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**Descriptive analysis of orange roughy fisheries in the
New Zealand region outside the EEZ:
Lord Howe Rise, Northwest Challenger Plateau,
West Norfolk Ridge, South Tasman Rise, and Louisville
Ridge to the end of the 2002-03 fishing year**

M. R. Clark

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EXECUTIVE SUMMARY

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Commercial catch and effort data for New Zealand vessels were obtained from the Ministry of Fisheries for the fishing years 2001–02 to 2002–03. The distribution of trawls confirmed the Lord Howe Rise, Northwest Challenger Plateau, and West Norfolk Ridge were the main areas of orange roughy catch in the Tasman Sea outside the New Zealand EEZ. A fishery on the Norfolk Ridge is a recent development, starting in 2001–02. The Louisville Ridge fishery continued to the east of New Zealand. The South Tasman Rise was not fished by New Zealand in the last two years. Catch data from Australian vessels fishing the five areas were provided by the Bureau of Resource Sciences in Canberra to the end of the 2003 calendar year.

Descriptive analyses of these fisheries were carried out. Total catch and levels of effort were summarised by month and by sub-area. The total catch by New Zealand vessels was similar in the three years, at 2500–3500 t. The Northwest Challenger Plateau and Louisville Ridge accounted for most of the catch (combined about 2 000–2 500 t each year), although their relative importance switched between 2000–01 and 2001–02. About 600 t was caught on the Norfolk Ridge in 2001–02, but this dropped to 35 t in 2002–03. There was no New Zealand catch on the South Tasman Rise or Southwest Indian Ocean in 2001–02, or 2002–03, although some fishing occurred in the South Atlantic Ocean. Catch rates on most grounds have remained relatively constant between years, although tow duration has increased in both Lord Howe Rise and Northwest Challenger fisheries. There was a substantial increase in effort and catch on the Northwest Challenger grounds in 2001–02, and, although effort remained high in 2002–03, catch and catch rates decreased. On the Louisville Ridge, catch and catch rates increased in 2002–03, but on the West Norfolk Ridge effort, catch, and catch rates decreased markedly.

1. INTRODUCTION

1.1 Overview

This report summarises commercial catch and effort information from New Zealand vessels for orange roughy fisheries outside the New Zealand EEZ. These areas include the Lord Howe Rise, Northwest Challenger Plateau, South Tasman Rise, Louisville Ridge, West Norfolk Ridge, and Southern Indian Ocean. Overall results are given for all years of the fisheries, but the most recent three fishing years, 2000–01, 2001–02, and 2002–03, are covered in more detail. This report therefore updates data given to the end of 2000–01 by Clark & O’Driscoll (2002), and for other Tasman Sea fisheries to the end of 2001–02 by O’Driscoll (2003) and Clark (2003a).

The work was carried out by NIWA in collaboration with the Bureau of Rural Sciences (BRS) as part of the Ministry of Fisheries research project ORH2003/03 (“Orange roughy fisheries outside the EEZ”). The specific objective was “To update descriptive analyses of commercial catch and effort data from orange roughy fisheries in the mid-Tasman Sea (Lord Howe Rise), Louisville Ridge, and South Tasman Rise with the inclusion of data up to the end of the 2002/03 fishing year”.

1.2 Description of the fishing grounds

The Lord Howe Rise extends from the northwestern margin of the Challenger Plateau, off the west coast of New Zealand, out to Lord Howe Island in the western Tasman Sea. The ridge is mostly in international waters, although it does extend into both the Australian and New Zealand EEZs. A major fishery for orange roughy developed on the Lord Howe Rise in 1988, and has progressively shifted to the Northwest Challenger Plateau (Figure 1). A number of countries fished the area in the late 1980s, but during the 1990s it has been fished mainly by New Zealand and Australian vessels.

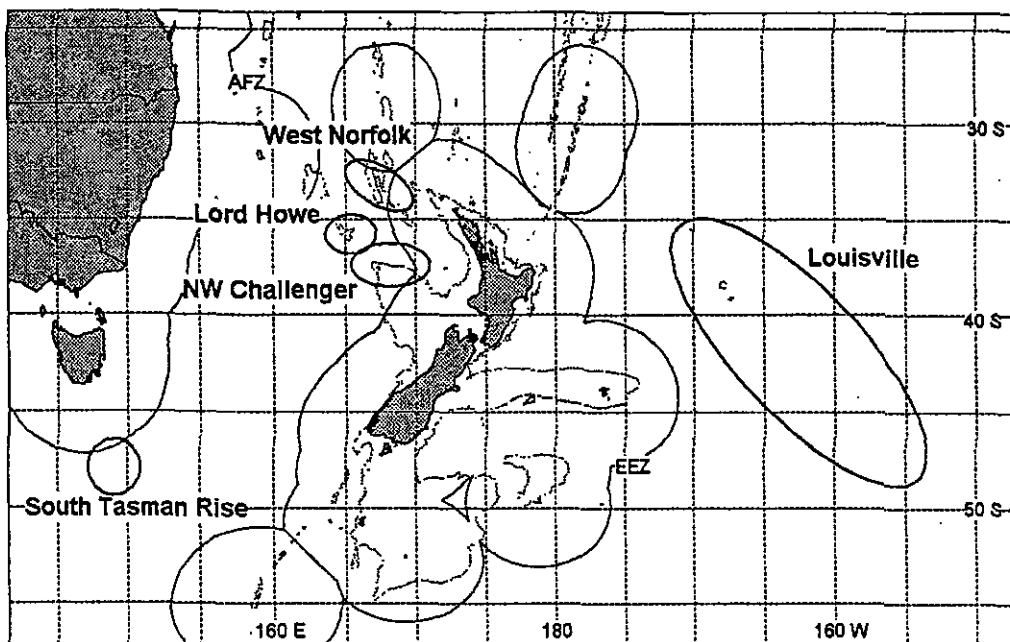


Figure 1: The New Zealand region, showing location of major fisheries for orange roughy outside New Zealand and Australian EEZs (1000 m depth contour shown around New Zealand).

New fishing grounds have recently developed on the West Norfolk Ridge, which runs northwest from the North Island towards New Caledonia. This comprises a chain of ridge peaks and seamount features both within (QMA ORH 1) and beyond the New Zealand EEZ.

The Louisville Ridge is a chain of seamount and guyot features extending southeast for over 4000 km from the Kermadec Ridge. It is a "hotspot" chain of more than 60 volcanoes, most of which rise to peaks of 200–500 m from the surrounding seafloor at depths around 4000 m. The Ridge is outside the New Zealand EEZ in international waters. The fishery dates from 1994.

The South Tasman Rise is a prominent ridge extending south from Tasmania into the Southern Ocean. It has a series of small peaks near its main summit at about 900 m just outside the Australian 200 mile Fishing Zone. A fishery developed for orange roughy in 1997, and it has since been fished mainly by Australian and New Zealand vessels. The fishery has been regulated by a Memorandum of Understanding between Australia and New Zealand since early 1998 which has limited the catches by vessels from the two countries.

1.3 Literature review

The Lord Howe Rise/Northwest Challenger fishery has been described in various assessment documents by Clark (1990, 1993, 1998a, 1998b), Clark & Tilzey (1996), Field (2000), O'Driscoll (2001), Clark & O'Driscoll (2002), and O'Driscoll (2003). These previous reports include summaries of commercial catch and effort data from New Zealand vessels, together with biological data on size structure and reproduction. A stock reduction analysis using CPUE indices to estimate biomass and indicate yields was carried out by Clark & Tilzey (1996). Field (2000) and O'Driscoll (2001, 2003) attempted similar stock reduction modelling including more recent data, but did not update estimates of virgin biomass. CPUE indices were not thought to be an appropriate estimate of abundance for Lord Howe and CPUE indices from the Northwest Challenger showed no decreasing trend over time.

The Louisville Ridge fishery has been described in recent years by Clark (1998c, 1998d, 1999, 2000, 2003b), and Clark & Anderson (2001, 2003). Standardised analyses of CPUE were carried out, but even when considered on an individual seamount basis, were not felt successful in tracking abundance of orange roughy. A "seamounts meta-analysis" was completed by Clark (2003c) which included estimates of virgin biomass based on the physical features of the fishing grounds.

Descriptive analyses of catch and effort data for the South Tasman Rise fishery were given by Tilzey (2000), Clark & Tilzey (2001), and Clark & O'Driscoll (2002). A standardised analysis by Wayte et al. (2001, 2003) showed a decline in catch rate over time. Echo-sounder surveys and biological sampling of the spawning grounds have been carried out in 2000 and 2001 (Prince & Diver 2001a, 2001b).

2. METHODS

2.1 Data sources

Data on catch and effort are recorded by all New Zealand registered deepwater fishing vessels (and charter vessels) on Trawl-Catch-Effort-Processing>Returns (TCEPR) and High-Seas Trawl-Catch-Effort>Returns (HS-CER). Australian vessels involved in the South East Fishery (SEF) report their catches in SEF logbooks. These both give tow-by-tow information, with specific location, duration, and estimated catch for each trawl. New Zealand data were obtained from the Ministry of Fisheries. Australian data were provided by the Australian Fisheries Management Authority (AFMA) to the Bureau of Rural Sciences (BRS) in Canberra, who in turn provided selected information for NIWA to combine with the New Zealand data. Available data where orange roughy or oreos were either caught

or targeted were extracted from the Ministry of Fisheries catch-effort database and loaded into a relational (Empress) database at NIWA in December 2003.

Data were error-checked. Obvious mistakes in position (e.g., large differences in start and finish coordinates) were corrected, as were positions well outside any other fished area where typing or recording mistakes could be resolved (by examining that vessel's tows in sequence). Data for the 2002–03 fishing year may be incomplete due to forms not yet supplied by fishing vessels and records not yet entered into the Ministry database. Records containing errors that couldn't be resolved or corrected were excluded from further analyses.

The fishery on the South Tasman Rise has been managed on the basis of quotas set from 1 March to 28 February. Therefore, where fishing year is referred to *for the South Tasman Rise fishery only*, it covers that period, and hence is not comparable with the New Zealand fishing year of October–September which is used for all the other fisheries.

2.2 Fishing area boundaries

The following coordinates were used to define fishing areas.

a) Lord Howe Rise

35°00' S – 36°45' S and 164°00' E – 167°00' E

b) Northwest Challenger Plateau

In this report there are two regions used for the Northwest Challenger fishery. The total area is between 36°50' S – 40°00' S and 166°00' E – 170°00' E, but excluding tows that fell within the New Zealand EEZ. Secondly, the area of the main target fishery (referred to as the "Core Area"), which is on the northern slopes of the Plateau, between 36°50' S – 38°00' S, and 166°00' E – 170°00' E (excluding tows within the EEZ).

c) West Norfolk Ridge

32°30' S – 34°30' S, 166°30' E – 168°10' E, excluding tows within the New Zealand EEZ.

d) South Tasman Rise

The area covered by this analysis is bordered by latitudes 46°00' S and 50°00' S, and longitudes 145°00' E to 150°00' E.

e) Louisville Ridge

Trawls on the Louisville Ridge have been clustered in three general areas for a number of analyses in this report (following the division by Clark 1998c, 1998d):

- North: from latitudes 35° S to 39.9° S, longitudes 165° W to 172° W.
- Central: latitudes 40° S to 44.9° S, longitudes 160° W to 167° W.
- South: latitudes 45° S to 50° S, longitudes 150° W to 159° W.

2.3 CPUE input data

Unstandardised CPUE analyses have been carried out for Lord Howe, Northwest Challenger, and Louisville fisheries as an update of previous work. Not all groomed data were included in these analyses. For Lord Howe and Northwest Challenger fisheries, CPUE indices were calculated using a sub-set of data from a group of core vessels in each fishery which had carried out 10 or more tows targeting orange roughy in each of at least two years to reduce the effect of novice vessels on the catch rate (after O'Driscoll 2003). In addition, the first four

years (1988–89 to 1991–92) of fishing at Northwest Challenger (when effort was low) were excluded from the analysis. Because catches showed a distinct seasonal pattern, a second set of CPUE indices for Northwest Challenger was calculated from a cropped data set of only tows less than 1 h conducted during June (peak spawning).

3. RESULTS

3.1 Location of the fisheries

The world-wide distribution of trawls outside the EEZ by New Zealand vessels is shown in Figure 2 for 2000–01 to 2002–03. Fishing in 2000–01 occurred around New Zealand in the Tasman Sea and to the east on the Louisville Ridge, as well as in several regions of the southwest Indian Ocean. There was a similar distribution in the New Zealand region in 2001–02 and 2002–03. However, no fishing was reported from the South Tasman Rise or Indian Ocean in 2001–02 or 2002–03. In 2001–02, there was some limited effort in the South Atlantic Ocean.

In the closer New Zealand region, there are clearly defined fishing grounds on the Lord Howe Rise, Northwest Challenger Plateau, West Norfolk Ridge, Louisville Ridge, and, up until 2000–01, on the South Tasman Rise. Several changes occurred in the distribution of fishing between 2000–01, 2001–02, and 2002–03 (Figure 3). The West Norfolk Ridge developed as a significant fishery, and the distribution of effort on the Northwest Challenger Plateau became more widespread, including extending southwards down the western flanks of the Plateau. There was some fishing further northwest on the Lord Howe Rise.

3.2 Overall catch and effort in the fisheries

The total reported New Zealand orange roughy catch outside the EEZ in 2000–01 amounted to over 3300 t (Table 1). About 2500 t of this was reported on the QMS system, the remainder presumably being from the Southwest Indian Ocean and not subject at that time to formal reporting requirements. Catch levels were very similar in 2001–02, although there were marked differences between areas. Catch decreased on the Louisville Ridge, but there was higher effort and catch levels on the Northwest Challenger, and West Norfolk Ridge. Effort decreased in 2002–03, and the total catch dropped to about 2500 t (although the data for this year may be incomplete). This was due to lower catch levels on the West Norfolk Ridge and Northwest Challenger Plateau.

Table 1: Reported catch by New Zealand vessels of orange roughy (t) and level of effort (Ntows) by fishing area for fishing years 2000–01, 2001–02, and 2002–03 (note South Tasman Rise catch is for a 1 March to 28 February fishing year).

Area	2000–01		2001–02		2002–03	
	Ntows	Catch (t)	Ntows	Catch (t)	Ntows	Catch (t)
Louisville	749	1 598	889	1 004	739	1 299
Lord Howe Rise	136	145	191	110	285	210
Northwest Challenger	1 002	944	2 431	1 863	2 013	955
West Norfolk	1	<1	297	586	91	35
South Tasman Rise	249	37	0		0	
Southwest Indian Ocean	361	652	0		0	
Reported total	2 498	3 340	3 808	3 563	3 128	2 499
QMS		2 514		3 201		2 410

Australian vessels are the only other nationality known to regularly fish these grounds (Table 2).

Table 2: Reported catch by Australian vessels of orange roughy (t) and level of effort (Ntows) by fishing area for fishing years 2000–01, 2001–02, and 2002–03 (note South Tasman Rise catch is for a 1 March to 28 February fishing year).

Area	2000–01		2001–02		2002–03	
	Ntows	Catch (t)	Ntows	Catch (t)	Ntows	Catch (t)
Lord Howe	88	288	11	10	26	64
Northwest Challenger	125	284	145	212	86	62
West Norfolk	17	9	66	63	78	3
South Tasman Rise	908	790	201	169	164	111
Reported total	1 138	1 371	423	454	354	240

Australian reported catches on the South Tasman Rise during 2003–04 (to December 2003) totalled just over 2 t, from 67 tows.

The fisheries outside the EEZ continue to be a significant proportion of the total New Zealand and Australian orange roughy fisheries (Table 3).

Table 3: Reported catch (t) of orange roughy in fisheries outside and inside the EEZs by New Zealand and Australian vessels (excludes Australian South west Indian Ocean fishing)

Fishery	2000–01	2001–02	2002–03
New Zealand ET	3 340	3 563	2 499
Australia ET	1 371	454	240
Total ET	4 711	4 017	2 739
New Zealand EEZ	11 903	13 459	14 671
Australia EEZ	3 858	3 817	3 091

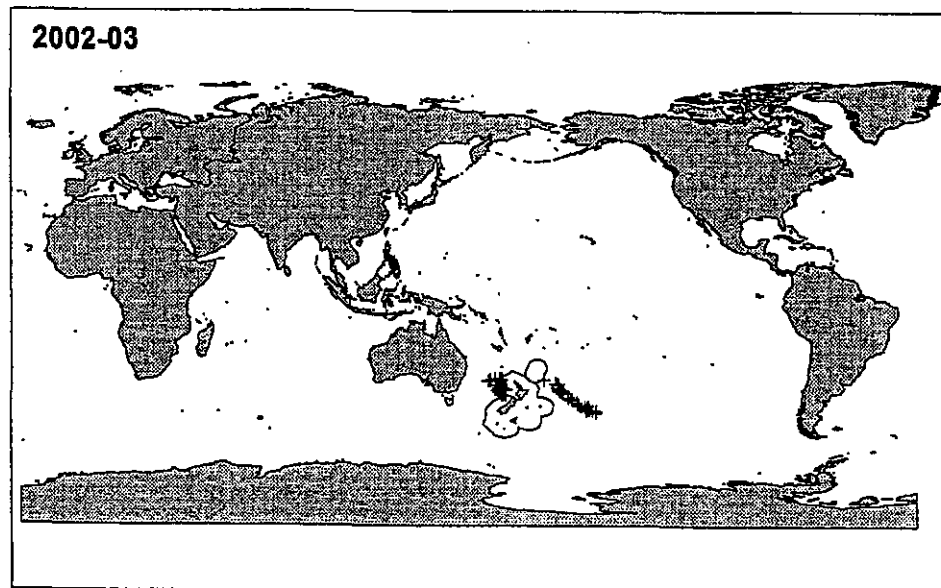
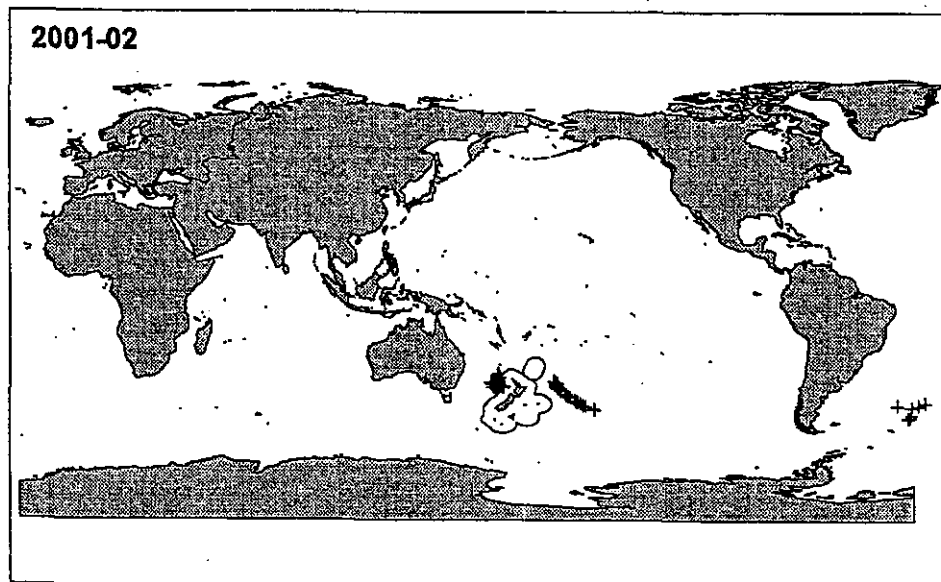
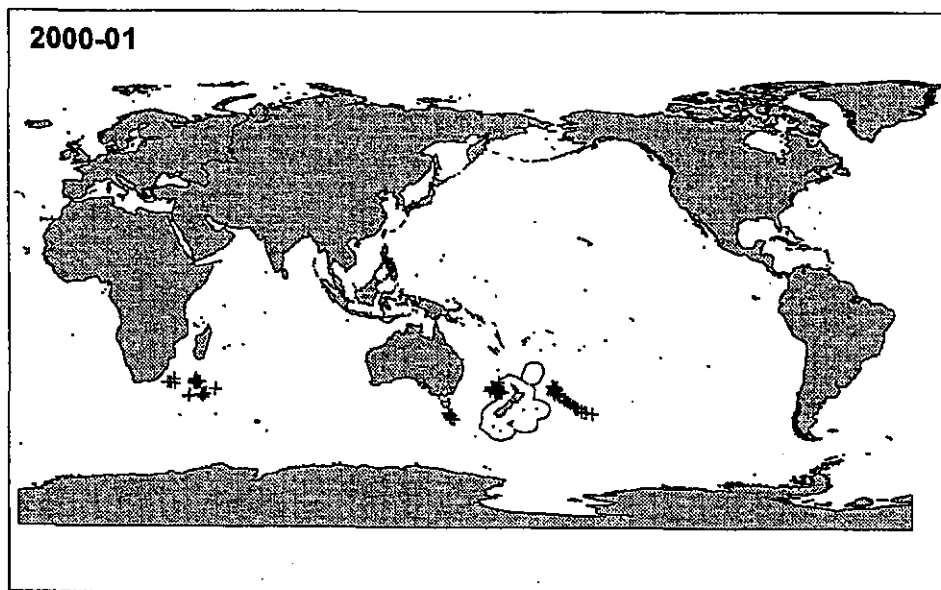


Figure 2: Distribution of New Zealand fishing for orange roughy outside the NZ EEZ during 2000-01 (upper panel), 2001-02 (middle panel), and 2002-03 (lower panel).

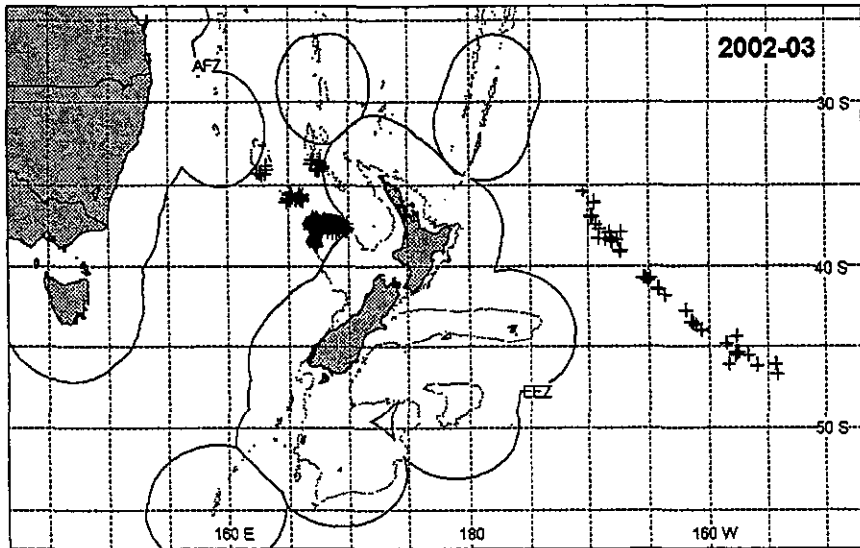
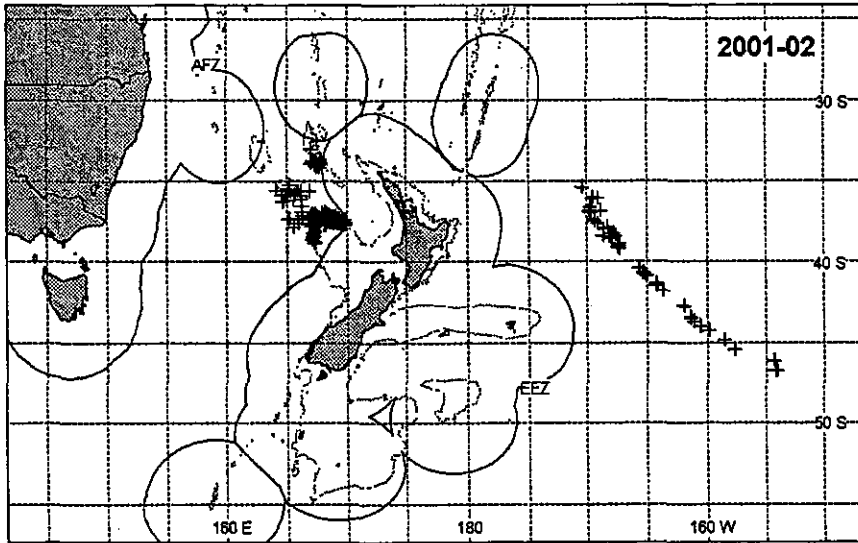
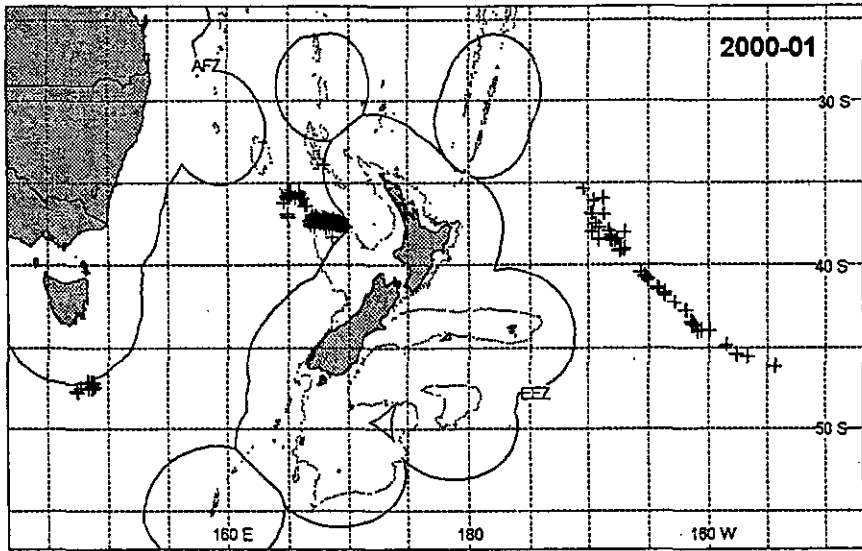


Figure 3: Distribution of New Zealand fishing for orange roughy in the New Zealand region during 2000-01 (upper panel), 2001-02 (middle panel), and 2002-03 (lower panel). 1000 m depth contour is shown around New Zealand

3.3 The Lord Howe Rise fishery

3.3.1 Catch effort data

There were 3659 tows representing 54 individual vessels in the groomed (error-checked) TCEPR/HS-CER and CELR data from Lord Howe Rise (Table 4). The fishery has been dominated by New Zealand registered vessels (85% of tows), although there was some effort in earlier years by vessels registered in Norway, Korea, Russia, Japan, Belize, and Panama. In the last three years all effort has been by domestic registered vessels. In 2002–03 one vessel accounted for over 50% of all tows. Almost all tows (99%) targeted orange roughy.

Tows were relatively long (3 h) in the early years (1988–91) of the Lord Howe fishery when most fishing effort was on the flat ground of the broad platforms (Table 4). There was then a trend towards shorter tows (less than 1 h) from 1991 to 1998 associated with a shift to fishing on rough ground in the area, and short tows still dominate with mean tow duration in the last three fishing years of 0.6–0.7 h.

Unstandardised catch rates for all groomed data combined were expressed as tonnes per tow, tonnes per hour, and tonnes per nautical mile (Table 4). Unstandardised catch rates on Lord Howe Rise in 2001–02 and 2002–03 (mean of 0.6–0.7 t/tow) had decreased from the peak of 1.1 t/tow in 2000–01, but were higher than catch rates from 1995–96 to 1999–2000.

3.3.2 Seasonal and spatial distribution of catch and effort

Catch and effort in Lord Howe (Tables 5, 6, 7) were historically concentrated during the winter spawning period (May–July), although the seasonal distribution of effort has at times been patchy since 1994–95 (Table 5). In 2000–01, there was significant effort in July for the first time since 1993–94, and 89% of the catch was taken in this month (Table 6). Catch rates on Lord Howe Rise in July 2001 were high (2.7 t/tow). Fishing in 2001–02 was also concentrated in July with 65% of the effort and 80% of the catch taken in this month, although the catch rate of 0.7 t/tow was much lower than in July 2001. Effort in July was reduced in 2002–03, but the mean catch rate was higher than in the previous year (Table 7). There was an increase in fishing in February 2003, a month where no fishing had occurred since 1994.

The distribution of catch rates has changed in recent years. In 2000–01, there were two regions of relatively high catch rates (Figure 4). These regions also gave the best catches in 2001–02, although catch rates were low. In 2002–03, only the more northern region produced high catch rates, with a more scattered distribution of catches in areas to the east.

Note that the scales used in the catch rate figure for Lord Howe are not comparable with other fishing ground figures. The maximum catch rate, and the scale of the plots, differ. They are consistent within an area, but are not intended for inter-area comparison.

Table 4: Summary of groomed tow-by-tow data from TCEPR/HS-CER forms for the Lord Howe Rise.

Fishing year	Number of vessels	Number of tows	Total recorded catch (t)	Mean tow speed (kt)	Mean tow length (h)	Mean tow length (nmile)	Mean catch rate (t/tow)	Mean catch rate (t/h)	Mean catch rate (t/nmile)
1988-89	6	181	766	3.3	3.0	9.9	4.2	5.2	1.5
1989-90	4	63	127	2.9	2.9	8.6	2.0	1.0	0.3
1990-91	3	14	52	3.0	2.9	8.7	3.7	2.0	0.7
1991-92	4	70	479	3.2	1.7	5.2	6.8	7.6	2.5
1992-93	18	825	1 363	3.0	1.3	3.9	1.7	3.6	1.2
1993-94	19	1 263	777	2.8	0.9	2.5	0.6	1.9	0.8
1994-95	8	110	61	2.9	1.2	3.6	0.6	0.5	0.2
1995-96	3	26	5	2.9	0.7	1.9	0.2	0.5	0.2
1996-97	5	179	44	3.0	0.8	2.5	0.2	0.8	0.3
1997-98	4	57	15	3.2	0.3	1.1	0.3	1.8	0.5
1998-99	16	138	48	3.1	1.0	3.3	0.3	0.5	0.2
1999-2000	8	121	34	2.9	1.1	3.4	0.3	1.3	0.5
2000-01	6	136	145	3.0	0.7	1.9	1.1	2.9	1.0
2001-02	10	191	110	3.1	0.7	2.3	0.6	2.3	0.7
2002-03	11	285	210	3.4	0.6	2.1	0.7	4.1	1.3

Table 5: Monthly distribution of effort (number of tows) in the Lord Howe orange roughy fishery from New Zealand TCEPR/HS-CER returns.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1988-89	0	0	0	0	0	0	0	0	8	99	64	10
1989-90	0	0	8	0	3	2	0	0	1	30	19	0
1990-91	0	0	0	0	0	0	0	1	1	12	0	0
1991-92	0	0	0	0	0	0	0	0	35	35	0	0
1992-93	0	0	0	4	0	0	0	121	209	479	12	0
1993-94	20	83	12	95	215	200	74	111	255	140	58	0
1994-95	6	9	12	10	12	0	11	22	16	8	3	1
1995-96	1	0	1	3	18	1	0	0	2	0	0	0
1996-97	55	3	17	6	13	0	26	42	17	0	0	0
1997-98	2	0	0	13	0	0	31	8	0	0	0	3
1998-99	2	0	2	2	0	13	1	36	72	0	0	10
1999-2000	12	1	0	21	0	0	0	51	33	3	0	0
2000-01	0	5	2	20	0	34	0	22	1	48	4	0
2001-02	6	6	9	4	3	3	16	11	12	121	0	0
2002-03	0	0	1	6	40	9	7	102	68	51	0	1

Table 6: Monthly distribution of catch (t) in the Lord Howe orange roughy fishery from New Zealand TCEPR/HS-CER returns. Blanks indicate months when there was no effort (see Table 5).

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1988-89									38	483	106	139
1989-90			2		0	0			0	119	5	
1990-91								0	0	52		
1991-92									269	211		
1992-93				0				165	313	876	9	
1993-94	137	57	8	53	153	87	7	49	158	53	16	
1994-95	1	0	1	2	15		0	1	39	3	0	0
1995-96	0		0	0	4	0			0			
1996-97	14	0	2	0	10		4	12	2			
1997-98	0			3			11	1				0
1998-99	0		0	0		0	0	4	42			1
1999-2000	11	0		3				5	14	1		
2000-01		1	0	4		5		5	0	129	0	
2001-02	2	2	8	2	1	2	3	3	1	86		
2002-03			0	0	43	3	1	49	16	98		0

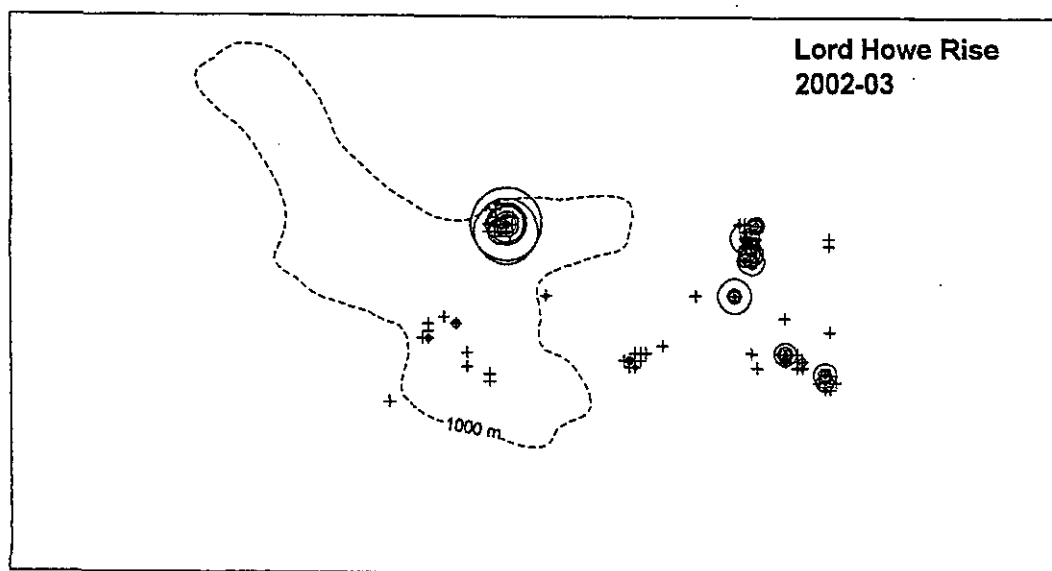
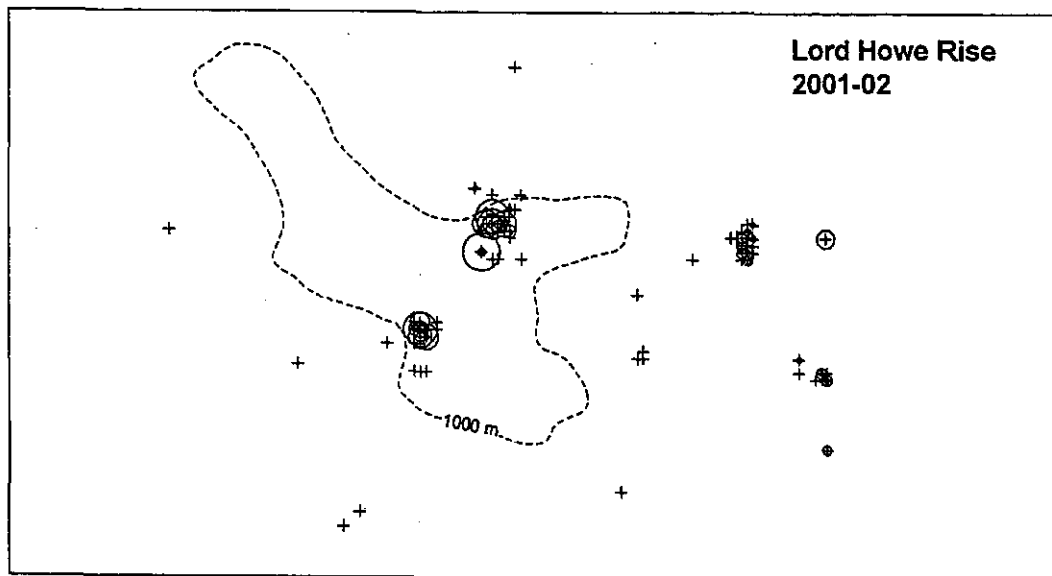
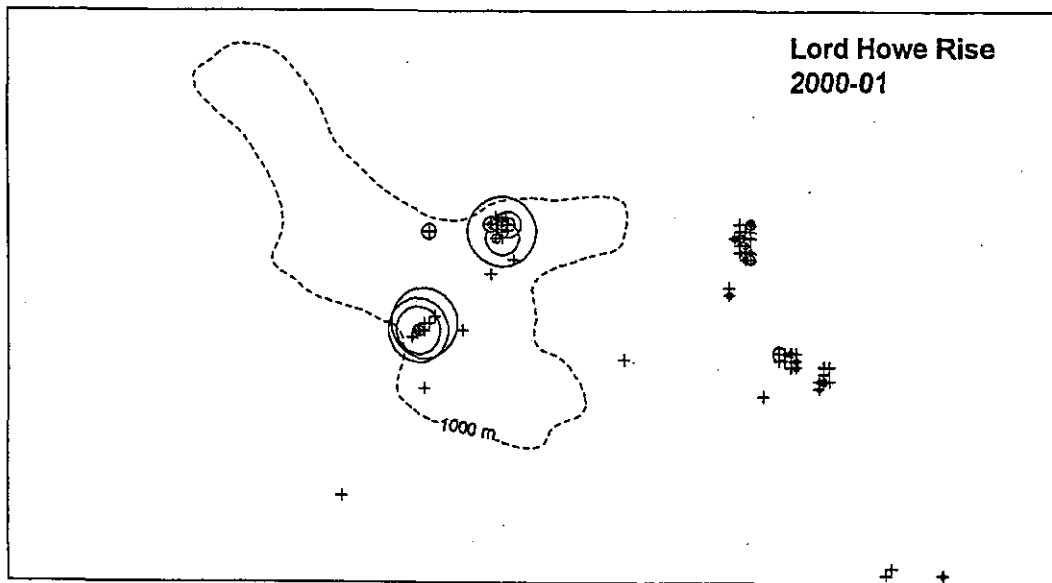


Figure 4: Distribution of catch rates of orange roughy (catch per trawl) on the Lord Howe Rise during 2000-01, 2001-02, and 2002-03 fishing years (=, trawl position, circle area proportional to catch, max = 30 t).

Table 7: Monthly distribution of catch rates (t/tow) in the Lord Howe orange roughy fishery from New Zealand TCEPR/HS-CER returns. Blanks indicate months when there was no effort (see Table 5).

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1988-89									4.8	4.9	1.7	13.9
1989-90			0.3		0.0	0.0			0.3	4.0	0.3	
1990-91								0.0	0.0	4.3		
1991-92									7.7	6.0		
1992-93				0.0				1.4	1.5	1.8	0.8	
1993-94	6.8	0.7	0.7	0.6	0.7	0.4	0.1	0.4	0.6	0.4	0.3	
1994-95	0.2	0.0	0.0	0.2	1.3		0.0	0.0	2.4	0.3	0.0	0.0
1995-96	0.0		0.0	0.1	0.2	0.0			0.1			
1996-97	0.3	0.0	0.1	0.0	0.7		0.2	0.3	0.1			
1997-98	0.0			0.2			0.3	0.1				0.1
1998-99	0.2		0.0	0.0		0.0	0.1	0.1	0.6			0.1
1999-2000	0.9	0.0		0.1				0.1	0.4	0.2		
2000-01		0.2	0.1	0.2		0.1		0.2	0.0	2.7	0.0	
2001-02	0.4	0.4	0.9	0.6	0.2	0.7	0.2	0.3	0	0.7		
2002-03			0.5	0	1.1	0.3	0.2	0.5	0.2	1.9	0	

3.3.3 Unstandardised CPUE analysis

The reduced input data set for CPUE analyses consisted of 2709 tows by 19 vessels for the Lord Howe fishery (Table 8). The distribution of effort between vessels over time was highly variable (Figure 5), and few vessels currently fishing were involved in the early years.

Table 8: Unstandardised CPUE indices for core vessels from Lord Howe Rise.

Fishing year	Number of tows	Catch (t)	t/tow	t/n.mile	% 0 catch
1988-89	65	268	4.1	0.4	9
1989-90	59	126	2.1	0.4	22
1990-91	13	52	4.0	0.7	8
1991-92	70	479	6.8	2.5	17
1992-93	473	994	2.1	1.2	27
1993-94	783	539	0.7	0.8	44
1994-95	98	58	0.6	0.2	59
1995-96	26	5	0.2	0.2	69
1996-97	173	44	0.3	0.3	64
1997-98	57	15	0.3	0.5	44
1998-99	30	2	0.1	0.0	41
1999-2000	45	24	0.5	1.1	36
2000-01	99	90	0.9	1.2	45
2001-02	157	104	0.7	0.8	26
2002-03	264	205	0.8	1.4	35

Catch rate was measured as both catch per tow and catch per nautical mile. Both unstandardised CPUE indices showed similar trends (Figure 6, Table 8). CPUE peaked in 1991-92, declined rapidly to low levels from 1994-95 to 1998-99, and has increased over the last 4 years.

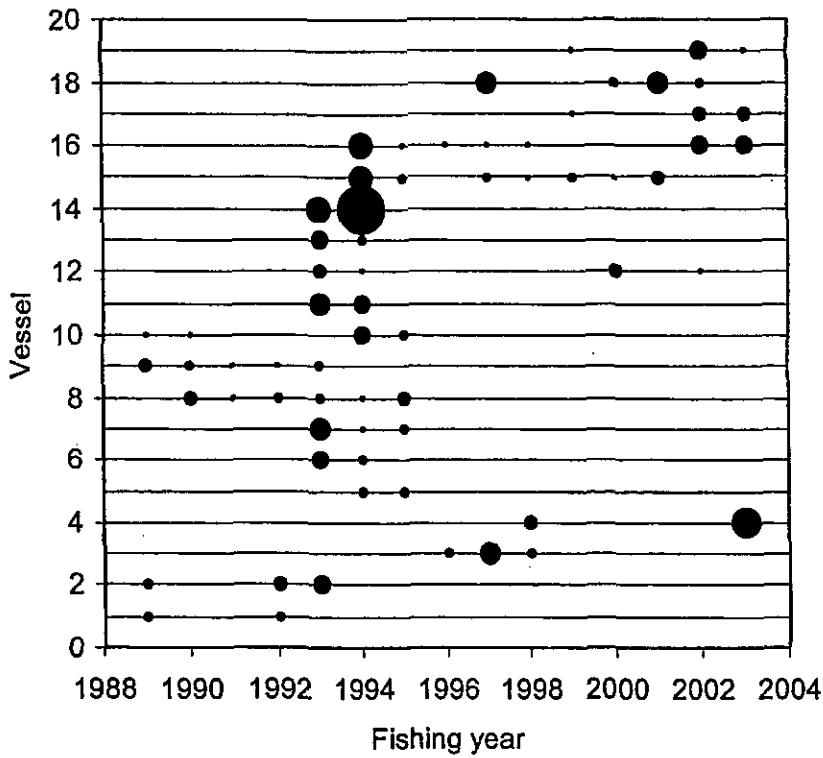


Figure 5: Annual distribution of tows by the 19 core vessels included in the CPUE analysis of the Lord Howe Rise orange roughy fishery. Circle area is proportional to the number of tows in each year. 1990 on x-axis refers to the 1989–90 fishing year.

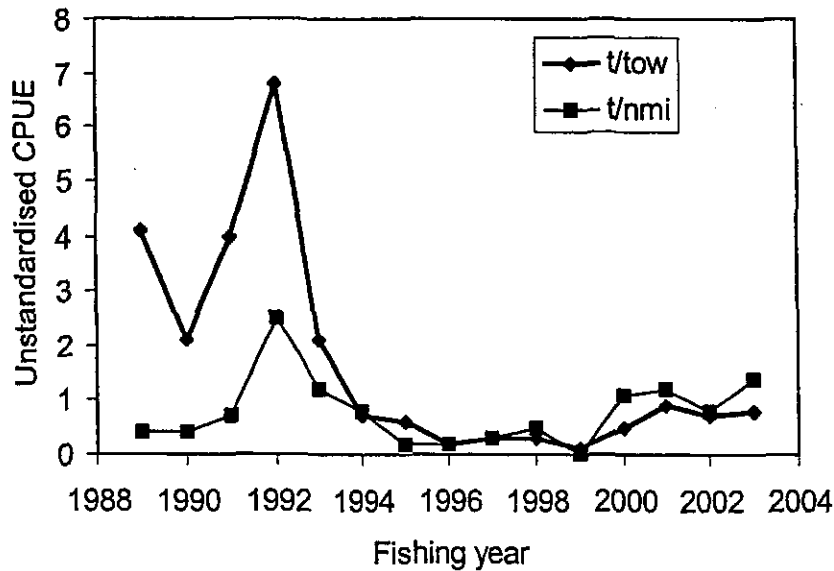


Figure 6: Unstandardised CPUE indices from the Lord Howe Rise orange roughy fishery 1988–89 to 2002–03 (data in Table 11). 1990 on x axis is the 1989–90 fishing year.

3.4 Northwest Challenger Plateau fishery

3.4.1 Catch effort data

There were 11500 tows by 62 individual vessels in the groomed (error-checked) TCEPR/HS-CER and CELR data from the Northwest Challenger region (Table 9). Note that the values in this table are for the entire Northwest Challenger area, and not the "core region", hence, numbers differ slightly from the data reported by O'Driscoll (2003). The fishery overall has been dominated by New Zealand registered vessels, and in the last three years this level has increased from about 80% to over 95%. The only non-New Zealand vessels in the 2002–03 year were two registered from Australia, and one from Korea. Almost all tows (99%) in recent years have targeted orange roughy.

Tow duration and distance on Northwest Challenger were long in the first two years of the fishery, but decreased as fishing shifted to hill features (Table 9). From 1992–93 to 1999–2000 mean tow duration was relatively constant at between 0.7 and 1.1 h. There was a major increase in tow duration from 1.0 h in 1999–2000 to 2.6 h in 2000–01, and this was higher still in 2001–02 (3.9 h) and 2002–03 (4.1 h). The increase in tow length was associated with changes in the spatial pattern of the fishery (see below), with some effort moving away from the hills on to flat areas to the east.

The mean catch per tow overall (Table 9) has generally been highly variable, at between 1 and 2 t/tow, although up to 4 t/tow in 1988–89. The catch rates in 2002–03 are the lowest for the entire time series since (1990–91 had only four tows and data are therefore of limited use). Catch rates have generally been greater than on the neighbouring Lord Howe Rise grounds, but in the last three years they have been lower, whether t/tow, t/h, or t/n.mile is considered. Peak catch rates in both areas were in 1991–92, with current (2002–03) levels between 5 and 12% of them.

3.4.2 Seasonal and spatial distribution of catch and effort

Catch and effort in the core region of the Northwest Challenger fishery (Tables 10, 11, 12) were historically concentrated during the winter spawning period (May–July), although some years have seen substantial effort in October, March, April, and August.

In 2001–02, there was significant effort in July for the first time since 1994–95, and this continued in 2002–03 (Table 10). The amount of fishing also increased dramatically in April 2002 and 2003. May and June have been the months of most fishing, although catches in both these months dropped between 2001–02 and 2002–03 (Table 11).

The relative distribution of catch rates by month has changed over the last 3 years (Table 12). In 2000–01, catch rates (t/tow) were similar in June and July, and higher than in May. June and July catch rates dropped in 2001–02, and further in 2002–03. Monthly overall catch rates are now all below 1 t/tow.

The distribution of catch rates has changed in recent years (Figure 7). In 2000–01, there was scattered fishing across much of the northern flank of the Challenger Plateau, with the highest catch rates clustered at the western end, and a little to the east. In 2001–02, there was a marked increase in the number of tows, and heavy fishing was reported in previously unfished areas slightly to the north, and extending east to the boundary of the EEZ. Catch rates in the western end decreased, with the highest catches now taken in the central areas. There was also an extension of fishing to the south along the western flank of the Plateau, although catches were small. The distribution of effort was similar in 2002–03 to the previous year. Catch rates were again low on the western end, highest in the central area, and low to the east. Much more fishing occurred to the east near the EEZ.

Table 9: Summary of groomed tow-by-tow data from TCEPR/HS-CER forms for Northwest Challenger. Additional data from CELR forms in 2001-02 and 2002-03 are given below in parentheses.

Fishing year	Number of tows	Number of vessels	Total recorded catch (t)	Mean tow speed (kt)	Mean tow length (h)	Mean tow length (nmile)	Mean catch rate (t/tow)	Mean catch rate (t/h)	Mean catch rate (t/nmile)
1988-89	33	3	107	2.8	3.2	9.2	3.3	1.5	0.5
1989-90	40	4	25	2.8	2.4	6.8	0.6	0.6	0.2
1990-91	4	1	1	3.5	0.2	0.6	0.3	1.5	0.4
1991-92	56	2	230	3.5	0.5	1.8	4.1	12.8	3.7
1992-93	1 370	19	2 250	3.2	0.8	2.5	1.6	3.9	1.2
1993-94	1 499	19	1 394	2.8	1.1	3.2	0.9	1.4	0.5
1994-95	877	11	1 138	2.9	0.8	2.2	1.3	5.7	2.0
1995-96	270	7	500	2.9	1.0	3.1	1.9	10.0	3.4
1996-97	385	7	332	3.0	0.8	2.5	0.9	3.5	1.2
1997-98	215	8	228	3.1	0.7	2.2	1.1	6.0	2.0
1998-99	707	21	838	3.0	0.8	2.3	1.2	4.2	1.4
1999-2000	598	11	335	3.0	1.0	3.2	0.6	2.6	0.9
2000-01	1 002	13	944	3.0	2.6	7.5	0.9	1.5	0.5
2001-02	2 154 (277)	20 (2)	1 656 (207)	2.9	3.9	11.2	0.8	1.4	0.5
2002-03	1 959 (54)	22 (2)	940 (15)	2.9	4.1	11.6	0.5	0.7	0.2

Table 10: Monthly distribution of effort (number of tows). From the "Core region".

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1988-89	0	0	0	0	0	0	0	0	17	5	1	10
1989-90	0	0	0	0	13	11	0	0	0	12	4	0
1990-91	0	0	0	0	0	0	0	0	3	1	0	0
1991-92	0	0	0	0	0	0	0	0	0	56	0	0
1992-93	0	0	0	2	0	0	23	338	762	219	24	2
1993-94	40	22	51	24	70	11	103	259	491	199	228	1
1994-95	126	81	71	36	2	0	32	43	179	168	74	65
1995-96	9	16	7	3	24	9	1	39	134	28	0	0
1996-97	24	8	32	8	11	0	58	79	165	0	0	0
1997-98	4	29	0	1	0	0	19	39	104	13	0	6
1998-99	1	0	5	23	3	24	3	113	487	23	0	25
1999-2000	59	56	28	49	28	34	11	100	216	6	0	11
2000-01	0	44	66	86	25	76	40	152	422	26	21	44
2001-02	71	54	25	41	48	103	356	535	843	200	91	31
2002-03	4	52	6	32	23	77	293	446	716	208	67	15

Table 11: Monthly distribution of catch (t) from the "Core region".

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1988-89									20	3	0	84
1989-90					9	13				3	0	
1990-91									1	0		
1991-92										230		
1992-93				0			3	473	1 473	298	3	0
1993-94	50	25	43	3	18	0	10	185	560	252	247	0
1994-95	141	73	21	3	0		20	12	653	158	29	28
1995-96	2	1	0	0	7	2	0	5	468	13		
1996-97	4	1	10	0	0		13	26	278			
1997-98	0	43		0			2	43	131	8		1
1998-99	0		0	7	0	3	1	92	726	4		5
1999-2000	40	27	5	12	9	2	0	54	178	1		7
2000-01		41	34	44	6	25	15	115	565	37	41	21
2001-02	45	34	9	27	65	92	227	417	724	166	36	8
2002-03	1	19	2	12	12	42	136	174	371	133	21	5

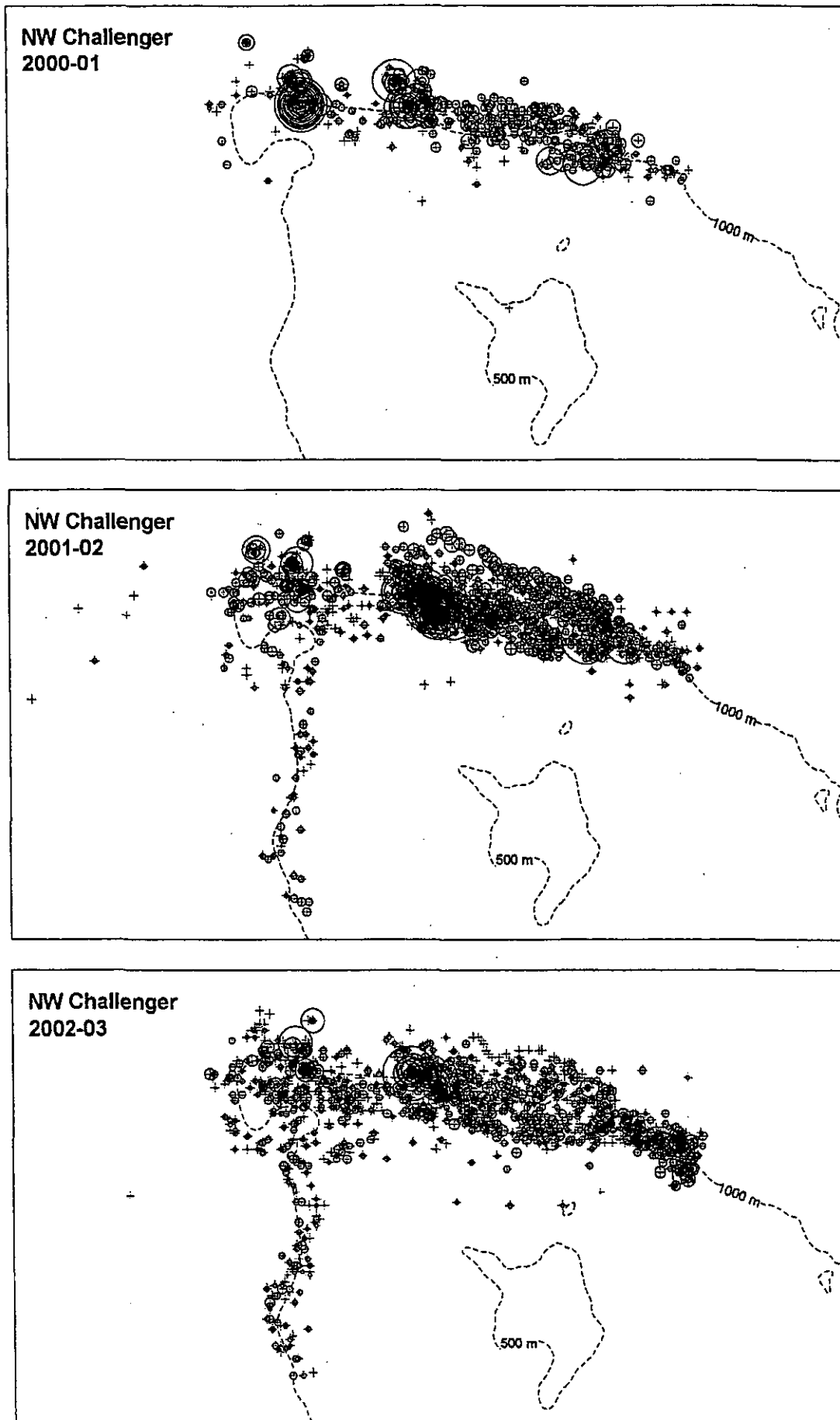


Figure 7: Distribution of catch rates of orange roughy (catch per trawl) on the Northwest Challenger Plateau (total area) during 2000-01, 2001-02, and 2002-03 fishing years (+, trawl position; circle area proportional to catch, max = 25 t).

Table 12: Monthly distribution of catch rates (t/tow) from New Zealand TCEPR/HS-CER and CELR returns. Blanks indicate months when there was no effort (see Table 10). "Core region".

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1988-89									1.2	0.7	0.4	8.4
1989-90					0.7	1.1				0.3	0.0	
1990-91									0.3	0.0		
1991-92										4.1		
1992-93				0.0			0.1	1.4	1.9	1.4	0.1	0.1
1993-94	1.2	1.1	0.8	0.1	0.3	0.0	0.1	0.7	1.1	1.3	1.1	0.0
1994-95	1.1	0.9	0.3	0.1	0.0		0.6	0.3	3.6	0.9	0.4	0.4
1995-96	0.3	0.1	0.1	0.0	0.3	0.2	0.0	0.1	3.5	0.5		
1996-97	0.2	0.1	0.3	0.0	0.0		0.2	0.3	1.7			
1997-98	0.1	1.5		0.0			0.1	1.1	1.3	0.6		0.2
1998-99	0.1		0.1	0.3	0.0	0.1	0.2	0.8	1.5	0.2		0.2
1999-2000	0.7	0.5	0.2	0.2	0.3	0.1	0.0	0.5	0.8	0.1		0.6
2000-01		0.9	0.5	0.5	0.2	0.3	0.4	0.8	1.3	1.4	2.0	0.5
2001-02	0.6	0.6	0.4	0.7	1.4	0.9	0.6	0.8	0.9	0.8	0.4	0.3
2002-03	0.3	0.4	0.1	0.4	0.5	0.5	0.5	0.4	0.5	0.6	0.3	0.3

3.4.3 Unstandardised CPUE analysis

The reduced input data set for CPUE analyses consisted of 8992 tows by 28 vessels for the core Northwest Challenger fishery (Table 13). These vessels accounted for 78% of the total effort in the fishery, and 77% of the catch. The number of unsuccessful tows (where no orange roughy catch was recorded) has decreased substantially in the last three fishing years, but in spite of this, catch rates have declined, and for the last four years have been below 1 t/tow or 1 t/n.mile (Table 13).

The cropped data set, using short tows in June only, gave slightly different results (Table 14). This set was relatively small, involving 16 vessels, which accounted for 14% of the total effort and 25% of the total catch. Catch rates in recent years have been variable, with an increase in 2001-02 from 2000-01, but a substantial decrease in 2002-03. The overall catch per tow in 2002-03 is similar to a number of years in the late 1990s-early 2000s, but catch rate per distance towed is the lowest reported in the period examined.

Trends in CPUE for both data sets are graphed in Figure 8.

Table 13: CPUE indices for core vessels from all seasons.

Fishing year	Number of tows	Catch (t)	Unstandardised CPUE		
			t/tow	t/nmile	% 0 catch
1992-93	474	819	1.7	0.9	20
1993-94	1 115	1 343	1.2	0.6	42
1994-95	869	1 136	1.3	2.0	39
1995-96	266	499	1.9	3.5	36
1996-97	379	330	0.9	1.2	41
1997-98	211	227	1.1	2.0	35
1998-99	463	622	1.3	1.3	25
1999-2000	430	190	0.4	0.6	29
2000-01	997	940	0.9	0.5	15
2001-02	2 098	1 633	0.6	0.5	10
2002-03	1 690	854	0.5	0.3	13

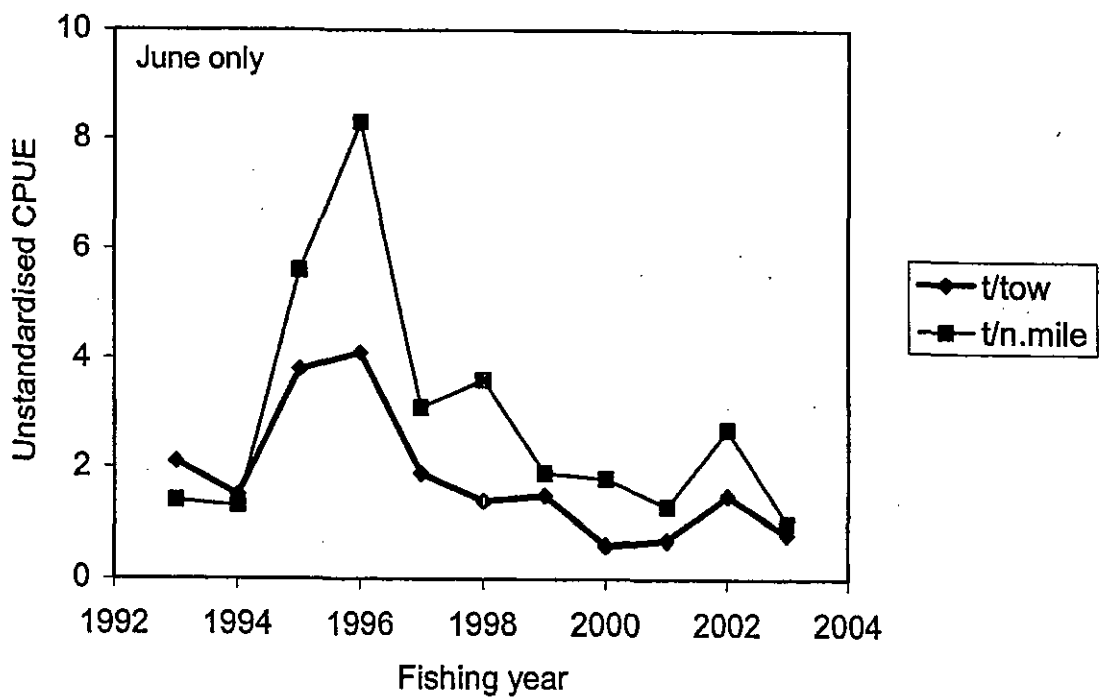
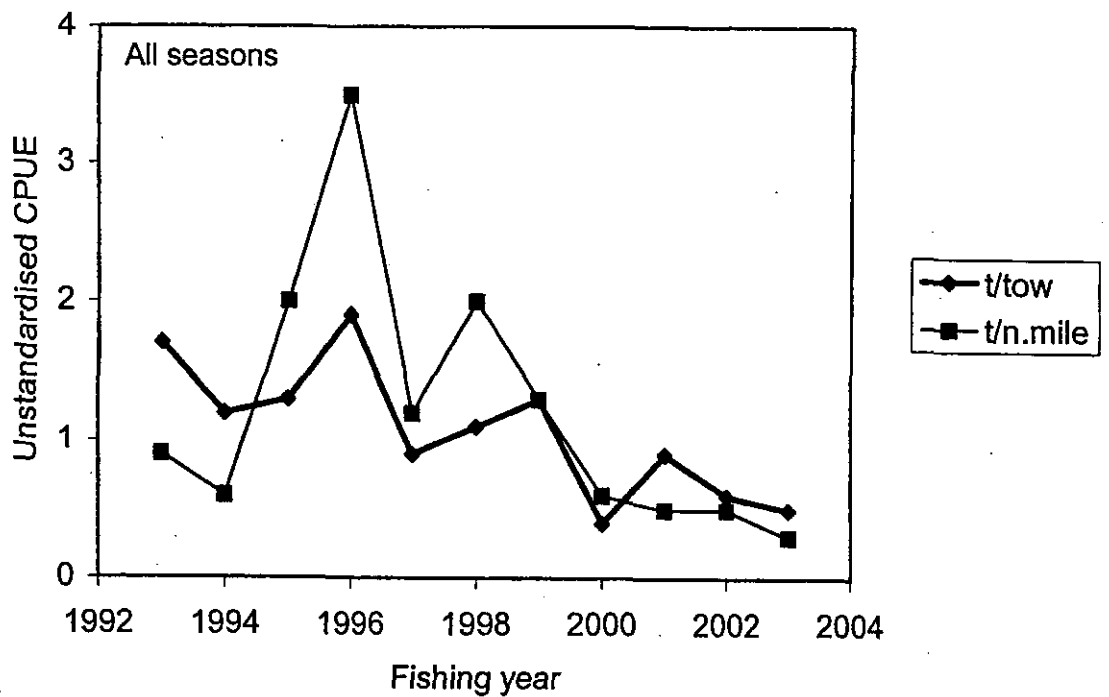


Figure 8: Unstandardised CPUE indices from the Northwest Challenger orange roughy fishery 1992–93 to 2002–03 (data in Tables 13–14). “All seasons” refers to the full data set. “June only” refers to that comprising tows less than 1 h by the core vessels in June (peak spawning). 1992 on x axis is the 1991–92 fishing year.

Table 14: CPUE indices for cropped data from June only.

Fishing year	Number of tows	Catch (t)	Unstandardised CPUE		
			t/tow	t/nmile	% 0 catch
1992-93	182	385	2.1	1.4	15
1993-94	187	283	1.5	1.3	28
1994-95	105	399	3.8	5.6	32
1995-96	103	426	4.1	8.3	33
1996-97	131	244	1.9	3.1	31
1997-98	80	108	1.4	3.6	26
1998-99	251	367	1.5	1.9	26
1999-2000	101	64	0.6	1.8	33
2000-01	65	49	0.7	1.3	32
2001-02	203	301	1.5	2.7	20
2002-03	159	124	0.8	1.0	26

The distribution of effort between vessels over time was highly variable in both the CPUE data sets (Figure 9). The composition of the fleet fishing outside the EEZ was inconsistent and variable, as in the Lord Howe fishery, and few vessels currently fishing were involved in the early years.

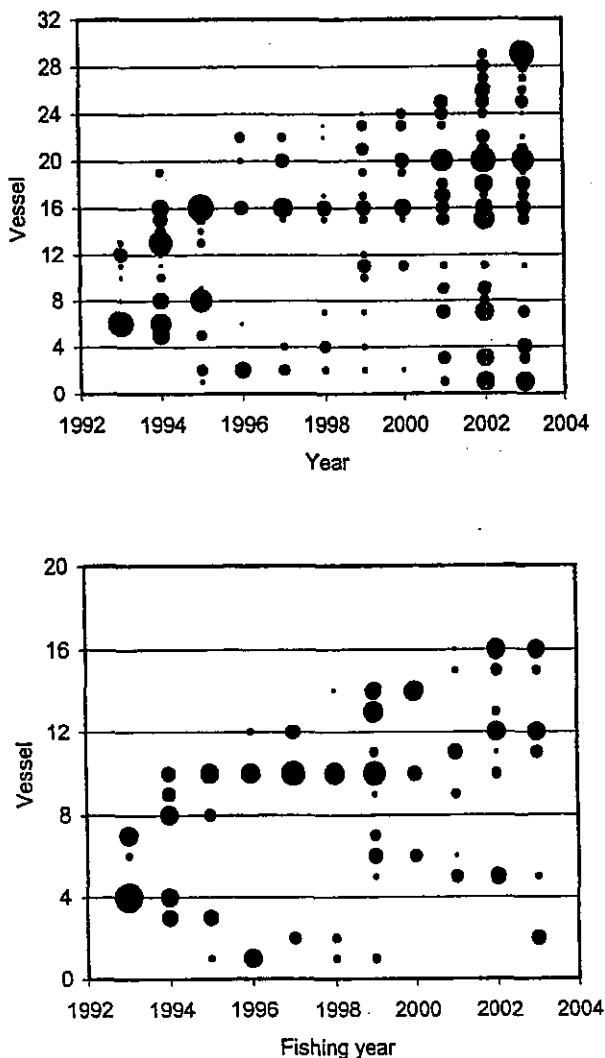


Figure 9: Annual distribution of tows by the core vessels included in the CPUE analysis from all seasons (upper panel) and from the June Hill fishery (lower panel). Circle area is proportional to the number of tows in each year. 1992 on x-axis refers to the 1991-92 fishing year.

3.5 West Norfolk Ridge fishery

3.5.1 Catch effort data

There were 389 tows from 6 individual vessels in the groomed TCEPR/HS-CER data from the West Norfolk Ridge (Table 15). The fishery was developed in 2000–01 by several Australian vessels, but New Zealand registered vessels quickly entered the fishery. The New Zealand data set consists of five domestic and one Australian-registered vessel. The former account for 99% of New Zealand tows. All trawls were reported as targeting orange roughy

Tows have been very similar in duration and distance in the two effective years of the fishery, with a mean tow duration of 0.3 h in both years, and a mean distance of 0.8–0.9 n.mile. The fishery takes place largely on small seamount-like features and peaks along the West Norfolk Ridge. There is limited ground for longer flat-bottom trawling. The proportion of zero reported catch of orange roughy was similar between 2001–02 (27% of tows) and 2002–03 (30% of tows).

Unstandardised catch rates for all groomed data combined were expressed as tonnes per tow, tonnes per hour and tonnes per nautical mile (Table 15). These three measures all changed dramatically between 2001–02 and 2002–03, with a decrease in 2002–03 to levels between 20% and 27% of the previous year.

3.5.2 Seasonal and spatial distribution of catch and effort

With only two years data, there is little one can say about seasonal trends in catch and effort. However, effort in the fishery has been spread over much of the year (Table 16). In 2001–02, most effort was in March and July, with more than 50 trawls in each. January, February, and August all recorded 30 or more trawls. There were fewer trawls in 2002–03, and no month had more than 20 tows.

The catch was also spread throughout the year in 2001–02 (Table 17), with November, December, March, and July all featuring with more than 50 t of catch. However, trawling in most months yielded relatively good catches. In 2002–03, there were no monthly catches over 11 t.

Catch rates in 2001–02 were high in November and December (6–7 t/tow), and over 2 t/tow were taken in May and June (Table 18). By contrast, the maximum monthly average catch rate in 2002–03 was less than 1 t/tow.

The distribution of catch rates was similar in the two most recent years (Figure 10). In 2001–02, most effort, and high catch rates, occurred on the northern end of an elongated seamount, with moderate effort and good catches in an area to the west. The distribution of tows was similar in 2002–03, but catch rates were clearly greatly reduced.

Table 15: Summary of groomed tow-by-tow data from TCEPR/HS-CER forms for the West Norfolk Ridge orange roughy fishery.

Fishing year	Number of vessels	Number of tows	Total recorded catch (t)	Mean tow speed (kt)	Mean tow length (h)	Mean tow length (nmile)	Mean catch rate (t/tow)	Mean catch rate (t/h)	Mean catch rate (t/nmile)
2000-01	1	1	0.2						
2001-02	3	297	586	3.0	0.3	0.9	2.0	9.0	3.0
2002-03	5	91	35	3.0	0.3	0.8	0.4	2.4	0.8

Table 16: Monthly distribution of effort (number of tows) in the West Norfolk Ridge orange roughy fishery from New Zealand TCEPR/HS-CER returns.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
2000-01	0	0	0	1	0	0	0	0	0	0	0	0
2001-02	12	16	11	31	31	55	25	14	15	57	30	0
2002-03	13	17	3	10	0	0	17	11	1	19	0	0

Table 17: Monthly distribution of catch (t) in the West Norfolk Ridge orange roughy fishery from New Zealand TCEPR/HS-CER returns. Blanks indicate months when there was no effort (Table 16).

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
2000-01				0.2								
2001-02	1	97	79	50	42	82	28	49	37	111	11	
2002-03	11	8	3	1			3	7	0	2		

Table 18: Monthly distribution of catch rates (t/tow) in the West Norfolk Ridge orange roughy fishery from New Zealand TCEPR/HS-CER returns. Blanks indicate months when there was no effort.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
2000-01				0.2								
2001-02	0.1	6.0	7.1	1.6	1.4	1.5	1.1	3.5	2.5	1.9	0.4	
2002-03	0.9	0.5	0.8	0.1			0.2	0.7	0	0.1		

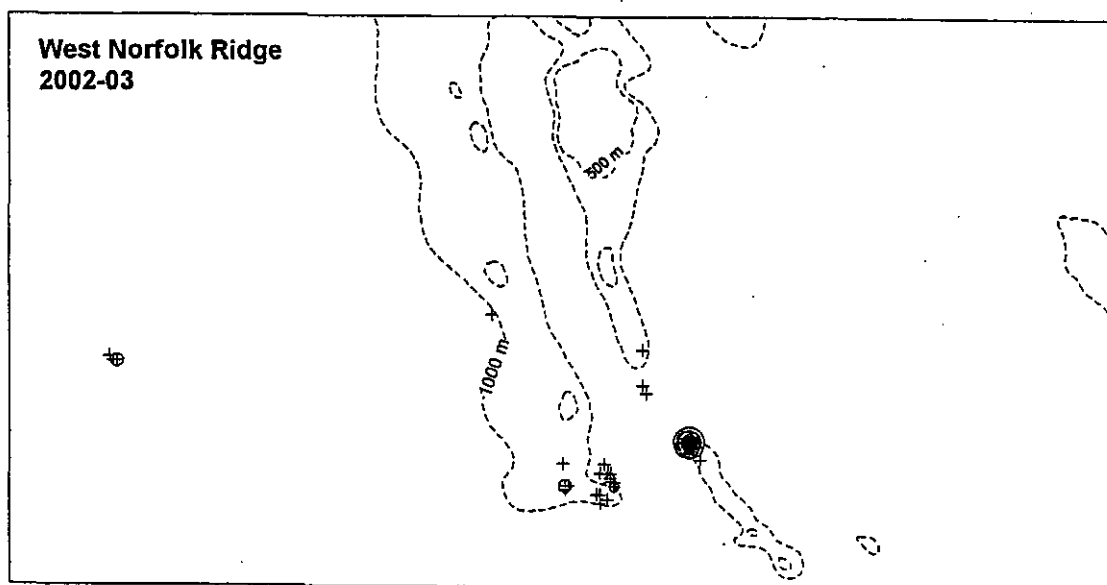
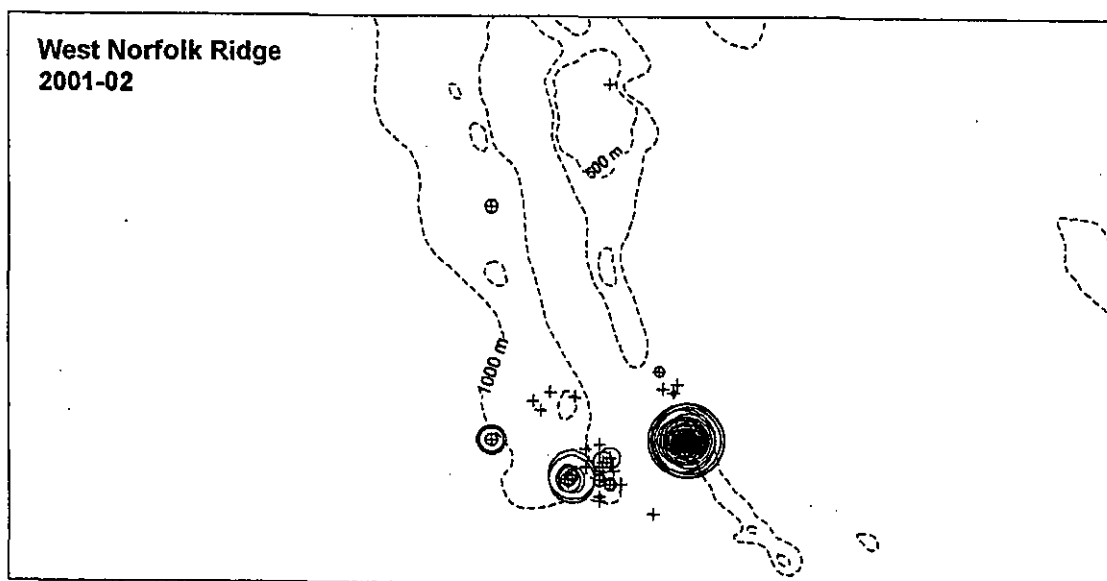
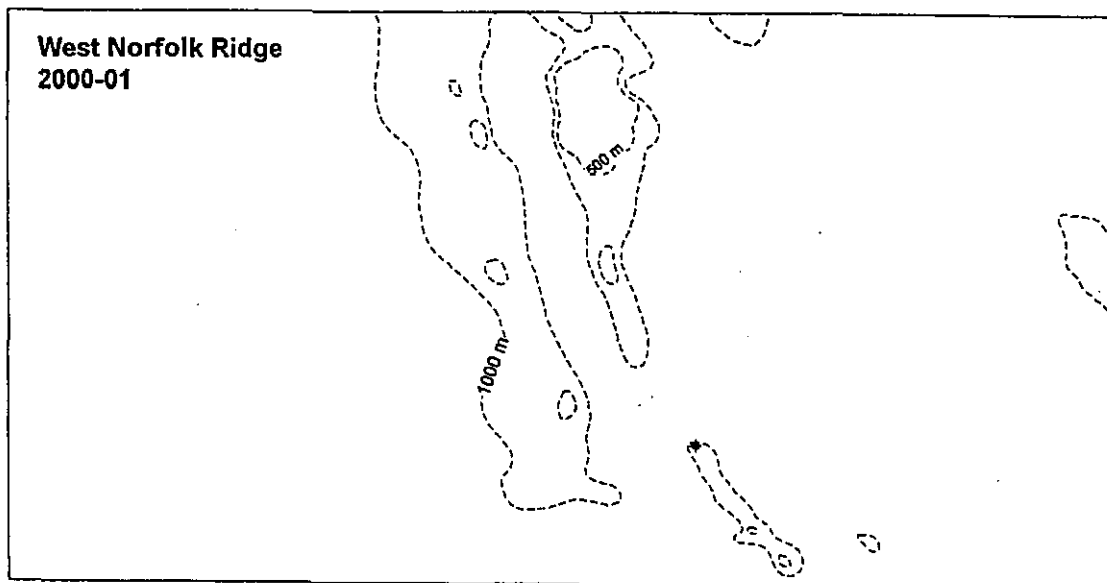


Figure 10: Distribution of catch rates of orange roughy (catch per trawl) on the West Norfolk Ridge during 2000–01, 2001–02, and 2002–03 fishing years (+, trawl position; circle area proportional to catch, max = 20 t).

3.6 Louisville Ridge fishery

3.6.1 Catch effort data

There were 15458 tows from 53 individual vessels in the groomed TCEPR/HS-CER data from the Louisville Ridge (Table 19). The New Zealand data set consists primarily of New Zealand registered vessels (77% of tows), although other nationalities include USSR (10%), Ukraine (since 1999, 3%), Korea (5%), Norway (4%), Japan, and Belize. The fishery is exclusively directed at orange roughy, with all but two tows in the last three years declaring orange roughy as the target species.

New Zealand vessels first fished the Louisville Ridge in the 1993–94 fishing year. Reported catches rose from about 200 t in that year to over 11 000 t the following year (Table 19). Catches subsequently dropped for the next three years, before an increase in 1998–99. The Australian catch is believed to have been substantial in 1993–94 (primarily August–September 1994, over 500 t) when the fishery first developed. This increased to about 2000 t in 1994–95, decreased to 50 t in 1995–96, and the only other year Australian vessels are known to have been active was 1998–99 (140 t). There are no data available on the catch of other countries, but it is not thought to have ever been very substantial.

Tows have been similar in duration and distance in the last few years of the fishery, with a mean tow duration of 0.4–0.6 h, and a mean distance of 1.2–2.0 n.mile (Table 19). These tows are relatively long for a fishery that takes place largely on seamount features, but the Louisville seamounts are much larger than those in most New Zealand fishing grounds.

Unstandardised catch rates for all groomed data combined were expressed as tonnes per tow, tonnes per hour and tonnes per nautical mile (Table 19). These three measures all changed dramatically between 2000–01 and 2002–03, with a decrease in 2001–02, and then a subsequent increase in 2002–03. Overall, catch rates have been variable, but have not shown any consistent trend over time.

3.6.2 Seasonal and spatial distribution of catch and effort

There have been strong seasonal trends between years in catch and effort. Initially effort in the fishery was spread over much of the year (Table 20), but this began to contract in 1997–98, and from 1998–99 onwards effort has been heavily concentrated in June, July, and August, with some limited trawling in February and May. The distribution of catch by month reflects the effort, with combined catches in June–July–August accounting for over 95% of the total New Zealand catch over the period 2000–01 to 2002–03 (Table 21).

Catch rates by month have been variable in recent years (Table 22). Through the late 1980s, the average catch per tow in June was between 2 and 3 t/tow, but this has decreased to about 1 t/tow in 2001–02 and 2002–03. In contrast to this, catch rates have tended to increase in July in the last two years, although they are still lower than early in the history of the fishery. Catch rates during August have been variable, with no obvious trend.

The distribution of New Zealand catches has varied between years. The fishery initially developed in the central region in 1994–95, with other grounds quickly developing in the northern region of the Ridge, and southern seamounts also yielding good catch rates from 1995–96. Over the last three years (Figure 11), effort has decreased in the central region, and good catch rates have occurred on fewer seamounts. Fishing success on the northernmost seamounts has also been reduced, but fishing has expanded to more features in the southern area.

Table 19: Summary of groomed tow-by-tow data from TCEPR/HS-CER forms for the Louisville Ridge.

Fishing year	Number of vessels	Number of tows	Total recorded catch (t)	Mean tow speed (kt)	Mean tow length (h)	Mean tow length (nmile)	Mean catch rate (t/tow)	Mean catch rate (t/h)	Mean catch rate (t/nmile)
1993-94	7	134	189	2.5	1.4	3.5	1.4	1.5	0.6
1994-95	31	4 294	11 340	2.5	0.7	1.7	2.6	10.6	4.2
1995-96	26	4 024	8 764	2.5	0.7	1.7	2.2	7.4	3.0
1996-97	16	1 849	3 209	2.5	0.8	1.9	1.7	5.3	2.1
1997-98	13	787	1 404	2.9	0.5	1.5	1.8	14.2	4.8
1998-99	17	1 093	3 025	2.9	0.5	1.5	2.7	14.2	5.2
1999-2000	12	918	1 369	3.0	0.5	1.5	1.5	11.4	3.8
2000-01	11	749	1 598	3.0	0.5	1.7	2.1	18.0	2.3
2001-02	15	889	1 004	3.1	0.6	2.0	1.1	7.4	2.4
2002-03	11	739	1 299	2.9	0.4	1.2	1.8	13.7	4.6

Table 20: Monthly distribution of effort (number of tows) in the Louisville Ridge orange roughy fishery from New Zealand TCEPR/HS-CER returns.

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1993-94	0	0	0	2	0	0	2	2	0	52	6	70
1994-95	13	102	142	307	304	742	327	474	516	769	295	303
1995-96	222	255	230	479	267	271	222	260	969	477	369	3
1996-97	29	123	112	12	78	39	142	108	603	304	299	0
1997-98	2	0	0	94	40	35	84	3	162	206	161	0
1998-99	0	0	0	0	13	0	9	0	140	511	414	5
1999-2000	0	52	0	9	8	14	0	110	227	370	114	0
2000-01	0	0	0	0	67	0	0	11	307	221	141	0
2001-02	0	0	0	32	21	0	0	121	474	166	74	0
2002-03	0	0	0	0	0	31	2	32	320	235	119	0

Table 21: Monthly distribution of catch (t) in the Louisville Ridge orange roughy fishery from New Zealand TCEPR/HS-CER returns. Blanks indicate months when there was no effort (see Table 20).

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1993-94				7			0	0		108	1	73
1994-95	25	144	339	763	1530	1882	981	995	2108	1662	535	377
1995-96	173	155	186	568	450	376	115	238	2408	2812	1233	1
1996-97	6	122	35	34	85	23	303	61	857	945	738	
1997-98	1			247	31	12	10	50	360	403	290	
1998-99					42		0		346	1339	1212	85
1999-2000		7		2	5	43		34	499	414	365	
2000-01					81			9	830	244	436	
2001-02				3	12			34	365	286	304	
2002-03						18	0	28	393	478	381	

Table 22: Monthly distribution of catch rates (t/tow) in the Louisville Ridge orange roughy fishery from New Zealand TCEPR/HS-CER returns. Blanks indicate months when there was no effort (see Table 20).

Fishing year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1993-94				3.5			0	0		2.1	0	1.0
1994-95	1.9	1.4	2.4	2.5	5.0	2.5	3.0	2.1	4.1	2.2	1.8	1.2
1995-96	0.8	0.6	0.8	1.2	1.7	1.4	0.5	0.9	2.5	5.9	3.3	0.3
1996-97	0.2	1.0	0.3	2.8	1.1	0.6	2.1	0.6	1.4	3.1	2.5	
1997-98	0.5			2.6	0.8	0.3	0.1	16.7	2.2	2.0	1.8	
1998-99					3.2		0		2.5	2.6	2.9	17.0
1999-2000		0.1		0.2	0.6	3.1		0.3	2.2	1.1	3.2	
2000-01					1.2			0.8	2.7	1.1	3.1	
2001-02				0.1	0.6			0.3	0.8	1.7	4.1	
2002-03						0.6	0	0.9	1.2	2.0	3.2	

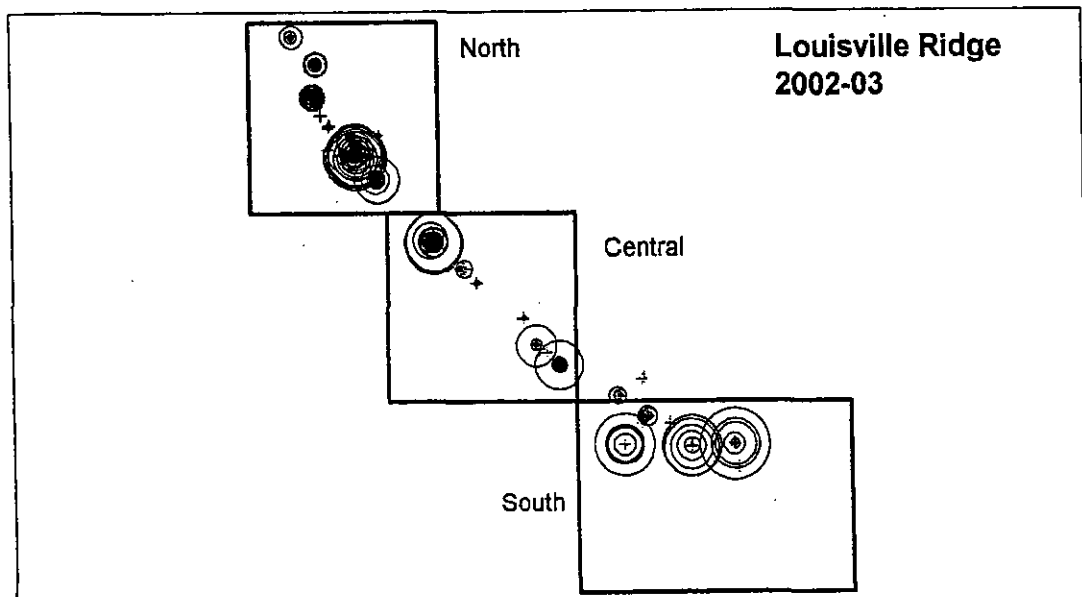
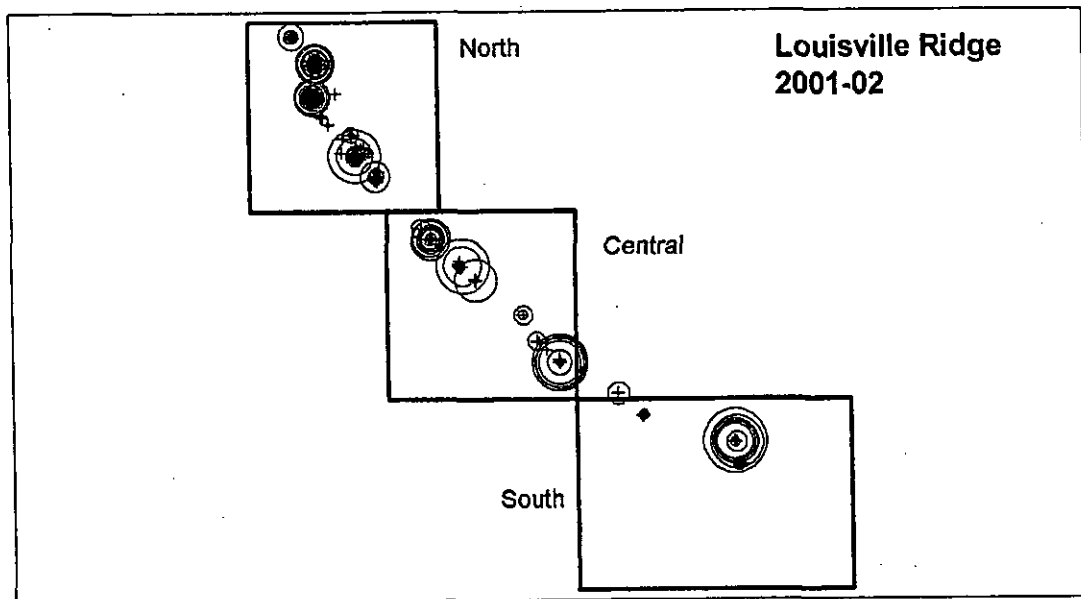
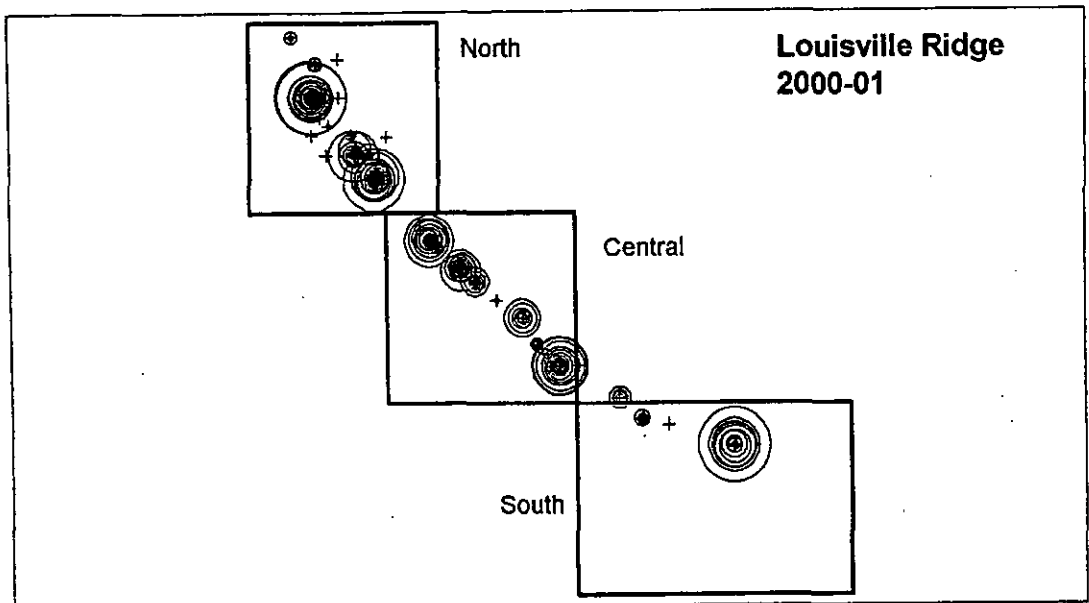


Figure 11: Distribution of catch rates of orange roughy (catch per trawl) on the Louisville Ridge during 2000-01, 2001-02, and 2002-03 fishing years (+, trawl position; circle area proportional to catch, max = 50 t).

3.6.3 Unstandardised CPUE

Unstandardised CPUE has been examined previously (e.g., Clark 1998c, 1999, Clark & Anderson 2003), based on mean catch per trawl for the total Louisville Ridge area and the three main regions separately. This is updated in Table 23. The progressive contraction in distribution of effort and catch towards the winter months has suggested that unstandardised CPUE should also be presented for the June to August period which has been fished consistently each year.

Most fishing grounds showed reductions in CPUE from peak values in the first few years to relatively low values in 1997–98. CPUE increased in all areas in 1998–99, and declined in north and central regions in 1999–2000. Over the last three years CPUE has fluctuated, with overall unstandardised catch rates dropping in 2001–02, but increasing in 2002–03. There is a similar pattern in the winter, which is to be expected as the bulk of the fishery occurs then. The patterns in catch rate differ between regions. On the northern seamounts there was a decrease between 2000–01 and 2001–02, and then an increase, while in the central region levels were similar between 2000–01 and 2001–02, and dropped in 2002–03. In southern regions there has been a progressive increase from 2000–01, with relatively high levels of 5 t/tow reached in 2002–03.

Table 23: Average catch rate (t per tow) of orange roughy by New Zealand vessels from the Louisville Ridge, 1993–94 to 2002–03, and by sub-area. The winter column is for June–August.

	Full Area		North		Central		South	
	All year	Winter	All year	Winter	All year	Winter	All year	Winter
1993–94	1.4	1.9			1.5	1.9		
1994–95	2.6	2.7	1.7	3.9	2.7	2.6	2.3	11.0
1995–96	2.2	3.6	3.0	6.0	1.4	2.1	2.8	3.9
1996–97	1.7	2.1	1.2	1.4	1.8	2.0	3.3	3.5
1997–98	1.8	2.0	1.7	1.9	2.0	2.4	0.7	0.7
1998–99	2.7	2.7	2.0	2.1	3.0	2.9	1.8	1.7
1999–2000	1.5	1.8	1.4	2.1	1.5	1.6	2.3	2.8
2000–01	2.1	2.3	2.4	2.6	1.9	2.0	1.9	1.9
2001–02	1.1	1.3	0.8	0.9	1.9	2.3	2.8	3.9
2002–03	1.7	1.9	1.6	1.7	1.2	1.2	5.2	5.2

The trends over the entire period of the fishery are clearly seen in Figure 12.

Vessel composition in the fishery has changed markedly over time (Figure 13). The number of vessels has decreased in recent years, and many of the current vessels were not involved in the early years of the fishery. However, most vessels have fished for several years, with a reasonable number of tows, and hence the data set was not reduced for the unstandardised CPUE analysis as it was for the Lord Howe Rise and Northwest Challenger fisheries.

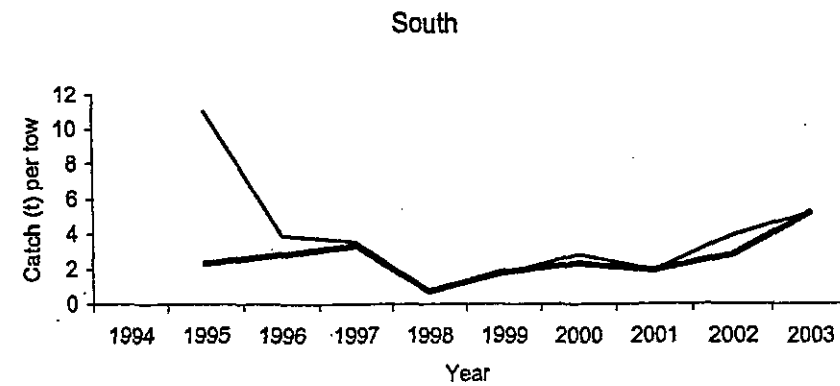
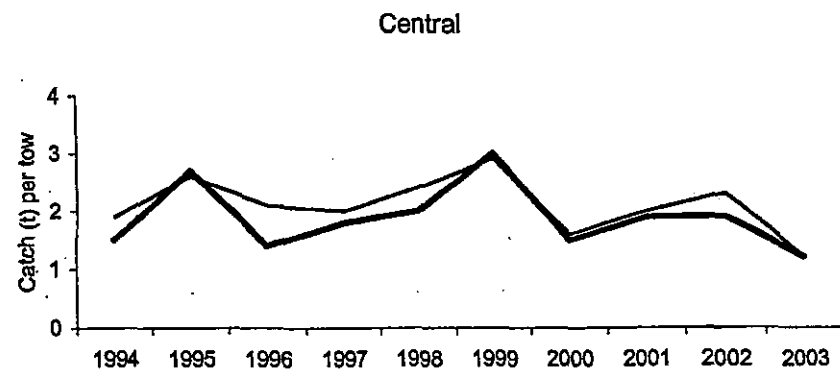
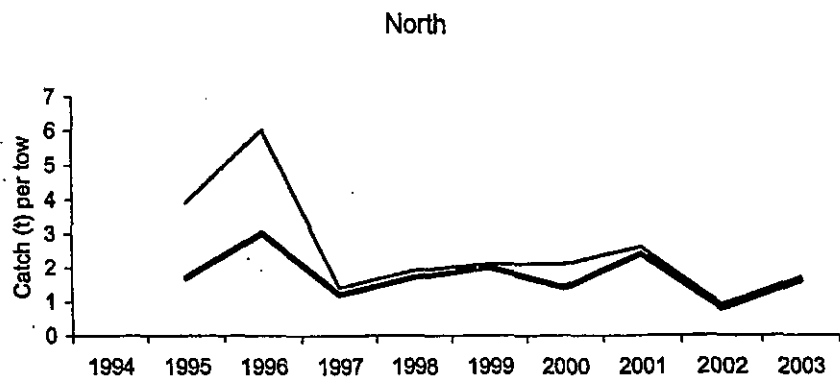
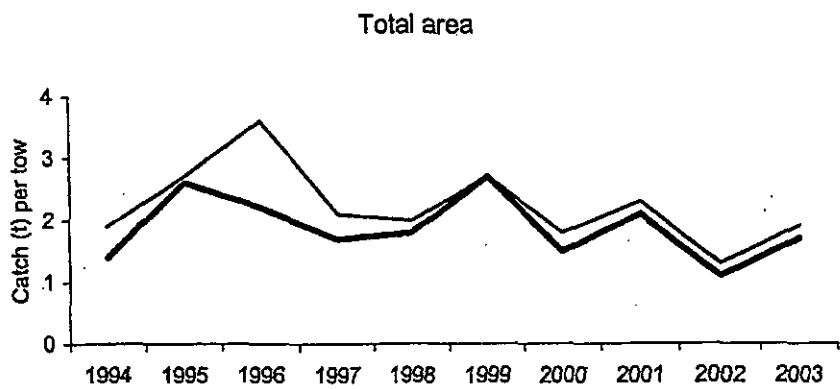


Figure 12: Unstandardised CPUE (t/tow) by area by year for all months (heavy line) and for the winter (thin line).

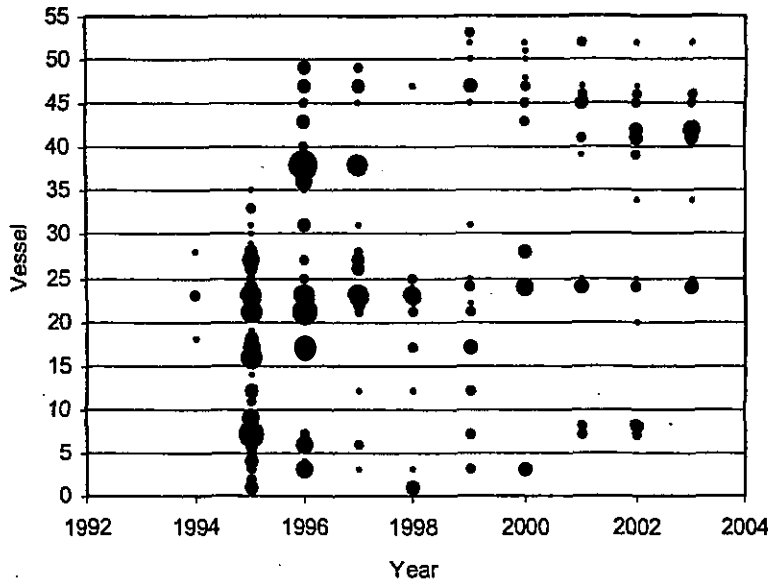


Figure 13: Annual distribution of tows by vessels included in the CPUE analysis from the Louisville Ridge. Circle area is proportional to the number of tows in each year. 1992 on x-axis refers to the 1991–92 fishing year.

3.6.3.1 Individual seamounts CPUE

The Louisville Ridge consists of an extensive chain of seamounts. The distribution of fishing has varied over time between seamounts, and this is thought to have been a confounding factor in previous CPUE analyses (Clark 2000) where broad regions have been considered. Up to 11 seamounts were chosen by Clark & Anderson (2001, 2003) and Clark (2003) to examine changes in catch and effort on the scale of an individual seamount (Figure 14). Over the duration of the fishery, these 11 features have accounted for 80% of the tows by New Zealand vessels, and 81% of the orange roughy catch.

Most of the seamounts have experienced a general decrease in catch rates over time (Figure 15), with broadly similar patterns in winter as the entire year. However, as one might expect, the extent of the decrease has varied between seamounts, indicating that the extent of depletion is unlikely to have been consistent over the large area covered by the fishery. Northern and western seamounts have seen large fluctuations in catch rates, and the major central seamounts of Mts Ghost and Whales a more gradual and consistent decline to 2000–01 and 2001–02 when high catch rates occurred on Mt Ghost. Catch rates have decreased on these seamounts again in 2002–03. Catch rates on those seamounts further east are more variable, although East 2, 3, and 4 catch rates have dropped markedly in recent fishing years.

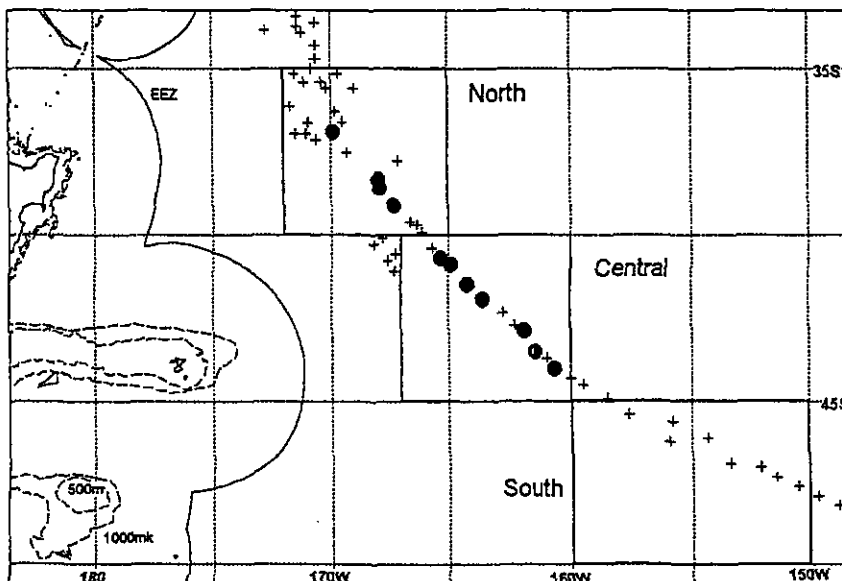


Figure 14: Location of the 11 seamounts (closed circles) relative to known seamounts (+) on the Louisville Ridge.

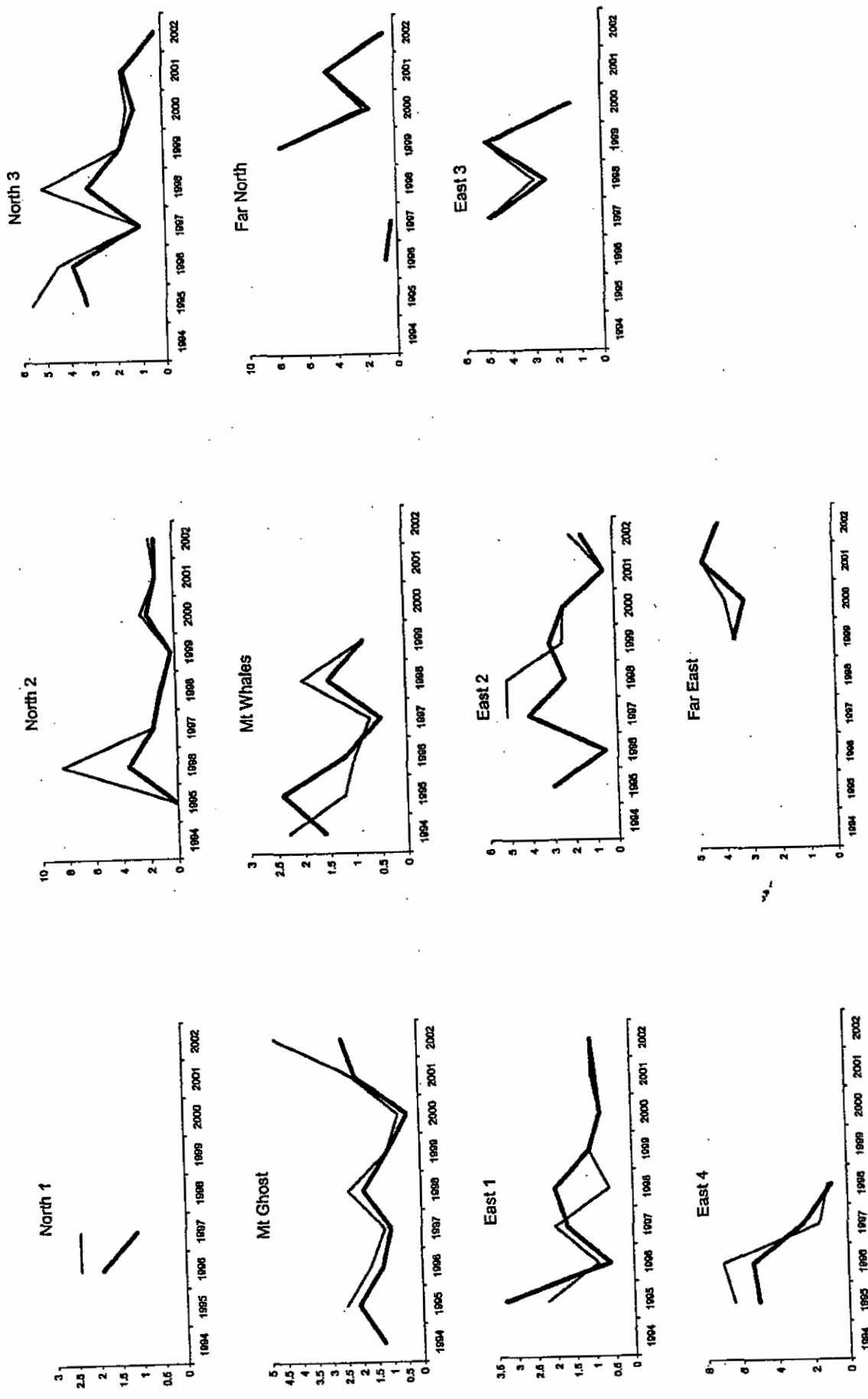


Figure 15: Unstandardised CPUE (t/tow, y-axis) on selected seamount groups by year for all months (heavy line) and for the winter (thin line) by fishing year (x-axis).

3.7 South Tasman Rise fishery

3.7.1 Catch effort data

The fishery started in September 1997, and expanded rapidly as more Australian and New Zealand boats entered the fishery; an estimated 3900 t was caught in the 1997–98 fishing year (Table 24). Reported catches were 1700 t the following year, and increased to over 4000 t in 1999–2000. Three South African and one Belizean vessels fished for a period during the 1999 winter, but no other non-Australasian vessels are known to have fished the region. Oreos were previously taken as bycatch in the fishery, with over 1000 t in both 1997–98 and 1998–99. Catches have dropped markedly since then, to about 100–200 t per year, but exceeded the orange roughy catch in 2003–04.

Table 24: Catch (t, rounded to nearest 5 t) of orange roughy (ORH) and oreos (OEO) by fishing year, 1996–97 to 2003–04 (up to December 2004). (Aus, Australia; NZ, New Zealand).

	ORH				OEO			
	Aus	NZ	Other	TOT	Aus	NZ	Other	TOT
1996–97	5	0	0	5	45	0	0	45
1997–98	3 520	410	0	3 930	1 085	120	0	1 205
1998–99	190	515	0	1 705	1 290	300	0	1 590
1999–2000	1 720	1 640	>750	>4 110	190	25	30	245
2000–01	790	40	0	830	190	80		270
2001–02	170	0	0	170	120	0	0	120
2002–03	110	0	0	110	70	0	0	70
2003–04	(5)	0	0	(5)	(160)	0	0	(160)

The fishery was formally regulated from March 1998. Following the establishment of a Memorandum of Understanding (MoU) between Australia and New Zealand in December 1998, a precautionary TAC of 2100 t was agreed on for 1 March 1998 to 28 February 1999, with an additional 300 t being made available for research surveys by commercial vessels during the winter spawning season. The MoU was not renewed for the 1999–2000 fishing season. The TAC was subsequently increased to 2400 t for the 2000–01 fishing season, before being reduced in 2002–03 to 1800 t, and subsequently to 800 t and 600 t for 2003–04 and 2004–05 respectively.

Detailed catch-effort data are available from a total of 33 Australian and New Zealand vessels, which have carried out 5197 trawls (Table 25). Overall, catch rates have been variable, whether measured by tonnes per tow or tonnes per hour (catch rates per distance are not given for this fishery, as Australian vessels do not report towing speed (which is used with tow duration to estimate distance)). Mean catch rates dropped from peak levels in 1997–98 and 1999–2000 to about one-third for 2000–01 to 2002–03. Catch rates in 2003–04 to the end of December 2003 have been extremely low.

3.7.2 Seasonal and spatial distribution of catch and effort

Data on levels of effort and catch by month are presented in Tables 26 and 27. Catch and effort levels were high in September–November 1997, and for the first few months of 1998 until the MoU came into effect. The MoU had limitations on the amount of catch in 6 month blocks per year, and this had the effect of forcing effort into March and April as fishers competed for the available quota. Since 2000–01, effort has focussed more on the winter months, as catches and catch rates (Table 28) outside July and August have decreased. However, even in the peak spawning months, catches have not generally been large despite intensive effort, and catch rates have been relatively low.

Table 25: Summary of groomed tow-by-tow data from the South Tasman Rise (combined Australian and New Zealand data).

Fishing year	Number of vessels	Number of tows	Total recorded catch (t)	Mean tow length (h)	Mean catch rate (t/tow)	Mean catch rate (t/h)
1996-97	2	61	4	0.6	0.1	0.5
1997-98	20	1 132	3 930	0.7	3.5	17.4
1998-99	18	1 332	1 705	0.6	1.3	10.4
1999-2000	16	1 086	3 360	0.5	3.1	21.1
2000-01	15	1 155	830	0.4	0.7	6.7
2001-02	5	201	170	0.8	1.0	3.5
2002-03	6	164	110	0.5	0.9	7.9
2003-04	5	67	2	0.3	0.1	0.4

Table 26: Monthly distribution of effort (number of tows) of New Zealand and Australian vessels.

Fishing year	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
1996-97	0	0	0	0	0	0	0	0	0	0	0	0
1997-98	6	0	6	13	0	1	57	239	316	0	87	339
1998-99	415	8	0	0	15	36	318	198	58	63	11	210
1999-2000	374	452	186	12	2	0	13	6	0	10	0	31
2000-01	145	200	62	57	441	165	37	0	25	7	10	6
2001-02	6	6	33	22	32	61	10	0	24	0	6	0
2002-03	4	0	2	0	56	90	0	0	0	0	9	3
2003-04	1	0	0	5	4	12	0	11	26	8	0	0

Table 27: Monthly distribution of catch (t) of New Zealand and Australian vessels. Blanks indicate months when there was no effort (see Table 26).

Fishing year	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
1996-97												
1997-98	0		0	0		0	106	1319	431		314	1748
1998-99	1042	0			0	238	13	37	8	1	0	269
1999-2000	445	1687	956	118	0		0	0		0		2
2000-01	31	20	13	96	620	48	0		0	0	0	0
2001-02	0	0	2	1	87	68	0		12		0	0
2002-03	0		0		62	41					9	0
2003-04	0			0	0	1		0	2	0		

Table 28: Monthly distribution of catch rates (t/tow) in the South Tasman Rise orange roughy fishery from New Zealand TCEPR returns. Blanks indicate months when there was no effort (see Table 26).

Fishing year	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
1996-97												
1997-98	0		0	0		0	1.9	5.5	1.4		3.6	5.1
1998-99	2.5	0			0	6.6	0	0.2	0.1	0	0	1.3
1999-2000	1.2	3.7	5.1	9.8	0		0	0		0		0
2000-01	0.2	0.1	0.2	1.7	1.4	0.3	0		0	0	0	0
2001-02	0	0	0.1	0	2.7	1.1	0		0.5		0	
2002-03	0		0		1.1	0.4					1.0	0
2003-04	0			0	0	0		0	0.1	0		

Vessel composition has varied between years: many vessels have fished in only one or two years (Figure 16). Since 2001–02, the number of vessels has decreased, with New Zealand boats leaving the fishery completely. The number of tows carried out by individual vessels has also declined markedly.

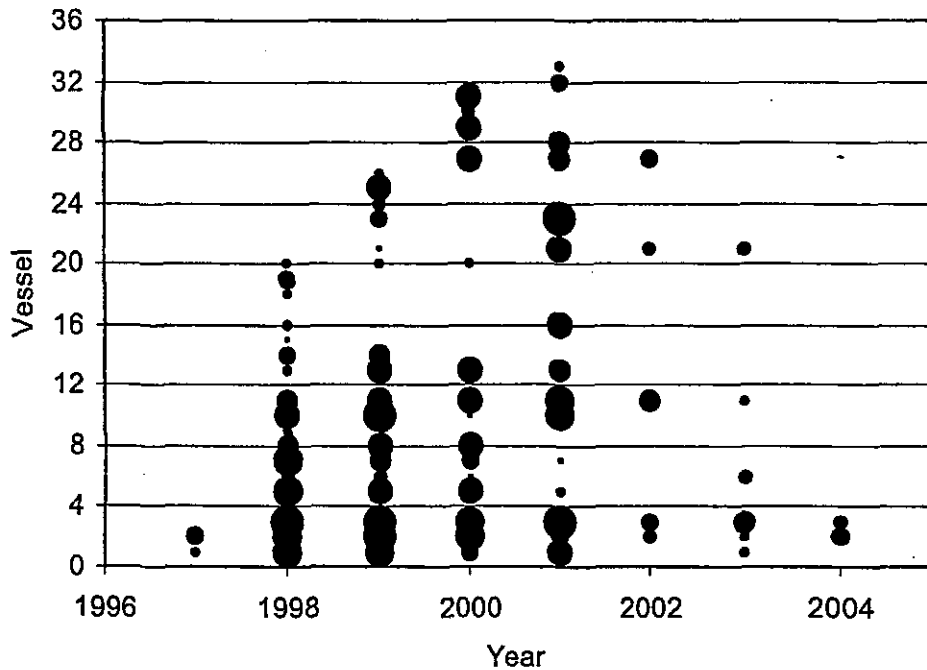


Figure 16: Annual distribution of tows by vessels on the South Tasman Rise. Circle area is proportional to the number of tows in each year. 1998 on x-axis refers to the 1997–98 fishing year.

The distribution of deepwater trawl shots (target/catch of orange roughy) is not plotted for this fishery (unlike the others) because, for the last three years, only Australian vessels have been involved in the fishery, and there is a need to preserve the confidentiality of their positional data.

4. DISCUSSION

Most fisheries outside the New Zealand EEZ continue to have variable levels of catch and effort between years. This restricts the usefulness of detailed catch-effort analyses, and, for Lord Howe Rise, CPUE has not been accepted as a measure of abundance. Data from the Northwest Challenger Plateau and Louisville Ridge are more stable, although even with these fisheries changes in the vessel composition over time and the areas fished between years pose difficulties. Standardised CPUE analyses were not carried out this year, but unstandardised CPUE has been updated to continue monitoring general trends in the fisheries.

Mean catch rates for the Lord Howe Rise, Northwest Challenger Plateau, and Louisville Ridge fisheries are broadly similar to the levels in recent years, and these fisheries appear to be relatively stable, although catch rates are quite low. The fishery on the South Tasman Rise has declined to very low levels, with an apparent shift to fishing for oreo rather than orange roughy. New Zealand vessels have not fished the Rise for three years. The West Norfolk Ridge fishery developed rapidly in 2002–02, but catch and catch rates have decreased substantially in 2002–03, raising concerns about the state of stock/s in that area.

Each of these fisheries should continue to be closely monitored, as typical catch rates are low, and none appear to represent substantial exploitable stocks, particularly if ecosystem concerns are considered. Levels of effort have increased substantially on Lord Howe Rise and Northwest Challenger Plateau grounds over the last two years, and this may require future management action to limit effort on the grounds to avoid further depletion of the stocks.

5. ACKNOWLEDGMENTS

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