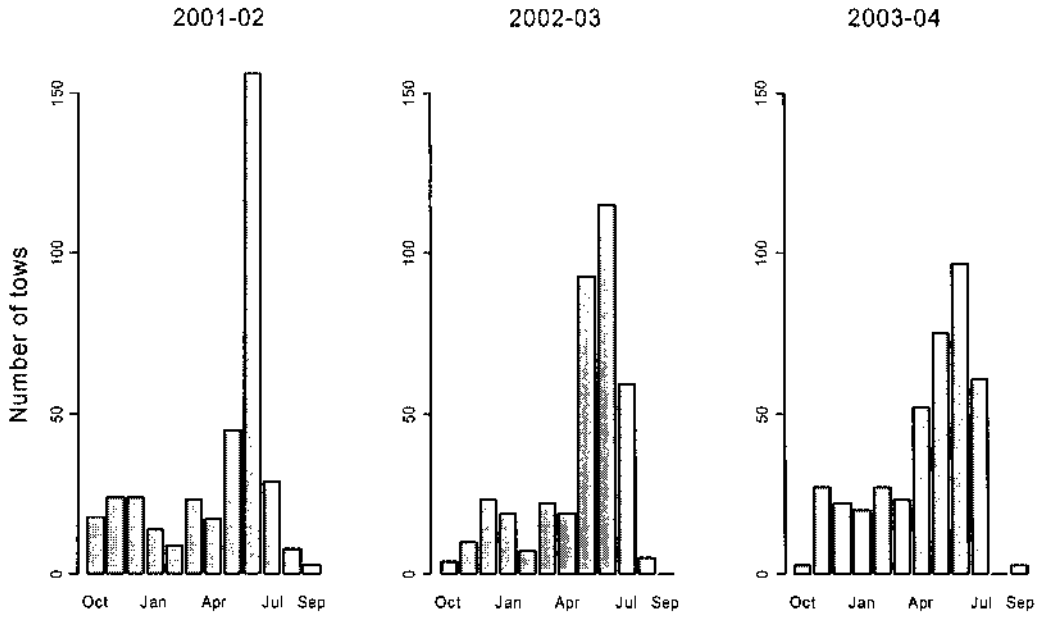

Figure 16: Monthly effort (tows) targeting orange roughy in the NECR in the Spawning Box, 2001–02 to 2003–04, for all tows.

6.3 Southern ORH 3B fisheries (south of 46° S) and Arrow Plateau

Nine major fishing grounds are recognised in the southern/exploratory area of ORH 3B (Figure 17).

- **Antipodes.** An area of small seamounts (e.g., Barbaras, Bob's Knob) within the boundary of 49° 00'–50° 30' S and 174° 00'–177° 00' E. Although the fishery has been termed "Antipodes" by the fishing industry, the position of the fishery is on the eastern margin of the Pukaki Rise.
- **Auckland Islands.** A complex of small seamounts (e.g., Barbara Thomas, DSW, Jenny Shipley) northwest of the Auckland Islands within the boundary of 49° 50'–50° 20' S and 165° 40'–166° 10' E.
- **Bounty Platform.** An area of undulating bottom with numerous peaks and drop-offs on the slopes north of the Bounty Islands within the boundary of 46° 30'–48° 00' S and 177° 30' E–180° 00'. It is mainly a target oreo fishery, with the occasional large catch of orange roughy.
- **Macquarie Ridge.** A long ridge southwest of Puysegur Bank lying south of 48° 30' S and west of 165° 00' E. Macquarie Ridge is mainly an oreo fishery.
- **Puysegur Box.** An area of small hills (e.g., Goomzy, Godiva, Malcolm's Monument, Acne) and drop-offs (e.g., Alistair's) within the boundary of 46° 00'–47° 30' S and 165° 00'–166° 30' E.
- **Snares.** A large elongated seamount (Bob's Gun) off the Snares Islands with two smaller features to the west, lying within the boundaries of 47° 45'–48° 15' S and 164° 50'–166° 20' E. Snares is mainly an oreo fishery.
- **Pukaki.** An area of small hill features on the northern edge of the Pukaki Rise, within the boundary of 47.5–49.0° S, 174–176° E.
- **Fiordland.** An area of the west coast of the South Island, lying between the boundaries 44° 20'–46° S and 166°–168° E
- **Arrow.** A small plateau to the northeast of the Chatham Rise, lying between latitudes 44° S and 46° S and bounded in the west at 173° W and in the east by the perimeter of the EEZ.

Of all these fisheries, a stock assessment has been carried out only for the Puysegur area, in 1998 (Sullivan et al. 2005).

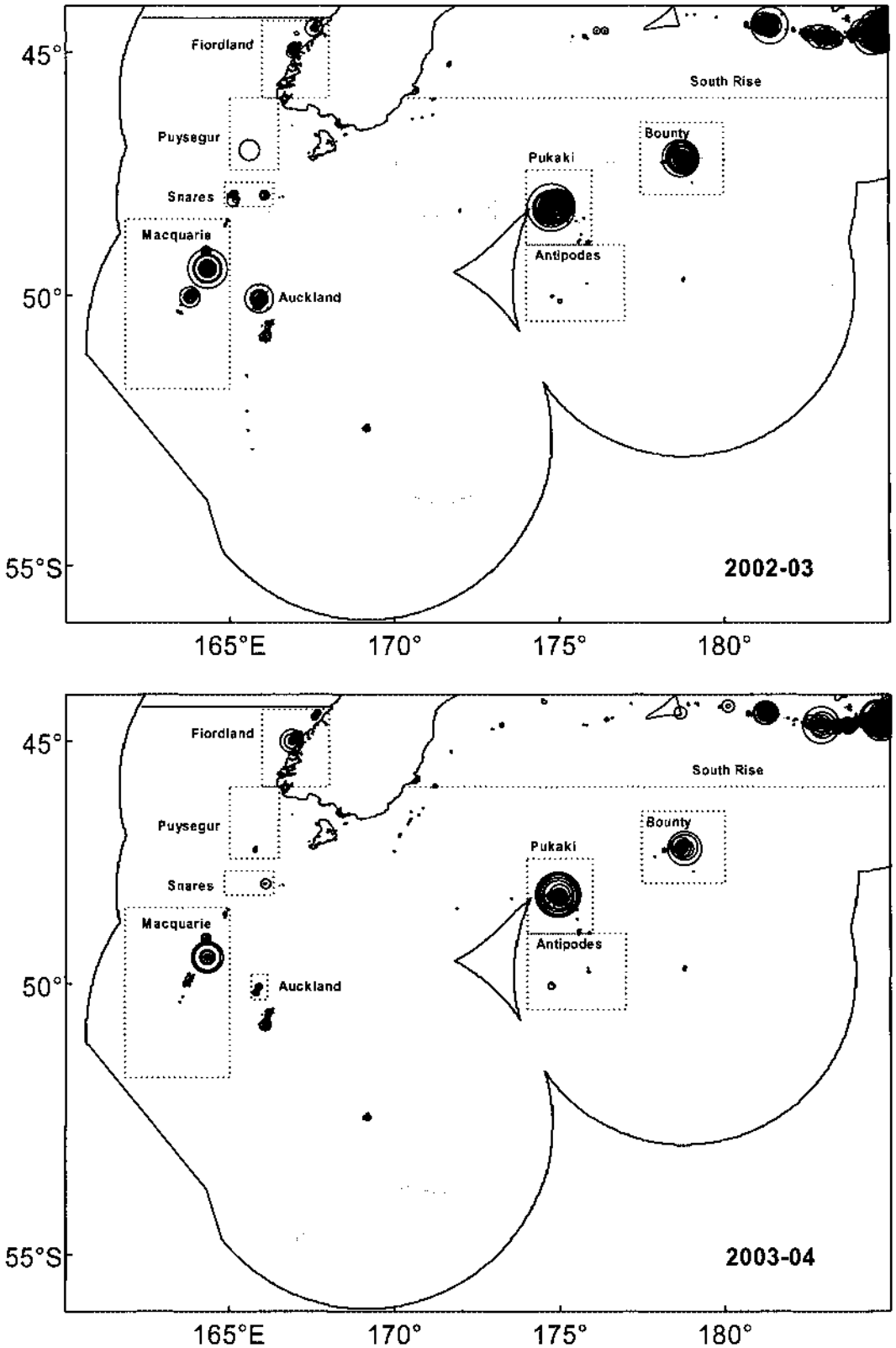

Figure 17: Distribution of trawl positions and unstandardised catch rates (circles, t per tow) for orange roughy targeted or caught in the southern ORH 3B area during 2002–03 and 2003–04 (circle area is proportional to catch rate; maximum is 65 t).

6.3.1 Total catch

The non-Chatham fisheries developed in the early 1990s, and were initially dominated by catches from Puysegur (Table 21). Voluntary closure of the Puysegur fishery by the Orange Roughy Management Company since 1997–98 resulted in zero catch of orange roughy during 1997–98 and 1998–99. In 1999–2000 and 2000–01, 7 t and 34 t respectively were taken as bycatch of oreo target fishing. No catches of orange roughy were then reported for 2001–02, but 12 t was reported from a single tow in 2002–03 and 5 t was reported from 23 tows targeting oreos in 2003–04 (Table 21).

Following the discovery of the Puysegur fishery, the Snares, Auckland Islands, Arrow Plateau, Bounty Platform, and Antipodes fisheries developed and produced peaks of high catches during the mid 1990s, but catches in all these areas have subsequently decreased. In 2000–01, some large catches were taken off Fiordland and in the following year in Pukaki. In 2001–02, about 51% of the non-Chatham catches were taken in the Pukaki fishery, and this remained the largest fishery in the area over the following two years, accounting for about 36% and 51% of the catch in 2002–03 and 2003–04 respectively. Most of the remaining southern ORH 3B catch in 2003–04 came from the Arrow fishery (15%), and the Bounty and Macquarie fisheries (both 13%). The catch taken at the Auckland Islands, accounting for about a third of the southern ORH 3B catch in the late 1990s and early 2000s, amounted to only 9 t (or 1%) of the 2003–04 catch in the area. Catches in Fiordland have also declined rapidly, to only 10% of the level of three years ago.

Although the Arrow Plateau fishery is geographically part of the Chatham Rise, it is not generally included when referring to the Chatham Rise fisheries, and catch limits for this fishery have in the past been combined with southern ORH 3B fisheries. The fishing grounds and hill features are relatively deep, and catches have generally been small. The Arrow Plateau is a dedicated target fishery, with all tows in the past 11 fishing years recording orange roughy as the target species, and a low bycatch fraction in most years (Table 21). The catch has decreased in recent years, and in 2002–03 was about 215 t from 77 tows, and in 2003–04 was about 132 t from 78 tows.

In the Antipodes fishery, an exploratory commercial fishing trip found orange roughy concentrations in an area on the eastern margin of the Pukaki Rise in April 1996, and recorded a catch of about 200 t. This was quickly followed by full commercial fishing, and about 3400 t of orange roughy was taken in 1995–96 (Table 21). There was a dramatic decline in catch to 717 t in 1996–97, and further to only 1 t in 2000–01. There were no catches or effort in 2001–02, and only about 2 t was recorded from a handful of tows in each of the last two fishing years.

Table 21: Summary statistics from the main non-Chatham Rise fishing locations. Note: catches are unadjusted (i.e., not scaled to the QMR total). Catch per tow and bycatch fraction are only calculated where the number of tows is greater than 10 (–, not calculated).

	Total fishery		ORH target fishery				
Area & fishing year	Number of tows	Catch of ORH	Number of tows	Catch of ORH	Catch of OEO	ORH catch per tow (t)	*Bycatch fraction
Auckland Is							
1993–94	158	206	154	177	264	1.1	1.5
1994–95	273	1 285	178	837	341	4.7	0.4
1995–96	249	405	239	372	425	1.6	1.1
1996–97	116	135	109	118	191	1.1	1.6
1997–98	193	372	187	363	276	1.9	0.8
1998–99	249	544	219	439	426	2.0	1.0
1999–00	174	235	132	151	264	1.1	1.7
2000–01	81	82	68	64	79	0.9	1.2
2001–02	71	158	58	132	127	2.3	1.0
2002–03	58	67	22	2	17	0.1	9.0
2003–04	39	9	25	4	47	0.2	11.8
Arrow							
1993–94	57	472	57	472	59	8.3	0.13
1994–95	252	746	252	746	44	3.0	0.06
1995–96	50	169	50	169	6	3.4	0.04
1996–97	152	279	152	279	15	1.8	0.05
1997–98	125	209	125	209	27	1.7	0.13
1998–99	157	575	157	575	14	3.7	0.02
1999–00	126	237	126	237	41	1.9	0.17
2000–01	78	184	78	184	17	2.4	0.09
2001–02	44	55	44	55	6	1.2	0.11
2002–03	77	215	77	215	15	2.8	0.07
2003–04	78	132	78	132	8	1.7	0.06
Antipodes							
1995–96	316	3 428	302	2 975	1 439	9.9	0.5
1996–97	601	717	595	650	2 660	1.1	4.1
1997–98	212	372	169	123	452	0.7	3.7
1998–99	74	124	59	56	60	0.9	1.1
1999–00	40	2	28	0.1	46	0.01	460.0
2000–01	13	1	8	0	2	–	–
2001–02	0	0	0	–	–	–	–
2002–03	13	2	0	–	–	–	–
2003–04	11	2	6	0	6	–	–
Bounty							
1993–94	10	4	0	–	–	–	–
1994–95	19	54	5	0	28	–	–
1995–96	73	225	34	0.4	38	0.01	95.0
1996–97	53	147	14	22	3	1.6	0.1
1997–98	132	281	111	235	357	2.1	1.5
1998–99	211	181	168	152	181	0.9	1.2
1999–00	89	191	71	172	69	2.4	0.4
2000–01	74	150	55	147	143	2.7	1.0
2001–02	51	38	31	37	163	1.2	4.4
2002–03	71	196	35	119	40	3.4	0.3
2003–04	86	117	53	94	25	1.8	0.3

• catch of oreos (OEO) divided by catch of orange roughy (ORH) from tows targeting orange roughy (ORH).

(*Continued over*)

Table 21:—*Continued*

Area & fishing year	Total fishery		ORH target fishery				
	Number of tows	Catch of ORH	Number of tows	Catch of ORH	Catch of OEO	ORH catch per tow (t)	*Bycatch fraction
Macquarie							
1993–94	13	0	13	0	116	0	–
1994–95	2	2	1	2	8	–	–
1995–96	71	12	65	10	399	0.2	39.9
1996–97	75	11	69	5	170	0.1	34.0
1997–98	48	4	42	2	168	0.1	84.0
1998–99	76	40	33	28	88	0.8	3.1
1999–00	73	15	28	1	48	0.1	48.0
2000–01	231	510	142	358	120	2.5	0.3
2001–02	81	92	21	43	83	2.1	2.0
2002–03	100	187	25	39	14	1.5	0.3
2003–04	68	119	27	99	34	3.7	0.3
Pukaki							
2000–01	39	44	12	19	12	1.6	0.6
2001–02	42	623	19	549	7	28.9	0.01
2002–03	62	490	38	483	2	12.7	0.01
2003–04	128	457	100	453	6	4.5	0.01
Puysegur							
1993–94	1 264	2 579	1 259	2 377	1 830	1.9	0.8
1994–95	183	1 557	157	1 252	308	7.9	0.2
1995–96	318	804	302	728	266	2.4	0.4
1996–97	201	344	191	493	89	2.6	0.2
1997–98	0	0	0	–	–	–	–
1998–99	0	0	0	–	–	–	–
1999–00	17	7	0	–	–	–	–
2000–01	10	34	0	–	–	–	–
2001–02	2	0	0	–	–	–	–
2002–03	1	12	0	–	–	–	–
2003–04	23	5	0	–	–	–	–
Snares							
1993–94	349	41	333	34	1 721	0.1	50.6
1994–95	30	31	26	20	120	0.8	6.0
1995–96	78	9	77	8	667	0.1	83.4
1996–97	85	59	81	54	588	0.7	10.9
1997–98	82	161	65	98	708	1.5	7.2
1998–99	92	92	29	38	77	1.3	2.0
1999–00	42	15	14	4	22	0.3	5.5
2000–01	46	24	14	15	19	1.1	1.3
2001–02	30	15	6	2	27	–	–
2002–03	33	14	0	–	–	–	–
2003–04	4	3	0	–	–	–	–
Fiordland							
1998–99	0	0	0	–	–	–	–
1999–00	7	2	0	–	–	–	–
2000–01	319	490	316	481	228	1.5	0.5
2001–02	117	223	117	223	39	1.9	0.2
2002–03	55	53	47	53	12	1.1	0.2
2003–04	35	49	35	49	2	1.4	0.04

* catch of oreos (OEO) divided by catch of orange roughy (ORH) from tows targeting orange roughy (ORH).

Catches from the Auckland Islands fishery peaked in the mid 1990s at about 1300 t (Table 21). Although catches have been variable since that period, they have generally declined, particularly in the last few years, with the 2003–04 catch only 9 t.

Small catches of orange roughy were reported from the Bounty Platform in the early 1990s as a bycatch in the developing oreo fishery. Catches increased rapidly to 225 t by 1995–96 and reached a peak of 281 t two years later. In 2001–02 catches were low with relatively low effort, but recovered in 2002–03 to a level similar to previous years (Table 21). Effort in 2003–04 was similar to the previous two years, with catches a little lower, at 117 t.

The Macquarie Ridge fishery has been mainly an oreo fishery in the past, and the mean annual oreo catch since 1995–96 has been 1400 t. The fishery typically produced small to moderate catches of orange roughy up until 2000–01 when over 500 t were caught. Catches have been about 100 t to 200 t in the last three years (Table 21). Effort and catches of orange roughy in 2003–04 were down on the previous year.

Orange roughy catches in the Snares fishery have generally been small and have fluctuated widely. Total catch has been under 100 t in most years (Table 21), except in 1992–93, when more than 500 t were taken, and 1997–98, when the catch was about 160 t. Catches and effort in 2003–04 were the lowest since the development of this fishery.

6.3.2 Distribution of catch and effort

The distribution of effort and catches are shown in Figure 17. In general, the geographical distribution of catch and effort was similar in the past two years, although no large catches were reported from the Auckland Island fishery in 2003–04. The largest catches in the last two fishing years have been made in the Antipodes, with some catches approaching 50 t. Moderate to large catches have also been made, less frequently, in the Bounty and Macquarie fisheries. The Pukaki Rise received the most targeted effort, followed by the Arrow Plateau and the Bounty Plateau (Table 21).

6.3.3 Catch rates

6.3.3.1 Annual catch rates

In the Arrow Plateau, unstandardised catch rates have dropped from the peak of 3.7 t/tow in 1998–99 to between 1.2 and 2.8 t/tow over the last four years. The catch rate of 1.7 t/tow for the 2003–04 fishing year is one of the lowest recorded for this fishery.

In the Auckland Islands fishery, unstandardised catch rates have been variable, but reached a peak in 1997–98 and 1998–99 at about 2 t/tow, before declining for two years, and then increasing to 2.3 t/tow in 2001–02 (Table 21). However, in 2002–03 the effort, catch, and catch rate dropped to the lowest recorded and this pattern persisted in 2003–04. In the Antipodes fishery, unstandardised catch rates in 1999–2000 were only 0.1% of the catch rate in 1995–96 (Clark et al. 2003). There were no tows targeting orange roughy in either 2001–02 or 2002–03 and only six tows in 2003–04 (Table 21).

On the Bounty Platform, catch rates have varied considerably between years. The number of tows, and more substantially the unstandardised catch rate, declined from 2000–01 to 2001–02. In 2002–03 effort increased slightly, and catches increased substantially, to give the highest recorded catch rate for this fishery (Table 21). Effort continued to increase in 2003–04, but catch rates returned to previous levels. In the Macquarie Ridge fishery, effort, catch, and catch rate increased markedly in 2000–01. In 2001–02, effort, catch, and catch rate declined, returning to levels not much greater than those of previous years. Effort remained at a similar level for the last two fishing years, but catch rates have fluctuated and were at an all-time high of 3.7 t/tow in 2003–04 (Table 21).

In contrast to the nearby Antipodes fishery, the catch rate increased in the Pukaki fishery, from 1.6 t/tow in 2000–01 to an exceptionally high level of 28.9 t/tow in 2001–02 (Table 21). In 2002–03 effort increased further but catches, and therefore catch rates, were reduced, although catch rates still remained almost an order of magnitude higher than those recorded in other areas. Effort more than doubled in 2003–04, while total catch declined slightly, and catch rates declined considerably. In the Snares fishery, the catch rate has been low and variable between years, but effort declined to a relatively low level in 2001–02 and 2002–03, with no tows targeting orange roughy in 2002–03 or 2003–04 (Table 21).

6.3.3.2 Seasonal catch rates

In the non-Chatham Rise fisheries, effort is scattered throughout the year, with sporadic effort in most fisheries except for the Arrow Plateau, where some fishing activity takes place in most months (Figure 18). Large catches (over 20 t/tow) were recorded in October in Pukaki, in January in Arrow Plateau, in August in Bounty Plateau, and in December in Macquarie.

In the Auckland Islands, the seasonal patterns of effort and catches were roughly similar in 2002–03 and 2003–04, with most effort at the beginning and end of the fishing year. High catch rates (over 5 t/tow) were made in August in 2002–03, but were not seen in any month in 2003–04. In the Antipodes fishery, the low level of effort showed no consistent pattern between the two years and catches were all low (Figure 18).

On the Bounty Platform, most effort and catches were at each end of the fishing year in both 2002–03 and 2003–04 and large catches were made in September, October, and December. In the Macquarie Ridge fishery, effort was concentrated in the first half of the year, between October and March, in both fishing years, with highest catch rates in November and December (Figure 18).

In the Pukaki fishery, almost all effort and high catch rates occurred during October in 2002–03 and 2003–04 and many catches of over 40 t/tow were made in both years. In Fiordland, fishing activity was limited to November, June, and September in 2002–03 and to June and September in 2003–04 (Figure 18).

There was no clear pattern of effort or high catch rates in the Snares fishery in 2002–03. Effort was spread out over much of the year in 2002–03, with no catches greater than 1 or 2 tonnes, and was restricted to a few tows in August in 2003–04 (Figure 18).

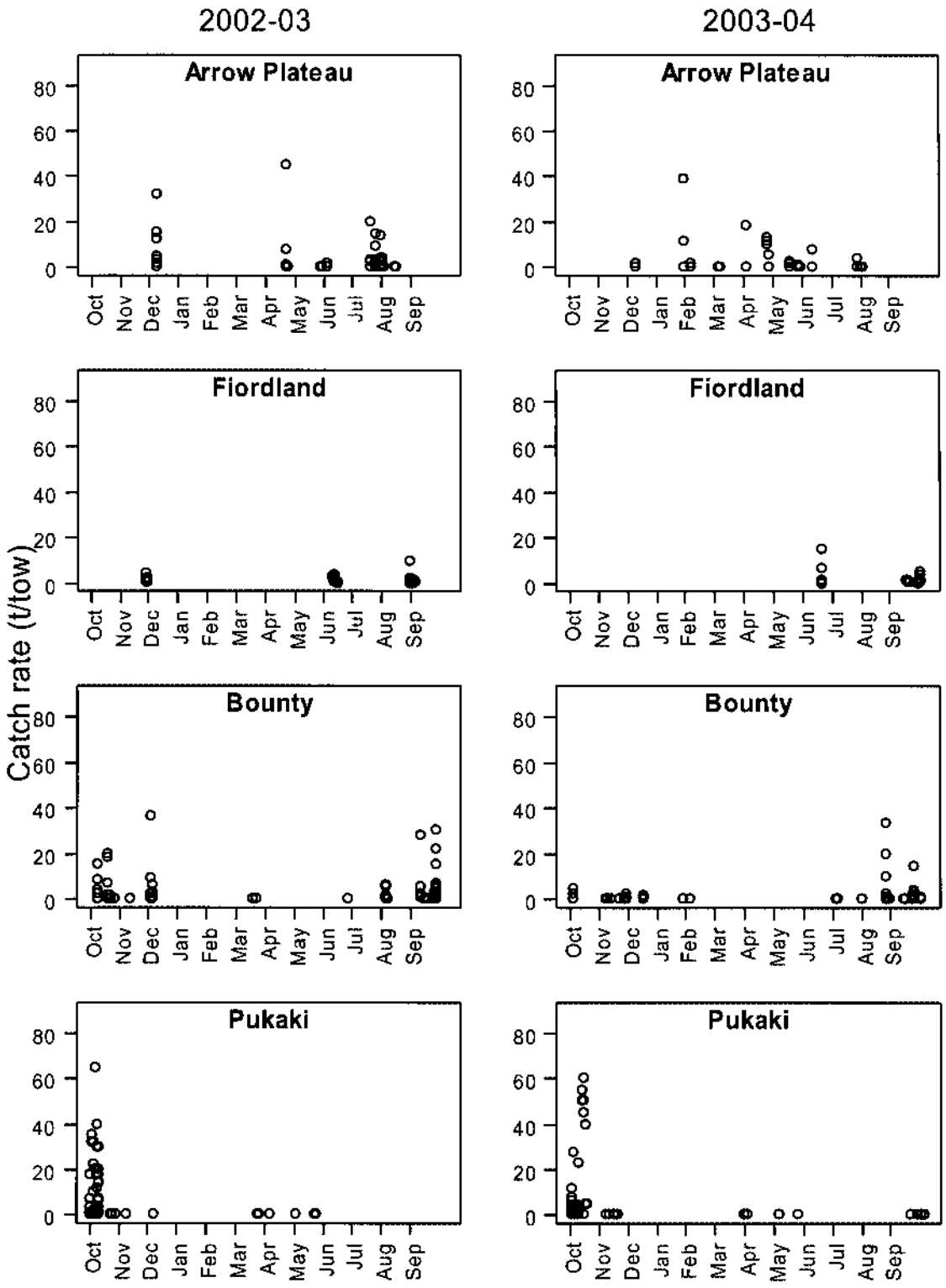

Figure 18: Unstandardised catch rate profiles (t/tow) of orange roughy in the exploratory/southern ORH 3B stocks for 2002–03 and 2003–04.

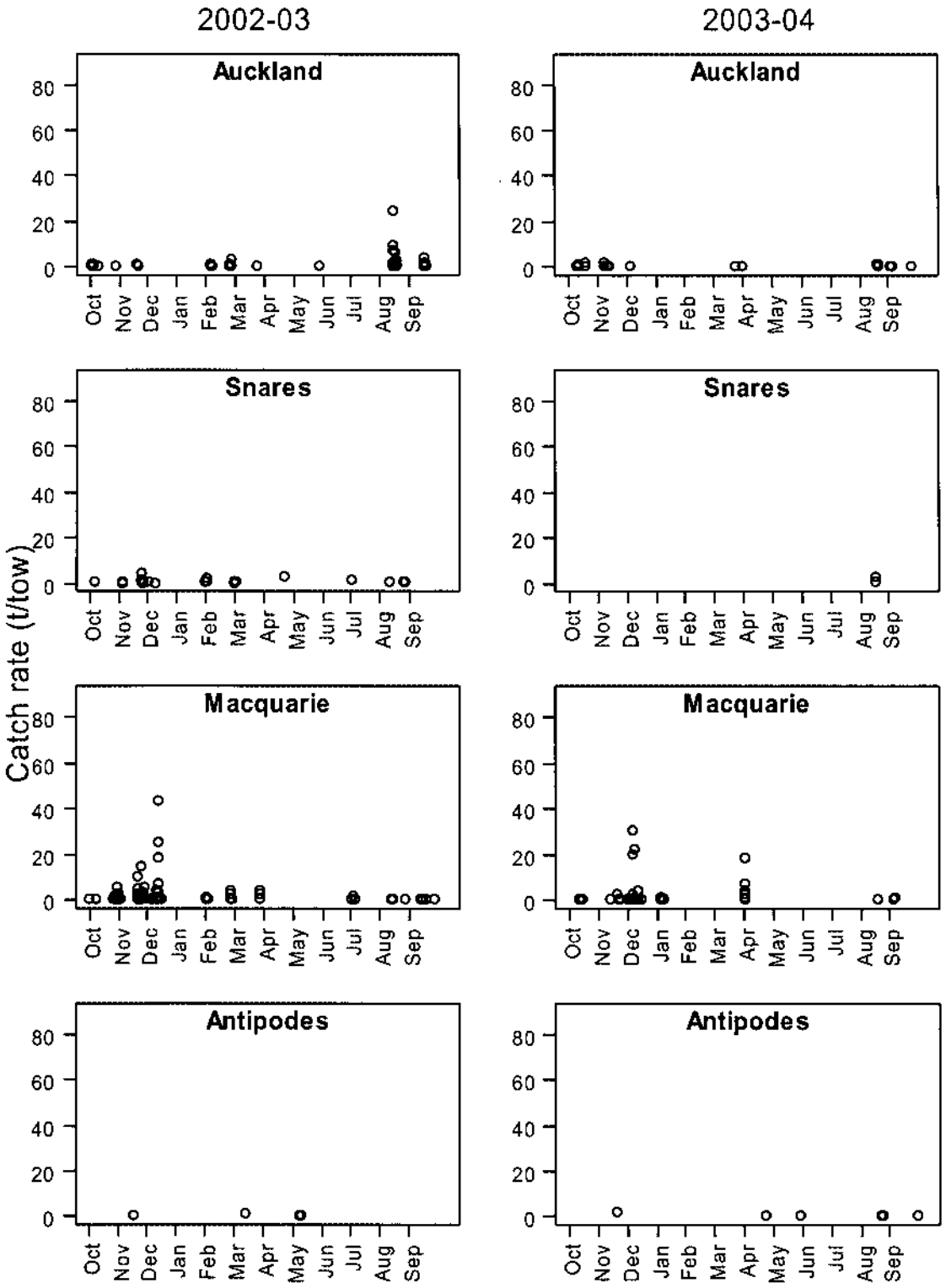

Figure 18—*continued*. Unstandardised catch rate profiles (t/tow) of orange roughy in the exploratory/southern ORH 3B stocks for 2002–03 and 2003–04.

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7. WEST COAST SOUTH ISLAND

Quota Management Area ORH 7B covers an area off the west coast of the South Island from near Westport to south of Jackson Head (Figure 19). The west coast South Island fishery is defined as the area between latitudes 42° and 44.25° S, and longitudes 166° and 171.5° E. A large, and increasing, fraction of the catches in this fishery are reported on the daily-summary CELR catch-effort forms, which generally only record tow positions to statistical area. This fishery includes statistical (or "domestic fishing return") areas 033, 034, 705, 706, and the northern part of 032 (Figure 19). The most recent stock assessment was conducted in 2004 (McKenzie 2005).

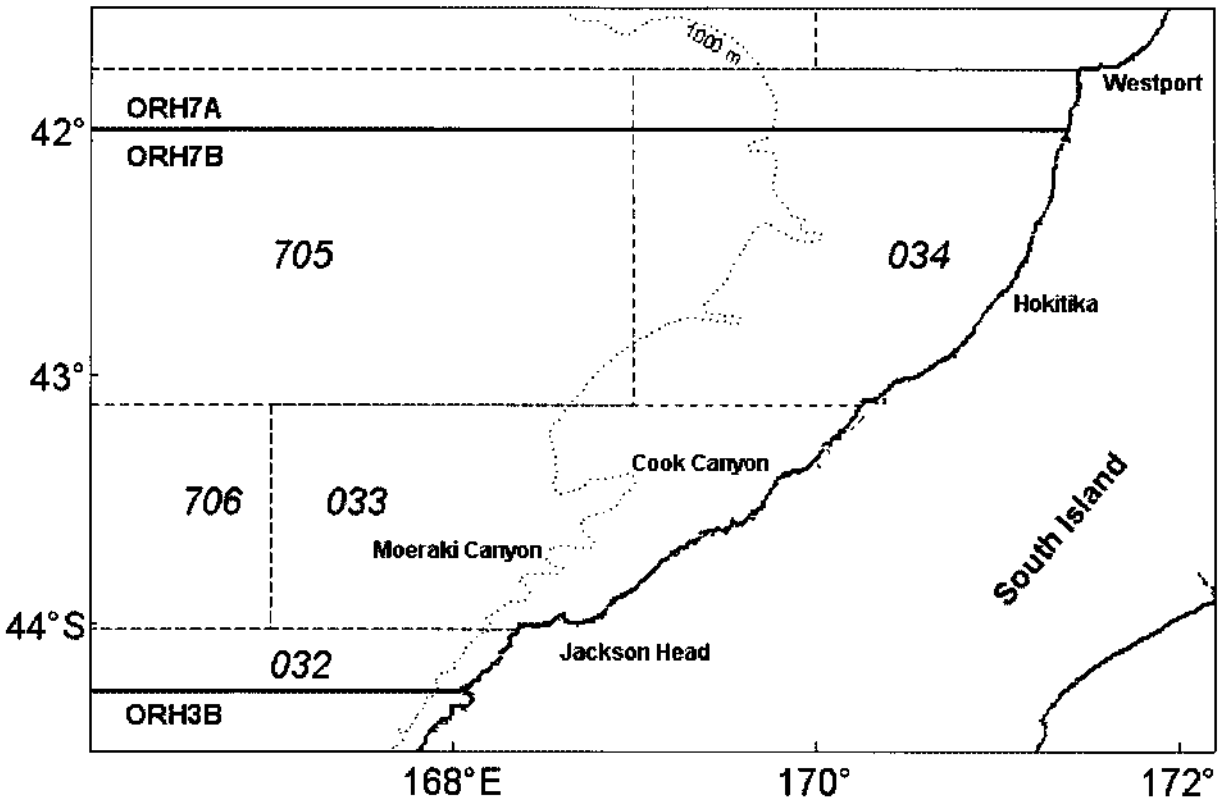

Figure 19: Location of the west coast South Island orange roughy fishery showing the extent of the ORH 7B QMA, and also the domestic fishing return areas (statistical areas).

7.1 Total catch

The fishery first developed in the mid 1980s, with a rapid increase in catches in 1985–86, when aggregations of spawning orange roughy were targeted in winter (Table 22). Catches from 1990–91 to 1994–95 fell increasingly below the TACC of 1708 t, and the TACC for 1995–96 was reduced to 430 t. This level of catch was achieved in the two following years, but catches fell steadily over the next four years and the TACC was further reduced in 2000–01 to 110 t. The reported catch of 119 t in 2003–04 is the highest in three years and the first time since 1995–96 that the TACC has been fully caught.

Table 22: Reported landings (t) of orange roughy and TACs (t) for ORH 7B from 1983–84 to 2003–04. "*" denotes FSU data; "‡" QMS data, reproduced from Sullivan et al. (2005).

Fishing year	Catches	TACC
1983–84*	2	–
1984–85‡	282	–
1985–86‡	1 763	1 558
1986–87‡	1 446	1 558
1987–88‡	1 413	1 558
1988–89‡	1 750	1 708
1989–90‡	1 711	1 708
1990–91‡	1 683	1 708
1991–92‡	1 604	1 708
1992–93‡	1 139	1 708
1993–94‡	701	1 708
1994–95‡	290	1 708
1995–96‡	446	430
1996–97‡	425	430
1997–98‡	330	430
1998–99‡	405	430
1999–00‡	284	430
2000–01‡	161	430
2001–02‡	95	110
2002–03‡	90	110
2003–04‡	119	110

7.2 Distribution of catch and effort

There have been significant changes in the geographical distribution of effort over the course of the fishery. Initially, effort was concentrated in a very small area at the intersection of statistical areas 033, 034, and 705, near Cook Canyon (Figure 19). This fishing pattern was repeated for several years until 1992–93 when effort became more dispersed as vessels were forced to search more widely throughout the QMA in order to catch the available quota (see Dunn et al. (2005) for a more detailed examination of catch and effort). This more dispersed pattern of fishing effort throughout ORH7B has persisted through to the 2003–04 fishing year (Figure 20). The decline in fishing effort and catch (only 17 tows in 2003–04, all less than 1 t) shown by the reducing number of points in Figure 20 is exaggerated by the trend of decreasing use of TCEPR catch effort forms and increasing use of CELR forms in this fishery. As tow coordinates are usually not given on CELR forms, these plots represent TCEPR recorded tows only. As Figure 21 shows, TCEPR forms have always represented less than 80% of the trawls in any year, less than 35% over the last 7 years, and only 12% and 7% in 2002–03 and 2003–04 respectively.

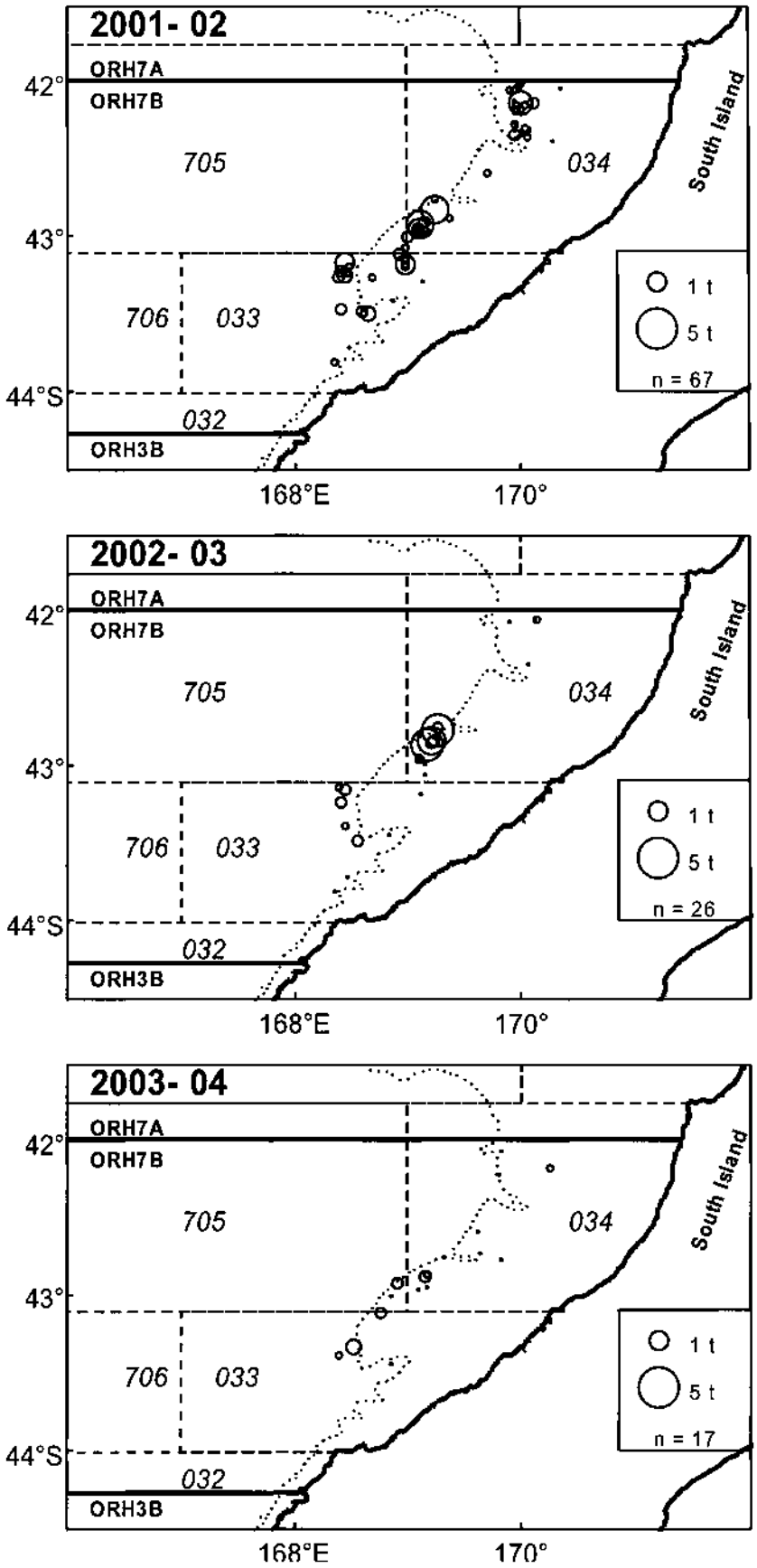

Figure 20: Unstandardised catch rates of tows which targeted or caught orange roughy in the west coast South Island fishery 2001–02 to 2003–04, from TCEPR records only. Circle area is proportional to t/tow, n, number of tows.

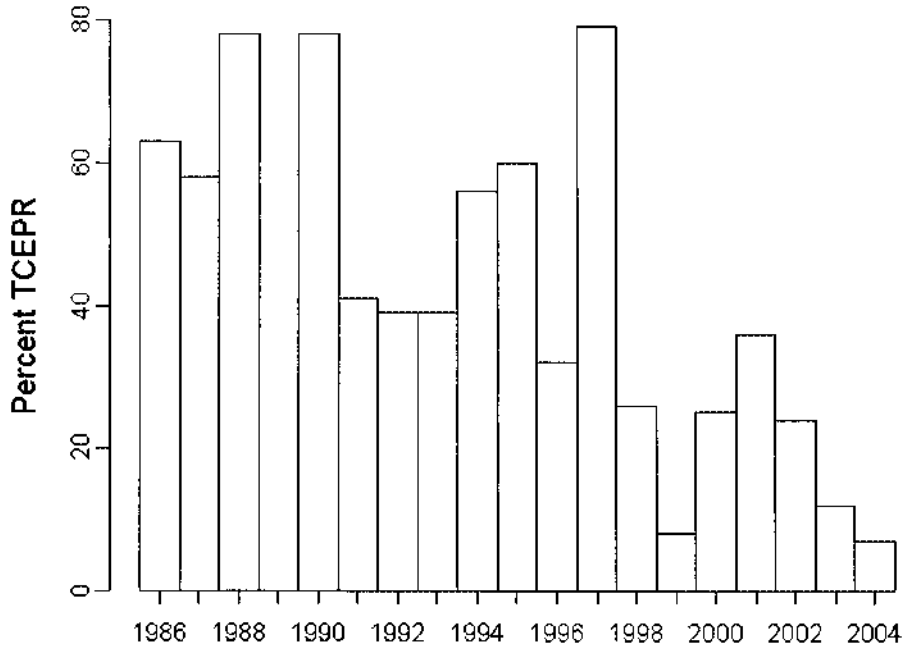

Figure 21: Percentage of trawls in each fishing year (1985–86 to 2003–04) which were recorded on TCEPR forms, and therefore included detailed position information.

Historically, most effort (Table 23) and catch (Table 24) in ORH 7B has been concentrated in the winter spawning period (June and July) with a smaller, secondary peak in catch and effort in September and October. After 1996–97, effort has tended to be more spread throughout the year.

Table 23: Monthly distribution of effort (number of tows) in the west coast South Island orange roughy fishery, from combined TCEPR and CELR records.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1985–86	129	4	0	9	2	0	24	45	104	4	8	28
1986–87	111	14	0	0	1	0	2	1	238	2	33	3
1987–88	0	0	0	2	0	0	0	23	359	30	6	0
1988–89	0	0	0	0	0	0	0	43	229	11	51	34
1989–90	0	0	4	0	0	0	21	0	204	77	50	0
1990–91	88	26	3	22	2	0	12	77	228	115	4	55
1991–92	26	16	0	0	0	3	0	24	416	285	39	1
1992–93	72	0	0	0	0	0	0	43	185	436	15	33
1993–94	28	15	5	27	9	11	5	7	206	367	22	6
1994–95	2	21	15	13	2	13	1	35	76	149	24	10
1995–96	11	4	0	0	0	1	0	2	53	79	0	0
1996–97	6	1	0	2	0	0	0	7	127	39	0	0
1997–98	14	2	3	3	0	7	8	3	77	47	1	63
1998–99	33	28	12	48	11	42	25	25	128	76	0	138
1999–2000	22	23	12	15	4	10	79	65	208	96	16	97
2000–01	1	21	7	0	4	4	15	50	188	60	21	71
2001–02	1	6	0	16	0	21	14	17	44	64	20	79
2002–03	0	0	0	6	0	11	15	44	81	4	15	43
2003–04	12	8	28	24	5	4	21	48	87	2	1	11

Table 24: Monthly distribution of reported catch (t) in the west coast South Island orange roughy fishery. Blanks indicate months when there was no effort from combined TCEPR and CELR records (see Table 23).

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1985–86	419	1		15	1		22	68	855	91	9	64
1986–87	144	0			1		0	0	994	19	44	48
1987–88				0				78	888	210	75	
1988–89								85	535	116	81	9
1989–90			6				14		248	827	188	
1990–91	184	34	12	30	1		3	62	474	734	12	111
1991–92	6	6				0		3	659	879	48	0
1992–93	30							17	494	531	19	36
1993–94	33	7	10	5	13	1	1	2	106	375	86	22
1994–95	0	43	10	3	2	5	0	8	76	164	3	3
1995–96	2	0				2		0	156	114		
1996–97	2	0		2				5	203	33		
1997–98	20	0	0	0		1	1	0	28	57	0	62
1998–99	45	31	7	22	2	10	10	3	94	68		69
1999–2000	7	12	7	4	0	1	27	13	91	57	3	38
2000–01	0	13	1		0	1	3	20	56	28	15	23
2001–02	0	1		5		11	3	4	16	18	4	15
2002–03				4		5	6	12	41	4	3	12
2003–04	3	3	13	11	2	2	6	12	54	0	0	13

7.3 Annual fluctuation in effort

Total annual effort has fluctuated considerably during the course of the fishery (Table 25). Relatively steady levels of effort (120–140 fishing days per year) between 1985–86 and 1989–90 were replaced by first rapidly increasing, and then rapidly decreasing, effort over the next six fishing years, reaching a peak of 298 fishing days in 1993–94, and a low of 66 days two years later (Table 25) after a large reduction in the TACC (see Table 22). This pattern repeated over the next seven years, with another peak (213 days) in 1999–2000, followed by another low (80 days) in 2002–03 after a further drop in the TACC. Effort has increased only slightly from this low, to 88 days fishing in 2003–04. The drop in the number of fishing days and tows in 2001–02 coincides with the reduction in TACC in that year, but the earlier drop in effort occurred a year before the previous, large drop in the TACC (see Table 22). In the last five fishing years, the mean tow length has increased to about three times the initial level, and the mean towing speed has increased from about 2.8–3.0 knots to about 3.5–3.8 knots (Table 25). This indicates a change in the fishing practice in this area from short tows at a typical towing speed for orange roughy bottom trawling to longer, relatively fast tows. There has been no reduction in the number of tows per day, however, as the total towing time per day has also increased, from about 4–6 hours per day to 10–12 hours per day.

Table 25: Summary of combined TCEPR and CELR data. To combined form types, tow-by-tow data from TCEPR were condensed into the daily (CELR) format. * denotes TCEPR data only.

Fishing year	No. of vessel days	No. of tows	Total estimated catch (t)	Mean daily catch rate (t/tow)	Mean daily catch rate (t/hr)	Mean tow speed* (kt)	Mean tow duration* (h)	Mean tow length* (nm)
1985–86	138	357	1 544	4.5	2.9	2.3	1.8	4.4
1986–87	132	405	1 250	4.0	2.7	2.3	1.9	4.3
1987–88	132	420	1 250	3.4	2.3	2.8	1.6	4.6
1988–89	133	368	827	2.5	1.6	2.9	1.7	4.9
1989–90	123	356	1 282	4.5	5.6	2.8	1.6	4.4
1990–91	208	632	1 657	2.8	3.3	2.9	1.6	4.7
1991–92	238	810	1 601	2.0	1.4	2.9	1.9	5.4
1992–93	258	784	1 128	1.5	2.3	3.0	1.7	5.2
1993–94	298	708	660	1.1	0.9	2.8	2.3	6.6
1994–95	162	361	320	0.9	1.6	2.9	2.0	5.8
1995–96	66	150	275	2.2	1.7	2.9	2.1	6.1
1996–97	90	182	244	1.3	7.5	2.8	3.1	8.6
1997–98	96	228	170	0.7	0.3	2.8	2.5	7.0
1998–99	188	566	359	0.6	0.2	2.6	2.6	6.5
1999–2000	213	647	259	0.4	0.1	3.5	4.5	13.5
2000–01	149	442	162	0.4	0.1	3.5	3.5	10.4
2001–02	117	282	76	0.3	0.1	3.8	4.7	12.3
2002–03	80	219	86	0.4	0.2	3.8	3.6	12.2
2003–04	88	251	119	0.4	0.2	3.6	4.1	12.1

7.4 Unstandardised catch rates

Unstandardised catch rates have also fluctuated over time, with peaks in daily catch per hour in 1989–90 and 1996–97, but have remained relatively low and steady since 1997–98 (Figure 22), with the mean catch rates (both measures) of the last 6 fishing years being less than 10% of the catch rate at the start of the fishery. Unstandardised catch rates (mean daily catch per hour) have shown a different pattern over time to the standardised indices of McKenzie (2005), which are based on the same units, but the two series match closely over the five most recent overlapping years.

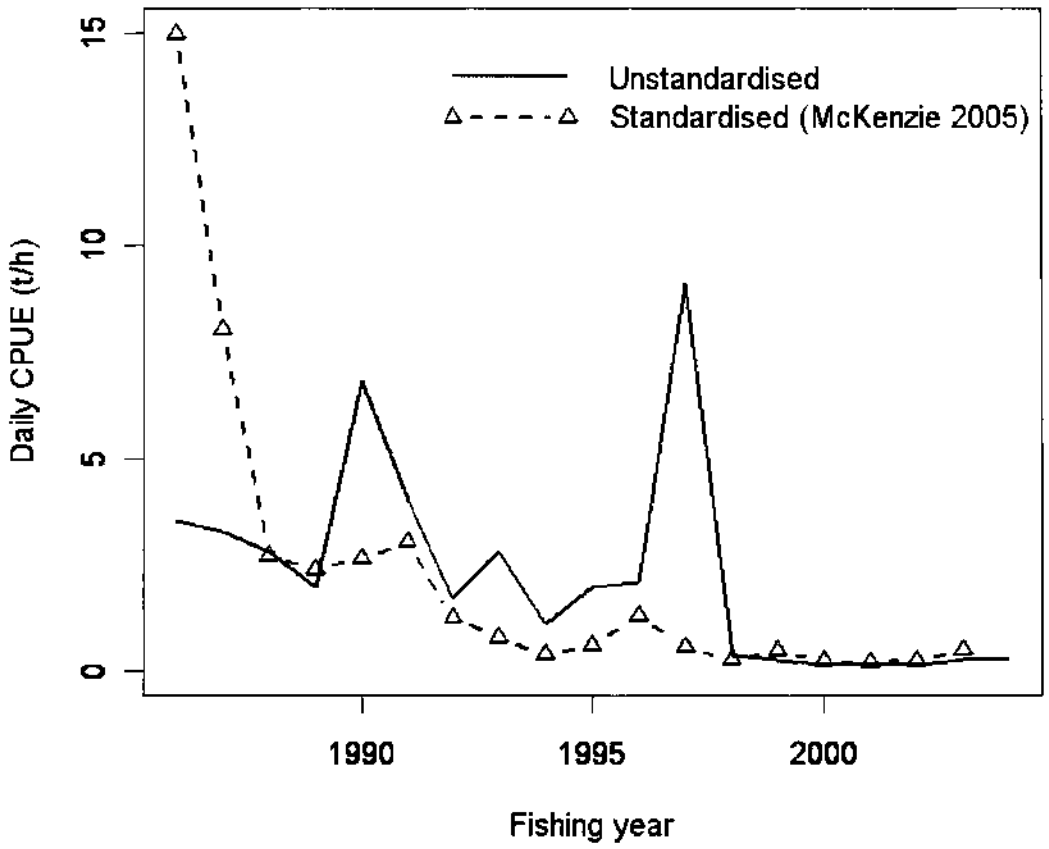

Figure 22: Unstandardised annual CPUE (mean daily catch (t) per hour) plotted alongside standardised indices used in the 2004 assessment (McKenzie, 2005) in the ORH 7B orange roughy fishery. The standardised CPUE indices have been scaled so as to have the same mean as the unstandardised catch rates.

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