



Descriptive analysis of catch and effort data from New Zealand orange roughy fisheries in ORH 1, 2A, 2B, 3A, 3B, 7A, and 7B to the end of the 2008–09 fishing year

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EXECUTIVE SUMMARY

Anderson, O.F.; Dunn, M.R. (2012). Descriptive analysis of catch and effort data from New Zealand orange roughy fisheries in ORH 1, 2A, 2B, 3A, 3B, 7A, and 7B to the end of the 2008–09 fishing year.

New Zealand Fisheries Assessment Report 2012/20. 82 p.

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 2008–09 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.

Catch totals, and patterns of catch and effort over time and space, were examined for each of the fisheries. The fishing grounds included are Northern North Island (ORH1), Challenger Plateau fishery (ORH7A), Mid-East Coast and East Cape (ORH2A, ORH2B, ORH3A), Chatham Rise and Sub-Antarctic (ORH3B), and West Coast South Island (ORH7B).

The TACCs for 2007–08 and 2008–09 were unchanged from 2006–07 for ORH1, ORH2A, ORH2B, ORH3A, ORH7A, and ORH7B. The TACC for ORH3B was reduced from 11 500 t in 2006–07, to 10 500 t in 2007–08, and then to 9420 t in 2008–09. The TACC was caught in ORH2A, ORH2B, and ORH3A, and under-caught in ORH1 and ORH3B. The fisheries in ORH7A and ORH7B remained effectively closed. Overall, the TACC was under-caught by 502 t (4%) in 2007–08, and 1167 t (9%) in 2008–09. Almost all orange roughy catches continued to be taken by bottom trawls targeting orange roughy. 2007–08 and 2008–09 were the first years in which only domestic registered vessels operated in the fishery.

The ORH1 TACC of 1400 t was under-caught by 296 t (21%) in 2007–08, and 495 t (35%) in 2008–09. The overall spatial pattern of catch and effort was largely unchanged from previous years. The seasonality of the fishery was largely unchanged. Unstandardised catch rates decreased in several subareas, but overall were close to the long-term average.

The ORH2A, ORH2B, and ORH3A catches have generally followed the TACCs, which have remained unchanged. The last three years of the fishery have been typical, and focused on the same areas, and fishing throughout the year. There was relatively little spatial progression in catches or effort, with most of the catch taken from recognised areas. Unstandardised catch rates were relatively low, but have continued to slowly and steadily improve in recent years.

The TACC for ORH 3B was reduced, but under-caught, by 209 t in 2007–08, and 662 t in 2008–09. The Puysegur area remained effectively closed. The overall fishing pattern on Chatham Rise was largely unchanged from recent years, with no new substantial areas developed. Catches from the Andes declined dramatically during 2007–08 and 2008–09. The steady spatial progression of the Sub-Antarctic fishery continued, with effort relatively widespread in 2008–09. Catches from north Pukaki continued to dominate the non-Chatham catch, although catch from the Priceless area on north Pukaki continued to decline. Most catch on the Chatham Rise was taken just prior to, or during, the spawning season (July). The fishery in the Sub-Antarctic shifted to later in the year, and in 2008–09 most effort and catch was during July and August. Unstandardised catch rates from the Northwest Chatham Rise showed no trend. On the East and South Chatham Rise, catch rates from the Andes, Chiefs, and Northeast Hills were either relatively low with no recent trend, or declined to an historical low. Catch rates in the Sub-Antarctic were relatively low, and declined dramatically for Priceless and north Pukaki.

1. INTRODUCTION

Orange roughy are widespread in New Zealand waters (Figure 1), and occur in all areas of the upper continental slope at depths between 700 and 1500 m. 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), Cook Canyon in the mid 1980s, and Puysegur Bank, East Cape, and Bay of Plenty in the early 1990s (Clark 1995). More recently, new fisheries have developed on parts of the Campbell Plateau. There have been, or are currently, over 15 major fishing grounds, which are distributed between eight Quota Management Areas (QMAs) (labelled *ORH 1*, *ORH 2B*, etc., in Figure 1).

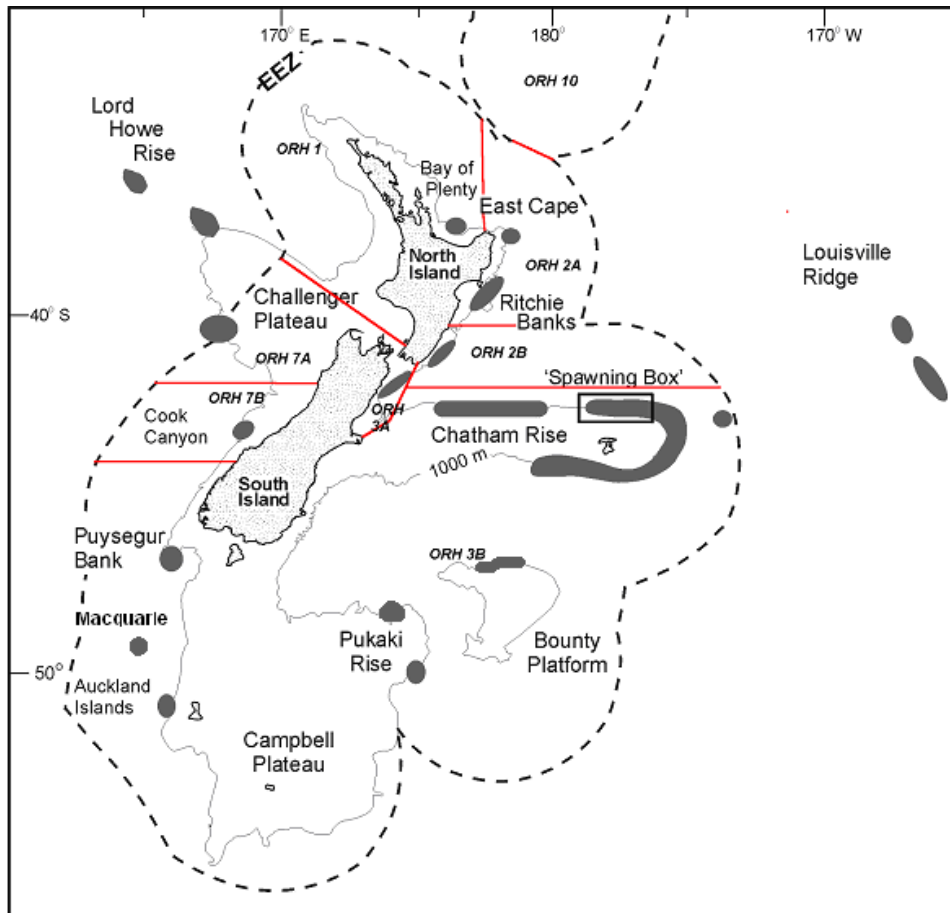


Figure 1: The New Zealand region, showing the distribution of the main orange roughy fishing grounds (grey areas), the main fishery names as mentioned in the text, and Quota Management Areas (italicised) for orange roughy.

The size of the total fishery was relatively stable during the 1980s, with landings of about 40 000–50 000 t, 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 and inform the stock assessment for each fishery, commercial catch and effort data must be monitored and the descriptive analysis of the commercial catch and effort data updated annually (Ministry of Fisheries 2008). This report therefore summarises the catch and effort of fishing vessels targeting or catching

orange roughy in all fisheries within the New Zealand Exclusive Economic Zone (EEZ) by undertaking analyses of the detailed tow-by-tow records of fishing activity made by vessel skippers and held in the *Catcheff* database of the Ministry of Fisheries. The work described in this report was carried out under Ministry of Fisheries project ORH2008/02: Objective 1, “*To update the descriptive analysis of the commercial catch and effort data from selected orange roughy fisheries with the inclusion of data up to and including the 2008/09 fishing year. These fisheries include ORH 1, ORH 2A (North and South), ORH 2B, ORH 3A, ORH 3B (Chatham Rise and other areas).*”

Although not specified in the Ministry of Fisheries contract, for completeness the Challenger Plateau fishery (ORH 7A) and West Coast South Island (ORH 7B) fisheries are also included. The Challenger Plateau fishery has had a TACC of only 1 t since 2000–01, and although fishing since then has been limited to industry-led spawning surveys carried out in the winters of 2005, 2006, and 2009, fishing effort may intensify with an increase in TACC from 1 October 2010. The West Coast South Island fishery was closed from 2007–08.

This report updates Anderson & Dunn (2008), for the fishing years 2007–08 and 2008–09. Although the orange roughy fishery description is regularly updated, the level of detail varies between reports in response to research efforts focusing on specific areas for stock assessment.

2. REVIEW OF THE FISHERY

2.1 Data sources and methods

Estimated catch and effort data for the orange roughy fishery have mostly been 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 provided daily estimated catch records with effort as the number and total duration of tows in the day. CELR forms have mostly been used by smaller inshore vessels. Larger deepwater vessels (over 28 m in length) are required to complete TCEPR forms. There are also “high-seas” versions of both form types for use by vessels fishing outside the New Zealand EEZ. A new form, the Trawl Catch Effort Return (TECR), was introduced on 1 October 2007 and records similar catch and effort data to the TCEPR forms. The use of the TECR form in the orange roughy fishery has been minor in the two years since being introduced (about 100 tows). Up-to-date data from each form type for the last three fishing years were requested from the Ministry of Fisheries catch-effort database in March 2010. TCEPR/TCER data were combined with data from previous extracts to provide a full set of tow-by-tow data for the entire history of the fishery. CELR data were stored in a spreadsheet file. This report focuses on data from the more detailed TCEPR/TCER forms. Although CELR forms were widely used in earlier years their use in most fisheries has declined over time, representing less than 10% of the total estimated catch since 1993–94, and they were not used to record any orange roughy fishing in either 2007–08 or 2008–09. Where CELR data were included in any table or figure, this is indicated in the text.

Data were selected from all trawls where orange roughy were either the declared target species, or were caught. TCEPR/TCER data were comprehensively error-checked using routines developed in the statistical software package R (Ihaka & Gentleman 1996). Error checks were performed for recorded bottom depth, fishing depth, location, trawl speed and duration, and time of day. Missing or erroneous values were replaced with imputed average values. For example: where depth was missing it was replaced with the median depth from all other tows recorded within 1 n. mile of that tow position. Obvious errors in the recording of target species, or due to confusion of the western with the eastern hemisphere, were also corrected. All tows were then assigned to a QMA and fishery or subarea.

Data for the 2008–09 fishing year may have been incomplete because any forms submitted by fishing vessels after the February request date will not have been entered into the Ministry database. Any records containing errors that could not be resolved or corrected were excluded from any analyses.

The total dataset of TCEPR/TCER recorded trawls, where orange roughy were either the declared target species or were caught, included 4420 records for 2007–08, and 4709 records for 2008–09.

3. THE TOTAL ORANGE ROUGHY FISHERY

3.1 Summary for 2007–08 and 2008–09

- The TACCs for 2007–08 and 2008–09 were unchanged from 2006–07 for ORH1, ORH2A, ORH2B, ORH3A, ORH7A, and ORH7B. The TACC for ORH3B was reduced from 11 500 t in 2006–07, to 10 500 t in 2007–08, and then to 9420 t in 2008–09.
- The TACC was caught in ORH2A, ORH 2B, and ORH3A, and under-caught in ORH1 and ORH3B. The fisheries in ORH7A and ORH7B remained effectively closed. Overall, the TACC was under-caught by 502 t (4%) in 2007–08, and 1167 t (9%) in 2008–09.
- Almost all orange roughy catches continued to be taken by bottom trawls targeting orange roughy.
- 2007–08 and 2008–09 were the first years in which only domestic registered vessels operated in the fishery.

3.2 Total catch

The New Zealand orange roughy fishery began in 1979–80, when landings of 11 800 t were reported from ORH 3B. The fishery expanded steadily, into ORH 7A in 1980–81, ORH 2B in 1981–82, ORH 3A in 1982–83, ORH 7B and ORH 2A in 1983–84, and finally into ORH 1 in 1984–85. Catches in all areas were controlled by TACCs by 1986–87 (Figure 2).

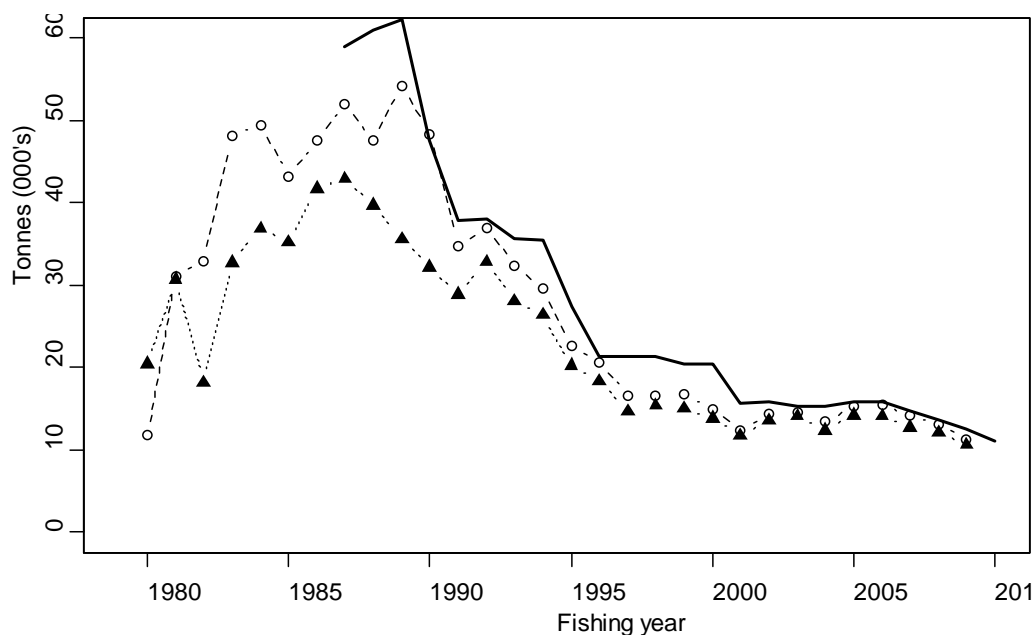


Figure 2: The total reported catch (o), TCEPR estimated catch (▲), and TACC (solid line) from 1986–87 (the year from which all areas were subject to TACCs), for orange roughy within the New Zealand EEZ.

The largest catches by far have come from ORH 3B, where annual landings have never fallen below 8500 t, and for a 13-year period from 1980–81 to 1992–93 annual landings were 20 000–30 000 t. Total landings of orange roughy peaked at just over 54 000 t in 1988–89. The TACC also peaked in 1988–89, at 62 294 t.

The total reported catch of orange roughy decreased from 14 167 t in 2006–07 to 11 365 t in 2008–09, a decrease of about 20% (Table 1). The reported landings were 3–4% below the TACC between 2004–05 and 2007–08, decreasing to 9% below the TACC in 2008–09. The TACCs remained unchanged from at least the past five fishing years in all QMAs except for ORH 3B and ORH 7B. In ORH 3B, the TACC was reduced by 1200 t in 2006–07, by a further 1000 t in 2007–08, and again by 1080 t in 2008–09. In ORH 7B, the TACC was reduced from 110 t to 1 t in 2007–08. The TACC has been under-caught in ORH 1 in each of the past eight fishing years, and under-caught since 1986–87 in ORH 3B. In recent years all other QMAs reported landings have generally been close to the TACC.

Table 1: Reported landings (t) and TACCs (t) of orange roughy by QMA for 1979–80 to 2008–09. There have been no reported landings in ORH 10 (Kermadecs) where there is a 10 t TACC.

	ORH 1		ORH 2A		ORH 2B		ORH 3A	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC
1979–80	0	–	0	–	0	–	0	–
1980–81	0	–	0	–	0	–	0	–
1981–82	0	–	0	–	554	–	0	–
1982–83	< 1	–	0	–	3 510	–	253	–
1983–84	< 1	–	162	–	6 685	–	554	–
1984–85	96	–	1 858	–	3 310	3 500	3 266	§
1985–86	2	–	2 778	4 576	867	1 053	4 326	2 689
1986–87	< 1	10	4 934	5 500	963	1 053	2 555	2 689
1987–88	0	10	6 203	5 500	982	1 053	2 510	2 689
1988–89	19	10	5 710	6 060	1 236	1 367	2 431	2 839
1989–90	86	190	6 239	6 106	1 400	1 367	2 878	2 879
1990–91	200	190	6 051	6 106	1 384	1 367	2 553	2 879
1991–92	112	190	6 329	6 286	1 327	1 367	2 443	2 879
1992–93	49	190	5 807	6 386	1 080	1 367	2 135	2 879
1993–94	189	190	6 610	6 666	1 259	1 367	2 131	2 300
1994–95	244	190	6 202	7 000	754	820	1 686	1 840
1995–96	965	1 190	4 268	4 261	245	259	612	580
1996–97	1021	1 190	3 761	4 261	272	259	580	580
1997–98	511	1 190	3 827	4 261	254	259	570	580
1998–99	* 1 543	1 190	3 335	3 761	257	259	582	580
1999–00	* 1 476	1 190	3 122	3 761	234	259	617	580
2000–01	858	800	1 385	1 100	190	185	479	415
2001–02	1 294	1 400	1 087	1 100	180	185	400	415
2002–03	1 123	1 400	719	680	105	99	235	221
2003–04	986	1 400	703	680	103	99	250	221
2004–05	1 151	1 400	1 120	1 100	206	185	416	415
2005–06	1 207	1 400	1 074	1 100	172	185	415	415
2006–07	1 036	1 400	1 131	1 100	203	185	401	415
2007–08	1 104	1 400	1 068	1 100	209	185	432	415
2008–09	905	1 400	1 114	1 100	173	185	414	415

§ Included in QMA 3B TACC

* Includes catches taken under an exploratory permit, not covered by the TACC: 699 t in 1998–99 and 704 t in 1999–2000.

Table 1—Continued

	ORH 3B		ORH 7A		ORH 7B		Total	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC
1979–80	11 800	–	0	–	0	–	11 800	0
1980–81	31 100	–	33	–	0	–	31 133	0
1981–82	28 200	23 000	4 248	–	0	–	33 002	23 000
1982–83	32 605	23 000	11 839	–	0	–	48 207	23 000
1983–84	32 535	30 000	9 527	4 950	2	–	49 465	34 950
1984–85	29 340	30 000	5 117	4 950	282	–	43 269	38 450
1985–86	30 075	29 865	7 753	6 190	1 763	1 558	47 564	45 931
1986–87	30 689	38 065	11 492	10 000	1 446	1 558	52 079	58 885
1987–88	24 214	38 065	12 181	12 000	1 413	1 558	47 503	60 885
1988–89	32 785	38 300	10 241	12 000	1 750	1 708	54 172	62 294
1989–90	31 669	32 787	4 309	2 500	1 711	1 708	48 292	47 547
1990–91	21 521	23 787	1 357	1 900	1 683	1 708	34 749	37 947
1991–92	23 269	23 787	1 911	1 900	1 604	1 708	36 995	38 127
1992–93	20 048	21 300	2 087	1 900	1 139	1 708	32 345	35 740
1993–94	16 960	21 300	1 732	1 900	701	1 708	29 582	35 441
1994–95	11 891	14 000	1 636	1 900	290	1 708	22 703	27 468
1995–96	12 501	12 700	1 669	1 900	446	430	20 706	21 330
1996–97	9 278	12 700	1 308	1 900	425	430	16 645	21 330
1997–98	9 638	12 700	1 502	1 900	330	430	16 632	21 330
1998–99	9 372	12 700	1 249	1 425	405	430	16 743	20355
1999–00	8 663	12 700	629	1 425	284	430	15 025	20355
2000–01	9 274	12 700	< 1	1	161	430	12 347	15641
2001–02	11 324	12 700	< 1	1	95	110	14 380	15921
2002–03	12 333	12 700	4	1	90	110	14 609	15221
2003–04	11 254	12 700	< 1	1	119	110	13 415	15221
2004–05	12 369	12 700	* < 1	1	106	110	15 368	15921
2005–06	12 554	12 700	* < 1	1	77	110	15 499	15921
2006–07	11 271	11 500	< 1	1	125	110	14 167	14721
2007–08	10 291	10 500	< 1	1	6	1	13110	13612
2008–09	8 758	9 420	* < 1	1	1	1	11365	12532

* Research survey catches of 158 t (2004–05), 200 t (2005–06), and 240 t (2008–09) were not reported.

Between 2006–07 and 2008–09, 92–94% 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 (Table 2). In 2006–07, about 2% of these estimated catches were recorded on the daily summary CELR forms, but since then all recording has been on the more detailed TCEPR-type forms (Table 2 and Figure 2).

Table 2: Summary of reported landings, TACCs, and recorded catch totals from TCEPR and CELR data, for fisheries within the EEZ in the fishing years 2006–07 to 2008–09.

	2006–07	2007–08	2008–09
Reported landings (QMS)	14 167	13 110	11 365
TACC	14 721	13 612	12 532
TCEPR estimated catch	12 770	12 093	10 654
CELR estimated catch	312	0	0
Total estimated catch	13 082	12 093	10 654
Estimated catch/reported landings (%)	92.3	92.2	93.7

The good agreement between the estimated catches and reported landings, and almost universal use of the TCEPR forms, means that the fishery characterisations in this report, which are mostly based on the tow-by-tow TCEPR data alone, will represent the total fishing effort well.

The proportion of fishing effort reported to the various target fisheries in 2008–09 was similar to that in 2007–08, and other recent years, with most tows targeting orange roughy (Table 3). For other target species, changes between years in the percentage of tows where orange roughy were caught were small (0–3%).

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

	2007–08		2008–09	
	No. tows	% tows	No. tows	% tows
Orange roughy	3 687	88	3 554	89
Oreos (unspecified)	85	2	0	0
Smooth oreos	135	3	241	6
Black oreo	47	1	61	1
Cardinalfish	158	4	139	3
Alfonsino and long-finned beryx	21	1	15	0
Other (hoki, hake, silver warehou, bluenose, spiky oreo)	59	1	57	1

New Zealand domestic vessels have increasingly dominated the orange roughy fishery over the last ten fishing years, with the low level of foreign effort from mostly Korean and Ukrainian vessels ending in 2007–08 (Table 4).

Table 4: Summary of effort in the orange roughy fishery by vessel nationality. Percentages are rounded to the nearest 1%.

	Percentage of tows by nation				Total tows
	Domestic	Korea	Ukraine	Other	
1999–00	95	3	1	1	9 423
2000–01	96	2	0	2	7 568
2001–02	94	4	2	0	8 382
2002–03	93	2	2	3	8 520
2003–04	90	3	2	5	7 766
2004–05	96	2	2	0	7 338
2005–06	95	4	0	0	6 288
2006–07	96	4	1	0	4 981
2007–08	100	0	0	0	4 418
2008–09	100	0	0	0	4 703

4. NORTHERN NORTH ISLAND FISHERIES (ORH 1)

4.1 Summary for 2007–08 and 2008–09

- The ORH1 TACC of 1400 t was under-caught by 296 t (21%) in 2007–08, and 495 t (35%) in 2008–09.
- The overall spatial pattern of catch and effort was largely unchanged from previous years. Sequential fishing of sub-areas was not pronounced, with increased fishing on the “Clark” seamount (to the east of Mercury-Colville), and there was no longer any fishing on the North Colville Ridge or Aldermen Knoll.
- The seasonality of the fishery was largely unchanged, with just over half of the catch taken during June and July.

- There were only four vessels operating in the fishery. The proportion of orange roughy catches reported in tows targeting orange roughy increased.
- Unstandardised catch rates have been variable, and decreased in several subareas, but overall were close to the long-term average.

4.2 Total catch

The coastline of ORH 1 extends northwards from north of Wellington on the west coast of the North Island, to Cape Runaway east of the Bay of Plenty on the east coast of the North Island (Figure 3). 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, in the area now known as the Mercury-Colville Box. Further detailed analyses for the Mercury-Colville Box were presented by Clark (2001b), and stock assessments for some of the ORH 1 subareas are summarised in Ministry of Fisheries (2009).

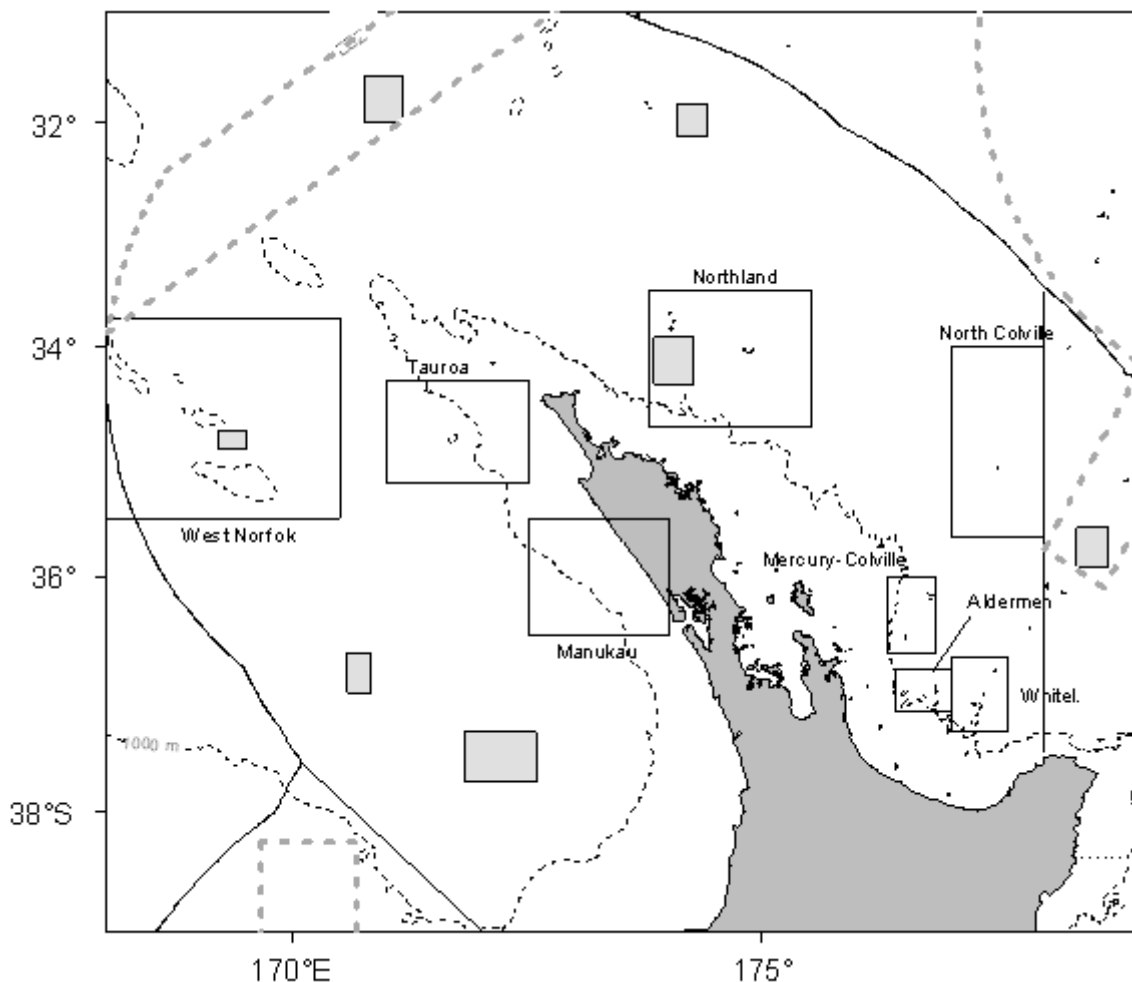


Figure 3: The ORH 1 fishery area. The position of the main grounds are marked as open rectangles, perimeters of Benthic Protection Areas* (BPAs) closed to bottom trawling are marked with dashed grey lines, and seamounts closed to trawling are marked as shaded rectangles.

* Fisheries (Benthic Protection Areas) Regulations 2007 (SR 2007/308)

An Adaptive Management Programme (AMP) was initiated for the Mercury–Colville Box in 1995, and after this concluded in 1999–2000 the ORH 1 TACC was reduced in 2000–01 to 800 t (Table 5). ORH 1 was then reintroduced into the AMP in October 2001, with the TACC increased to 1400 t, and decision rules based upon catch per unit effort (CPUE) to restrict or maintain catches, including the use of specific feature catch limits (Ministry of Fisheries 2009). This programme ran for five years, ending on 30 September 2006. In 2001–02, under the reintroduced AMP programme, the total catch was the highest recorded under TACC in ORH 1 (Table 5). The TACC has then remained at 1400 t, and catches have fluctuated between about 900 t and 1300 t. The amount of catch reported on TCEPRs has accounted for between about 90% and 100% of the reported landings since 1995–96, but in the most recent year this figure dropped to 82%. The only stock assessment for this fishery was conducted in 2001, for the Mercury–Colville Box (Ministry of Fisheries 2009). Detailed analyses of the catches and effort, and spatial patterns of CPUE, were described by Mormede (2010).

Table 5: ORH 1. Reported landings (t), TACC (t), and percentage of landings recorded on TCEPR forms, for 1989–90 to 2008–09. The figures in parentheses indicate combined exploratory (under special permit) and TACC landings.

Fishing year	Landings	TACC	Estimated TCEPR as % of landings
1989–90	86	190	73
1990–91	200	190	0
1991–92	112	190	0
1992–93	49	190	75
1993–94	189	190	100
1994–95	244	190	*160
1995–96	965	1 190	97
1996–97	1 021	1 190	97
1997–98	511	1 190	101
1998–99	845 (1 543)	1 190	101
1999–00	771 (1 476)	1 190	97
2000–01	858	800	90
2001–02	1 294	1 400	94
2002–03	1 123	1 400	90
2003–04	986	1 400	92
2004–05	1 151	1 400	88
2005–06	1 201	1 400	89
2006–07	1 036	1 400	93
2007–08	1 104	1 400	91
2008–09	905	1 400	82

* Reported landings for 1994–95 do not include about 250 t of orange roughly caught under special permit, but TCEPR records do.

4.3 Distribution of catch and effort, and catch rates

As in previous analyses, eight subareas have been defined.

- **West Norfolk Ridge.** The area within the boundary of 34.3°–35.5° S and from the EEZ boundary in the west to 170.5° E. The area was extended to the northwest in 2004–05 to encompass new fishing grounds.
- **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°–36.67° S and 176.33°–176.83° 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 pattern of catch and effort in 2007–08 and 2008–09 was similar to that of the previous two fishing years in most areas (Figure 4). Almost all of the fishing effort was contained within the recognised subareas, with the distribution of effort and catch varying only slightly between years. The main exception to this has been the “Clark” seamount east of the Mercury-Colville fishery, where intermittent fishing has been taking place since 1999, with a total catch for these ten years of about 150 t. The 41 t taken in 2008–09 (mostly from two large catches) represented the largest annual catch taken from this feature.

Most areas were fished by only one or two vessels in 2008–09, compared with mostly two or three in the previous year. The total number of vessels in the fishery dropped from between six and eight vessels per year since 1997–98, to five in 2006–07, and then to four in 2008–09.

On the **West Norfolk Ridge**, the focus of catch and effort continued to be to the northwest, close to the edge of the EEZ (Figure 4). Catches in this fishery peaked at about 350 t in 2001–02, and since then have remained steady at about 150–250 t (Table 6). Catch and effort in 2008–09 were low compared to recent years, and the median catch rate was also relatively low, at 0.1 t/tow.

On **Tauroa Knoll**, annual catches have been almost constant over the last three years, at 141–143 t (Table 6). Effort has been variable, however, as have catch rates. The median catch rate (t/tow) in 2008–09 was less than a seventh of the previous year, although similarly low catch rates were recorded from earlier in the fishery. The proportion of catches greater than 10 t was also much lower in 2008–09.

In **Manukau**, catch rates have been variable (t/tow) or gradually decreasing (t/h) over recent years, but by both CPUE measures were low in 2008–09 (Table 6). The annual catches for recent years were typical for this area. This fishery has been characterised by long tows from the outset, but tow duration has been steadily increasing, with a median tow duration in 2008–09 of 4.3 h.

In **Northland**, the fishing grounds developed in the southwest area in 2005–06 (features “Birdflue” and “Boulder Ridge”) continued to provide most of the catch from this region. Tows were typically short on hill features, and large catches were rare, but a high level of effort and median catch rates of about 0.1–0.4 t/tow have sustained an annual catch of about 200–300 t (Table 6).

There has been little effort in the **North Colville** region since 2005–06, and no fishing at all in 2008–09 (Table 6). Annual catches peaked at over 200 t in 2001–02 but halved the following year, despite a similar level of effort, and although catch rates remained relatively high in the following three years, this fishery has been mostly unattended since.

The catch limit for the **Mercury–Colville Box** was reduced to 30 t in 2000–01, to be caught as bycatch in the cardinalfish fishery. Catches of orange roughy have remained below this level in most years since (Table 6), and the target species has mostly been recorded as cardinalfish. Large catches of orange roughy have been rare, even during the peak of this fishery in the mid-1990s. Median catch rates have consistently been below or equal to 0.2 t/tow since the beginning of the fishery, but t/h have been relatively high during the last three years.

Catches in the **White Island** fishery have declined over time (from over 600 t in 1998–99 to 8 t in 2008–09), in 2008–09 there were 32 tows, and the median catch rate dropped to 0.1 t/tow and 0.3 t/h (Table 6). This area was heavily fished in the late 1990s, but effort has declined to only 20–50 tows per year since 2005–06.

Annual catch in the **Aldermen** fishery peaked at 100–140 t in the late 1990s, but with declining effort the catch has declined to less than 20 t per year since 2001–02 (Table 6).

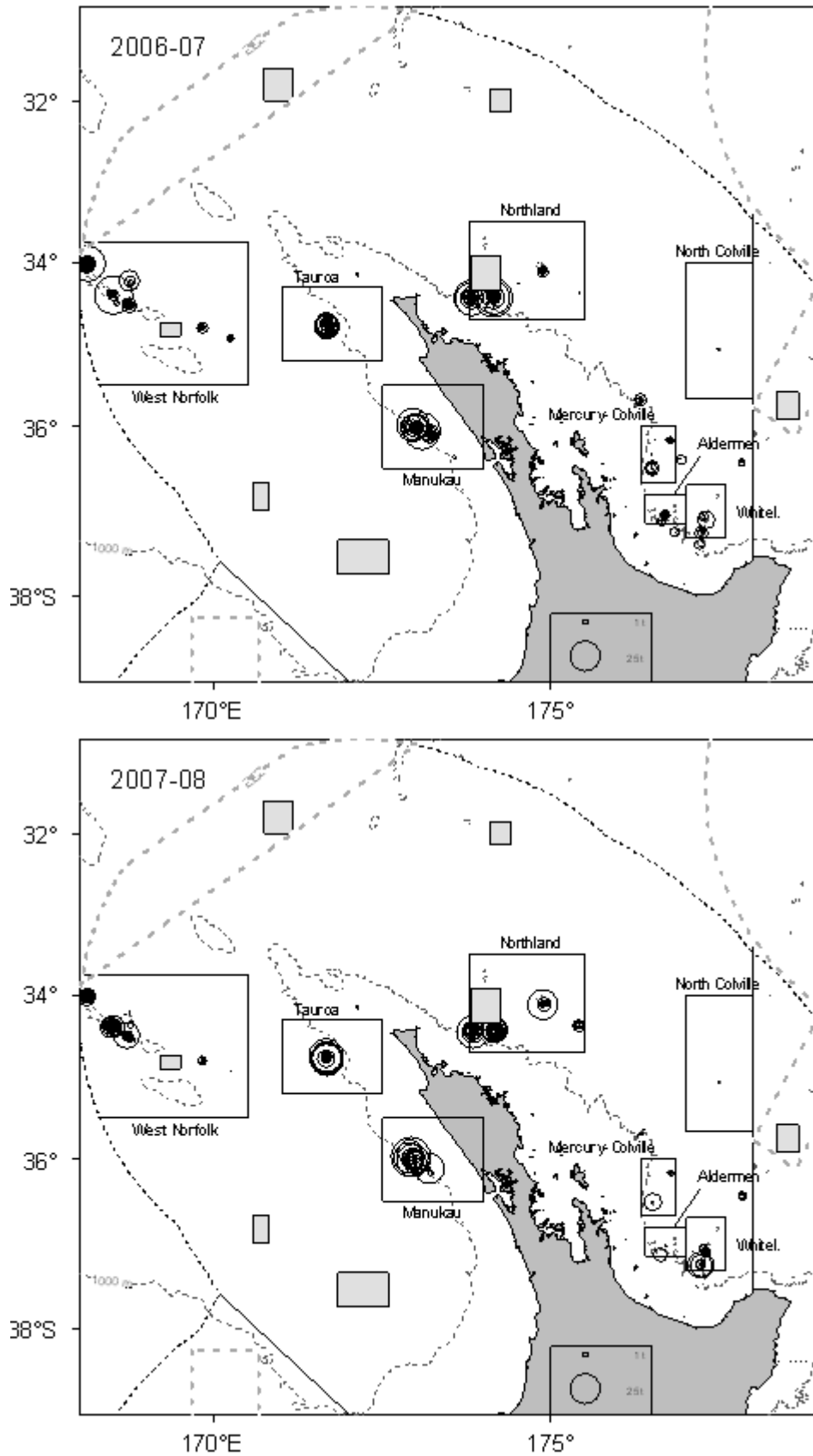


Figure 4: Distribution of trawls and orange roughy catch rate (t/tow) in ORH 1 for 2006–07 (max.catch = 40 t), 2007–08 (max.catch = 45 t), and 2008–09 (max.catch = 60 t). Perimeters of Benthic Protection Areas (BPAs) closed to bottom trawling are marked with dashed grey lines, and seamounts closed to trawling are marked as shaded rectangles

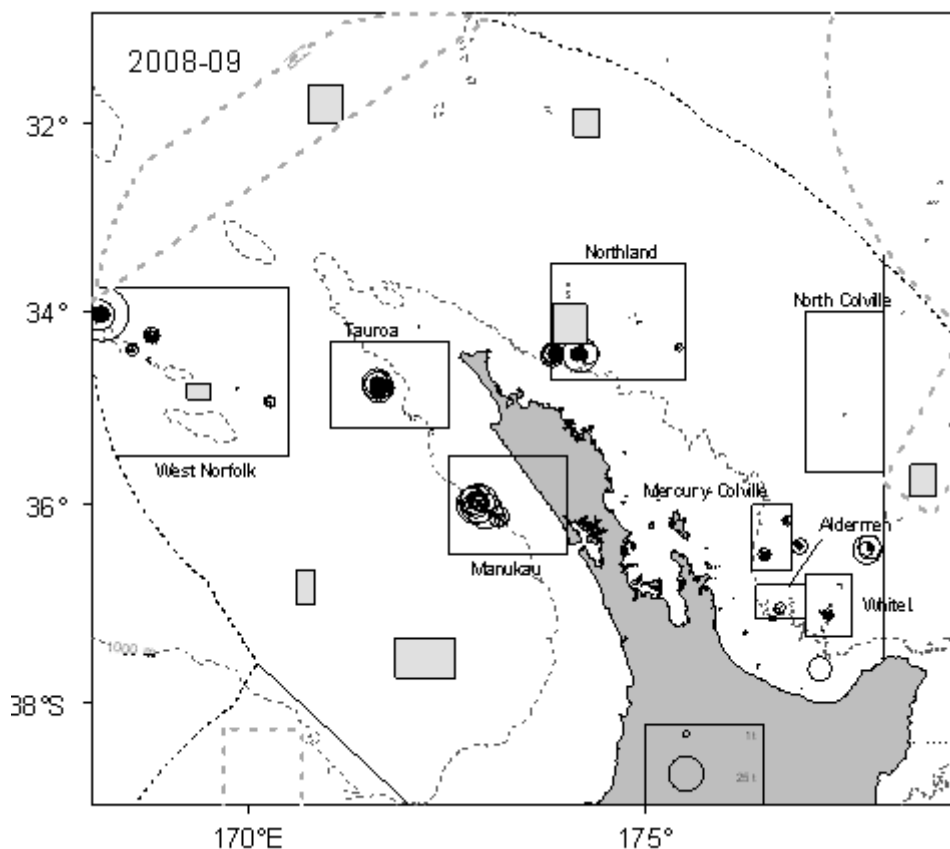


Figure 4 (cont.): Distribution of trawls and orange roughy catch rate (t/tow) in ORH 1 for 2006–07 (max.catch = 40 t), 2007–08 (max.catch = 45 t), and 2008–09 (max.catch = 60 t). Perimeters of Benthic Protection Areas (BPAs) closed to bottom trawling are marked with dashed grey lines, and seamounts closed to trawling are marked as shaded rectangles

For ORH 1 as a whole, total catch peaked at over 1500 t in 1998–99, and catches remained at just over 1000 t in most years since then. In 2008–09 the catch dropped to 740 t, the catch rate dropped, and the four vessels operating in the fishery were the fewest for 16 years (Table 6).

Table 6: Summary of effort, catch (t), catch rates, tow duration, and proportion of large catches for subareas of ORH 1 from 1989–90 to 2008–09. Catch rates and tow duration are calculated only for years in which there were ten or more tows.

Fishing year	Number of vessels	Total number of tows	% ORH target	Total estimated catch	Median catch rate (t/tow)	Median catch rate (t/h)	Median tow duration	Proportion of tows > 10 t
West Norfolk Ridge								
1989–90	0	0	–	–	–	–	–	–
1990–91	0	0	–	–	–	–	–	–
1991–92	0	0	–	–	–	–	–	–
1992–93	1	1	100	5	–	–	–	0.00
1993–94	0	0	–	–	–	–	–	–
1994–95	0	0	–	–	–	–	–	–
1995–96	1	1	100	0.1	–	–	–	0.00
1996–97	1	2	100	0	–	–	–	0.00
1997–98	1	2	100	0	–	–	–	0.00
1998–99	1	4	100	0.1	–	–	–	0.00
1999–00	1	34	82	112	0.2	0.7	0.3	0.15
2000–01	2	82	73	169	0.5	2.4	0.3	0.02
2001–02	2	172	92	357	0.2	0.9	0.3	0.07

Table 6 (cont.)

Fishing year	Number of vessels	Total number of tows	% ORH target	Total estimated catch	Median catch rate (t/tow)	Median catch rate (t/h)	Median tow duration	Proportion of tows > 10 t
West Norfolk Ridge (cont.)								
2002–03	2	114	65	219	0.2	1.2	0.2	0.04
2003–04	3	171	66	157	0.1	0.6	0.2	0.01
2004–05	2	210	65	267	0.3	1.0	0.3	0.02
2005–06	2	76	99	223	0.1	0.7	0.2	0.08
2006–07	3	195	97	266	0.2	1.1	0.2	0.02
2007–08	2	181	99	222	0.2	0.7	0.2	0.02
2008–09	1	92	99	155	0.1	0.3	0.2	0.02
Tauroa Knoll								
1989–90	0	0	–	–	–	–	–	–
1990–91	0	0	–	–	–	–	–	–
1991–92	0	0	–	–	–	–	–	–
1992–93	0	0	–	–	–	–	–	–
1993–94	0	0	–	–	–	–	–	–
1994–95	0	0	–	–	–	–	–	–
1995–96	2	19	100	44	1.0	1.9	0.8	0.05
1996–97	3	8	100	5	–	–	–	0.00
1997–98	3	25	100	6	0.0	0.0	0.5	0.00
1998–99	3	72	100	583	2.0	4.8	0.5	0.19
1999–00	4	144	100	517	1.0	1.4	0.7	0.10
2000–01	2	17	24	143	2.5	2.0	0.8	0.24
2001–02	2	37	100	176	1.5	3.0	0.3	0.24
2002–03	4	78	100	209	0.5	2.6	0.2	0.04
2003–04	6	59	98	229	2.0	3.3	0.5	0.10
2004–05	2	34	100	123	2.0	6.0	0.3	0.06
2005–06	4	103	100	197	0.5	2.7	0.3	0.01
2006–07	2	34	100	143	2.0	5.8	0.4	0.18
2007–08	2	16	100	141	3.0	40.5	0.1	0.25
2008–09	3	83	100	141	0.4	1.8	0.2	0.04
Manukau								
1989–90	0	0	–	–	–	–	–	–
1990–91	0	0	–	–	–	–	–	–
1991–92	0	0	–	–	–	–	–	–
1992–93	0	0	–	–	–	–	–	–
1993–94	1	1	100	0	–	–	–	0.00
1994–95	0	0	–	–	–	–	–	–
1995–96	0	0	–	–	–	–	–	–
1996–97	0	0	–	–	–	–	–	–
1997–98	0	0	–	–	–	–	–	–
1998–99	0	0	–	–	–	–	–	–
1999–00	0	0	–	–	–	–	–	–
2000–01	0	0	–	–	–	–	–	–
2001–02	2	44	100	115	0.2	0.1	1.7	0.11
2002–03	3	52	100	185	0.9	0.6	2.0	0.08
2003–04	4	81	100	220	1.0	0.3	2.5	0.06
2004–05	6	59	100	243	0.7	0.3	3.0	0.14
2005–06	5	156	100	134	0.5	0.2	3.3	0.00

Table 6 (cont.)

Fishing year	Number of vessels	Total number of tows	% ORH target	Total estimated catch	Median catch rate (t/tow)	Median catch rate (t/h)	Median tow duration	Proportion of tows > 10 t
Manukau (cont.)								
2006–07	3	86	99	199	0.2	0.1	4.0	0.07
2007–08	2	34	100	237	0.8	0.1	3.7	0.26
2008–09	3	53	100	172	0.2	0.1	4.3	0.09
Northland								
1989–90	0	0	–	–	–	–	–	–
1990–91	0	0	–	–	–	–	–	–
1991–92	0	0	–	–	–	–	–	–
1992–93	1	4	100	0.3	–	–	–	0.00
1993–94	0	0	–	–	–	–	–	–
1994–95	1	2	100	0	–	–	–	0.00
1995–96	1	9	100	0.3	–	–	–	0.00
1996–97	2	2	100	0	–	–	–	0.00
1997–98	1	1	100	0	–	–	–	0.00
1998–99	2	24	100	37	0.1	1.9	0.1	0.08
1999–00	2	20	100	7	0.0	0.0	0.2	0.00
2000–01	1	4	100	54	–	–	–	0.50
2001–02	2	52	100	47	0.0	0.6	0.1	0.02
2002–03	4	96	98	105	0.1	1.4	0.1	0.01
2003–04	3	51	71	49	0.1	1.1	0.1	0.00
2004–05	2	39	90	49	0.2	1.0	0.2	0.03
2005–06	2	125	94	333	0.4	3.9	0.1	0.06
2006–07	3	166	100	276	0.1	1.5	0.1	0.04
2007–08	2	148	100	313	0.3	3.2	0.1	0.05
2008–09	2	127	98	175	0.2	2.4	0.1	0.02
North Colville Ridge								
1989–90	0	0	–	–	–	–	–	–
1990–91	0	0	–	–	–	–	–	–
1991–92	0	0	–	–	–	–	–	–
1992–93	0	0	–	–	–	–	–	–
1993–94	0	0	–	–	–	–	–	–
1994–95	1	2	100	0.7	–	–	–	0.00
1995–96	2	5	100	0	–	–	–	0.00
1996–97	3	17	100	0.8	0.0	0.0	0.1	0.00
1997–98	1	4	100	0	–	–	–	0.00
1998–99	1	12	92	130	1.5	2.1	0.6	0.17
1999–00	1	65	63	120	0.1	0.4	0.3	0.08
2000–01	1	15	60	106	0.2	0.5	0.3	0.20
2001–02	2	72	86	217	0.1	1.0	0.2	0.08
2002–03	3	77	70	109	0.5	4.0	0.2	0.00
2003–04	2	26	58	90	0.4	3.0	0.2	0.08
2004–05	2	40	68	119	0.6	3.0	0.3	0.08
2005–06	1	10	70	0.2	0.0	0.0	0.2	0.00
2006–07	2	9	100	0.1	–	–	–	0.00
2007–08	1	5	80	0	–	–	–	0.00
2008–09	0	0	–	–	–	–	–	–

Table 6 (cont.)

Fishing year	Number of vessels	Total number of tows (TCEPR)	% ORH target	Total estimated catch	Median catch rate (t/tow)	Median catch rate (t/h)	Median tow duration	Proportion of tows > 10 t
Mercury-Colville								
1989-90	0	0	—	—	—	—	—	—
1990-91	0	0	—	—	—	—	—	—
1991-92	0	0	—	—	—	—	—	—
1992-93	1	1	100	2	—	—	—	0.00
1993-94	3	70	100	175	0.1	0.4	0.2	0.06
1994-95	6	138	37	369	0.2	1.0	0.2	0.04
1995-96	11	454	79	873	0.1	0.3	0.3	0.05
1996-97	10	482	85	747	0.0	0.0	0.3	0.04
1997-98	6	639	96	280	0.0	0.0	0.3	0.01
1998-99	4	238	92	131	0.0	0.0	0.3	0.01
1999-00	4	164	69	285	0.1	0.4	0.3	0.04
2000-01	3	36	3	30	0.1	0.4	0.2	0.03
2001-02	2	78	53	117	0.0	0.2	0.2	0.05
2002-03	6	69	51	39	0.0	0.3	0.2	0.01
2003-04	4	29	48	27	0.0	0.2	0.2	0.03
2004-05	3	49	14	57	0.1	0.3	0.2	0.04
2005-06	2	43	70	35	0.0	0.1	0.1	0.02
2006-07	3	43	53	22	0.0	0.3	0.1	0.00
2007-08	4	21	29	13	0.1	0.5	0.2	0.00
2008-09	1	57	12	24	0.1	0.5	0.1	0.00
White Island								
1989-90	1	8	100	18	—	—	—	0.00
1990-91	0	0	—	—	—	—	—	—
1991-92	0	0	—	—	—	—	—	—
1992-93	1	7	100	24	—	—	—	0.00
1993-94	2	5	100	2	—	—	—	0.00
1994-95	1	1	0	0	—	—	—	0.00
1995-96	0	0	—	—	—	—	—	—
1996-97	5	47	96	16	0.0	0.0	0.3	0.00
1997-98	6	249	89	64	0.1	0.1	0.7	0.00
1998-99	5	474	85	612	0.2	0.2	1.0	0.01
1999-00	4	293	86	295	0.1	0.1	0.6	0.02
2000-01	4	57	53	184	0.6	1.4	0.5	0.07
2001-02	3	70	70	130	0.1	0.1	0.3	0.06
2002-03	8	98	76	18	0.0	0.1	0.3	0.00
2003-04	4	106	83	66	0.1	0.2	0.5	0.02
2004-05	5	103	84	144	0.2	0.3	0.4	0.04
2005-06	2	20	85	74	0.4	1.6	0.3	0.10
2006-07	3	18	67	23	0.1	0.2	0.2	0.00
2007-08	3	51	65	64	0.2	0.6	0.3	0.04
2008-09	1	32	50	8	0.1	0.3	0.2	0.00
Aldermen Knoll								
1989-90	0	0	—	—	—	—	—	—
1990-91	0	0	—	—	—	—	—	—
1991-92	0	0	—	—	—	—	—	—
1992-93	2	7	100	6	—	—	—	0.00

Table 6 (cont.)

Fishing year	Number of vessels	Total number of tows	% ORH target	Total estimated catch	Median catch rate (t/tow)	Median catch rate (t/h)	Median tow duration	Proportion of tows > 10 t
Aldermen Knoll (cont.)								
1993–94	1	11	91	1	0.0	0.0	0.5	0.00
1994–95	0	0	–	–	–	–	–	–
1995–96	1	2	0	0.1	–	–	–	0.00
1996–97	5	67	100	98	0.2	0.6	0.2	0.03
1997–98	6	119	98	137	0.1	0.6	0.3	0.02
1998–99	4	33	97	24	0.1	0.0	1.0	0.00
1999–00	2	41	100	34	0.7	0.4	1.8	0.00
2000–01	1	3	33	75	–	–	–	0.67
2001–02	2	13	100	44	0.1	0.3	0.5	0.15
2002–03	4	19	100	2	0.0	0.1	0.6	0.00
2003–04	3	29	97	16	0.1	0.0	2.0	0.00
2004–05	2	16	56	4	0.1	0.1	0.6	0.00
2005–06	1	10	100	21	0.7	3.1	0.2	0.00
2006–07	2	10	90	9	0.6	0.3	2.7	0.00
2007–08	2	3	100	6	–	–	–	0.00
2008–09	1	7	100	4	–	–	–	0.00
All subareas								
1989–90	2	22	100	62	2.3	1.2	2.9	0.00
1990–91	2	2	50	0	–	–	–	0.00
1991–92	1	1	100	0	–	–	–	0.00
1992–93	4	23	100	37	0.3	1.1	0.7	0.00
1993–94	6	98	99	189	0.0	0.1	0.3	0.04
1994–95	7	149	41	397	0.2	1.0	0.2	0.05
1995–96	14	517	80	936	0.1	0.3	0.3	0.05
1996–97	11	759	90	988	0.0	0.0	0.3	0.03
1997–98	8	1128	95	514	0.0	0.0	0.3	0.01
1998–99	7	944	90	1564	0.1	0.1	0.8	0.03
1999–00	6	823	85	1437	0.1	0.3	0.4	0.04
2000–01	6	231	53	774	0.5	1.5	0.3	0.08
2001–02	7	566	85	1218	0.1	0.4	0.2	0.08
2002–03	8	717	83	1013	0.2	0.5	0.2	0.02
2003–04	6	609	79	906	0.2	0.5	0.3	0.03
2004–05	8	585	72	1019	0.2	0.6	0.3	0.04
2005–06	6	569	94	1065	0.4	0.6	0.3	0.03
2006–07	5	591	94	964	0.2	0.7	0.2	0.04
2007–08	5	491	92	1004	0.2	0.9	0.2	0.05
2008–09	4	490	84	741	0.1	0.6	0.2	0.03

In the earlier years of the ORH 1 fishery, effort was generally at the highest level in March and June or July (Clark et al. 2003). In the last three fishing years, the fishery has been focussed on the May to July period (45–70% of the effort), with October and November (19–26%) also being important, but less effort now between December and May (Figure 5). The catch was taken relatively early in 2008–09, with 30% of the annual estimated catch taken in the first month and some large catches in May contributing to an earlier than usual uptake of the total catch at the start of the spawning period (Figure 5). Typically in this fishery, the annual catch is 95% caught by the middle of July, and the last three fishing years were no exception.

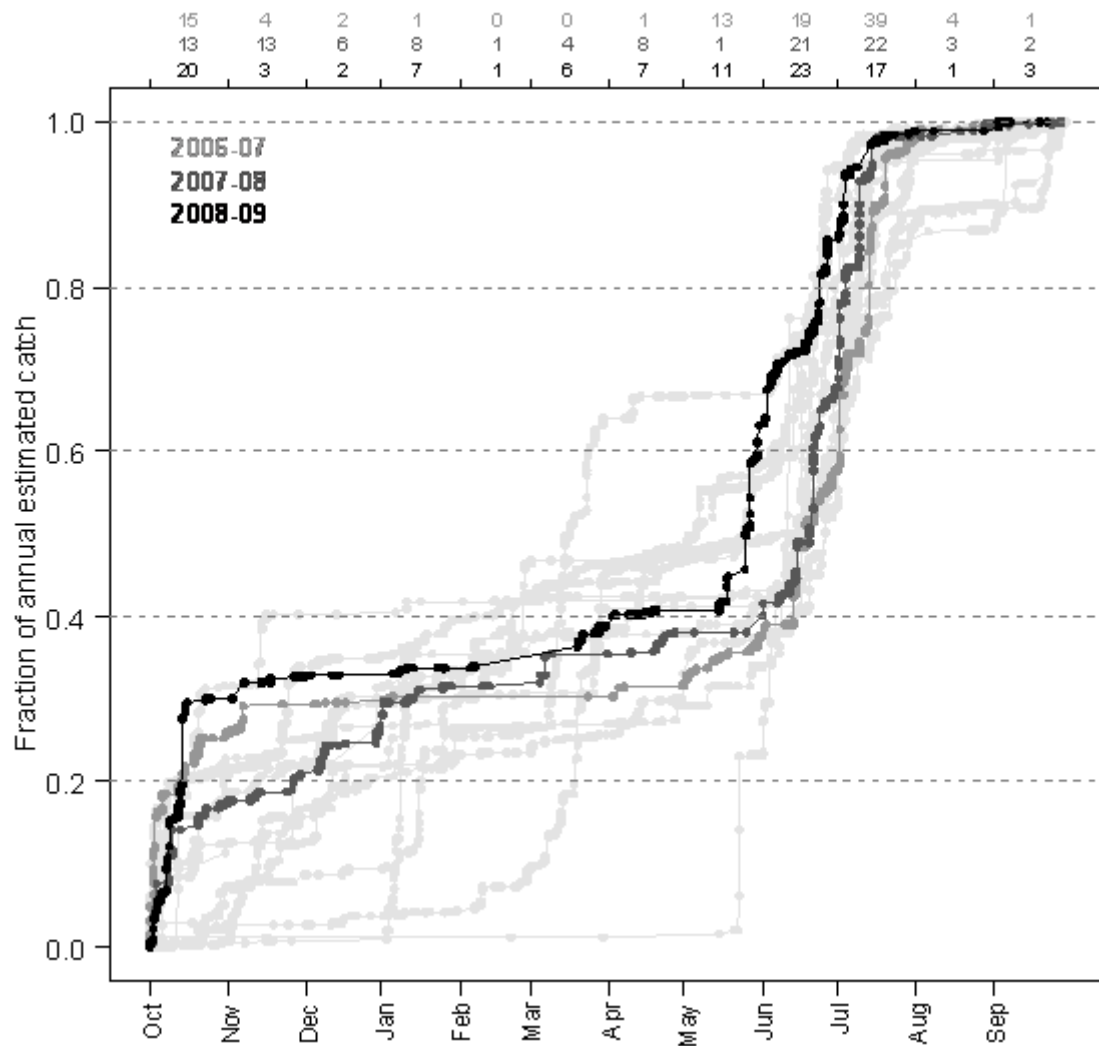


Figure 5: Cumulative catches and effort in ORH 1. Catches are summed in chronological order through the fishing year, and scaled to the total estimated catch for the year. Each point represents the relative accumulated catch after the addition of the catch from each new trawl. The 2006–07, 2007–08, and 2008–09 fishing years are shown individually in grey (2006–07), dark grey (2007–08), and black (2008–09). The percentage of trawls by month is shown above each panel, using the same shading to represent years. Cumulative catches for all previous years are shown in light grey.

Since the late 1990s, the ORH 1 fishery has not shown a strong pattern of sequential depletion of areas, and although new fishery areas were regularly developed after 1996–97, fishing tended to continue in most of these areas through to 2008–09 (Figure 6). The areas fished before the late 1990s do show a subsequent decline, but this is largely due to the introduction of catch limits for the Mercury–Colville Box.

New areas have continued to be an important part of this fishery right up to the 2008–09 fishing year. There were a number of lightly fished areas where catches of orange roughy were not taken (areas above the index value of about 300 in Figure 6). The pattern of effort was similar to that of catch, although effort has tended to be more even than catch across years.

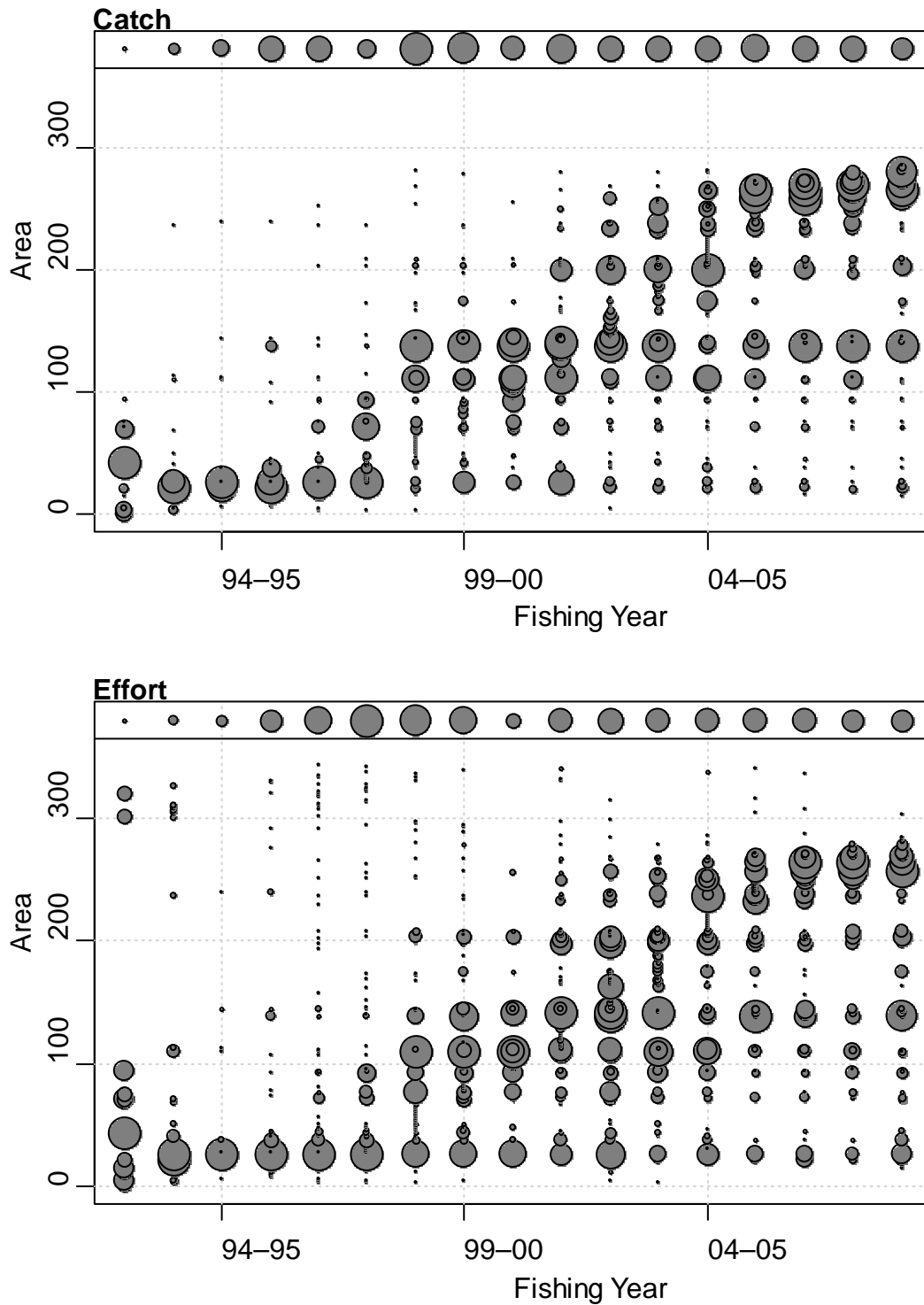


Figure 6: The distribution of orange roughy estimated catch (top panel) and effort (number of tows, bottom panel) by fishing year and area (where area is a square of 1/10th of a degree latitude and longitude) for the ORH 1 fishery. Catch and effort are proportional to circle size. The top panel in each plot shows the (relative) total catch (upper) and total effort (lower) by year. The maximum circle size in each year is set to be equal. Areas were ordered, in both plots, by the mean year in which the catch was taken.

Unstandardised median annual catch rates in ORH 1 have fluctuated considerably, with the highest catch rates occurring in Tauroa Knoll, and very low overall catch rates in the oldest fishery, Mercury–Colville (Figures 7 and 8).

Catch rates increased through the late 1990s due to the influence of the developing Tauroa Knoll and West Norfolk fisheries, peaking in 2000–01 (Figures 7 and 8). Catch rates declined in 2001–02 and 2002–03, then peaked again in 2005–06 on the back of high catch rates in the Northland and Aldermen fisheries, and since then have catch rates trended slightly downwards to a level at about the long-term average for the fishery.

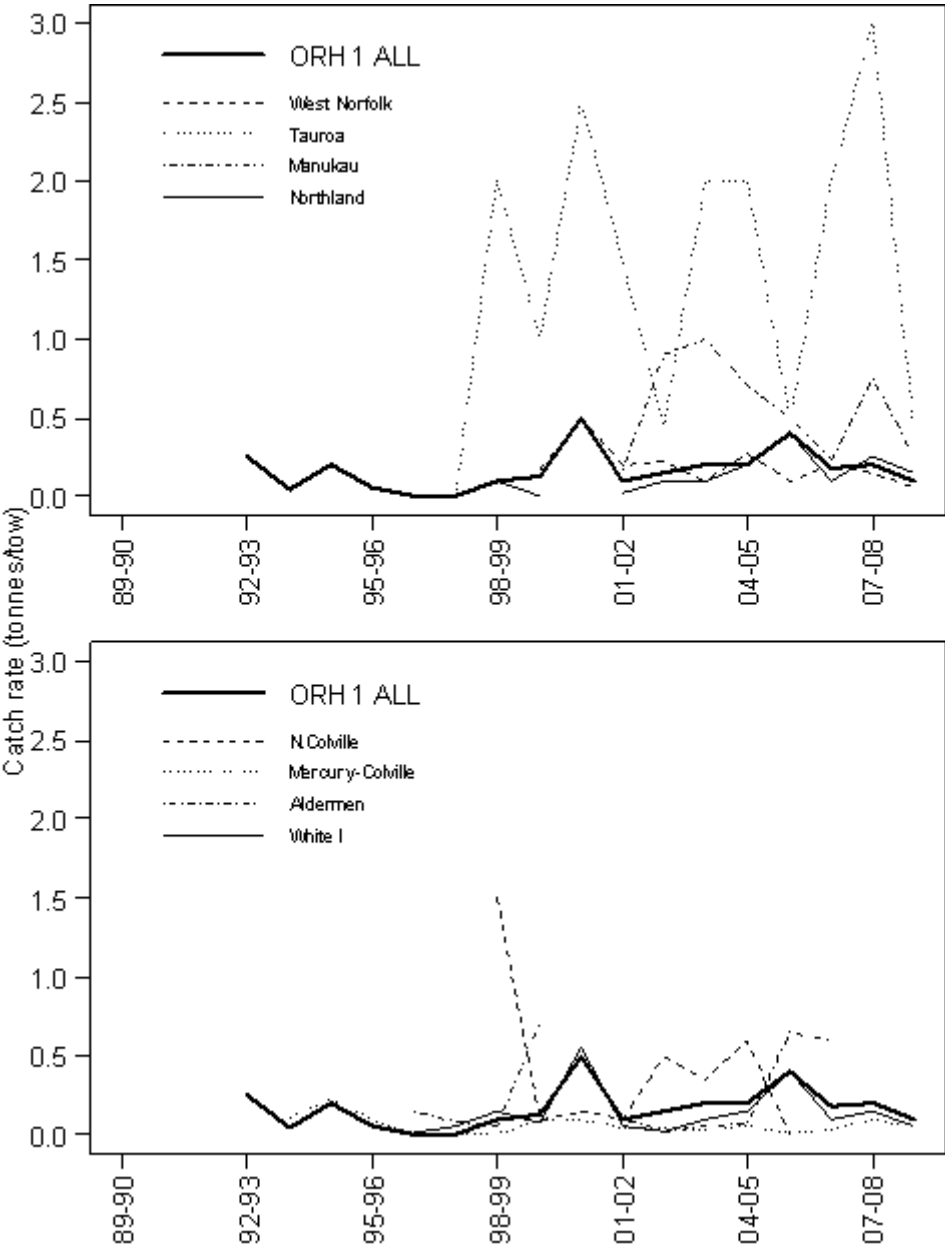


Figure 7: ORH 1. Median catch rates (tonnes per tow) of orange roughy for the years 1989–90 to 2008–2009. Catch rates not shown for area/year combinations where the number of tows was less than 10.

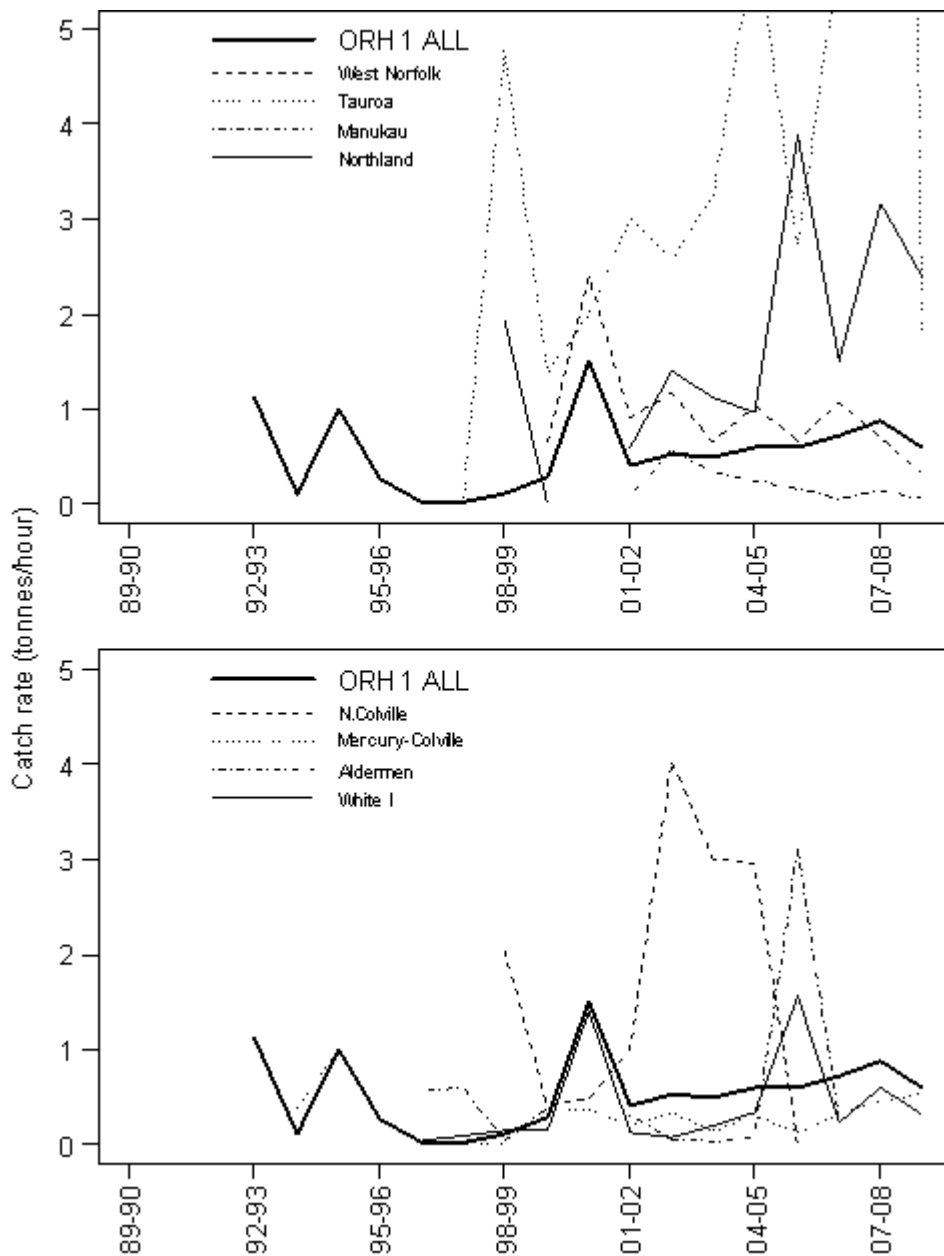


Figure 8: ORH 1. Median catch rates (tonnes per hour) of orange roughy for the years 1989–90 to 2008–2009. Catch rates not shown for area/year combinations where the number of tows was less than 10.

In the eastern half of ORH 1 the orange roughy fishery has overlapped with a black cardinalfish fishery (Dunn 2007) and, to a small extent in several areas, with an alfonsino fishery. Between 1999–2000 and 2004–05, about 15–45% of the tows catching orange roughy were reported as targeting other species (predominantly cardinalfish), but more recently this percentage has dropped, to between 5% and 15% (Table 7).

Table 7: Percentage of tows in ORH 1 catching orange roughy, by target species and fishing year.

	Target species		
	Orange roughy	Black cardinalfish	Other species
1992–93	100	0	0
1993–94	99	0	1
1994–95	41	56	3
1995–96	80	20	0
1996–97	90	10	0
1997–98	95	5	0
1998–99	90	10	0
1999–00	85	15	0
2000–01	53	44	3
2001–02	85	13	2
2002–03	83	16	1
2003–04	79	16	5
2004–05	72	26	2
2005–06	94	5	1
2006–07	94	6	0
2007–08	92	8	0
2008–09	84	15	0

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

5.1 Summary for 2007–08 and 2008–09

- Catches have followed the catch limits, which have remained unchanged. The catch limit was under-caught in 2008–09 by 29 t (MEC) and overcaught by 30 t (EC).
- The last three years of the fishery have been typical, and focused on the same areas, with fishing throughout the year.
- There has been relatively little spatial progression in catches or effort, with most of the catch taken from recognised areas.
- Unstandardised catch rates were relatively low, but have continued to slowly and steadily improve in recent years.

5.2 Total catch

The fishery extends from Cape Runaway in the north, down the east coast of the North and South Islands to Banks Peninsula in the south (Figure 9). 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 from allozyme studies (Ministry of Fisheries, Science Group 2008).

Before the spawning fishery in ORH 2A North was developed, the EC and MEC fisheries were assessed together as part of the “Cape Runaway to Banks Peninsula” stock. 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 a separate catch limit set for the East Cape hills and another for an exploratory area comprising the remainder of ORH 2A North, north of a line at 37° S. Following a large reduction in the overall catch limit for the EC fishery in 2000–01, this agreement lapsed.

5.2.1 Mid-East Coast (MEC)

In recent years 60% of the MEC catch was allocated to ORH 2A South, 12% to ORH 2B, and 28% to ORH 3A, and the distribution of annual landings between these fisheries has remained stable since the mid-1980s (Table 8).

Annual landings in the MEC peaked at about 9000–10 000 t in the late 1980s to early 1990s, then declined after 1992–93 following a series of reductions in the TACC. The catch limit was raised in 2004–05, to 1500 t. Landings have been close to the catch limit for the MEC in most years, and the combined catch for the last ten years exceeds the total TACC for the same period by about 700 t.

Since 1993–94, TCEPR records have provided data covering between 74% and 108% of the total landings (Table 9), peaking in 2008–09. The use of CELR forms, once predominant in this fishery, has declined over time, representing less than 10% of the orange roughy catch since 1993–94.

5.2.2 East Cape (EC)

Up until 1999–2000, annual landings in the EC ranged from 1500 to 3400 t, with very little of the catch coming from outside the East Cape hills area. A large decrease in the catch limit in 2000–01, from 2500 t to 200 t, restricted landings from the fishery to between 170 and 300 t over the past nine years (Table 9). The catch limit was caught exactly in 2007–08, but exceeded (by 8–45%) in each other year since 2004–05.

Since 1993–94, TCEPR records have provided data covering between 75% and 98% of the total landings (Table 9). CELR forms have never been widely used in this fishery, accounting for 4–12% of the total catch between 1993–94 and 1999–2000, and not used at all since then.

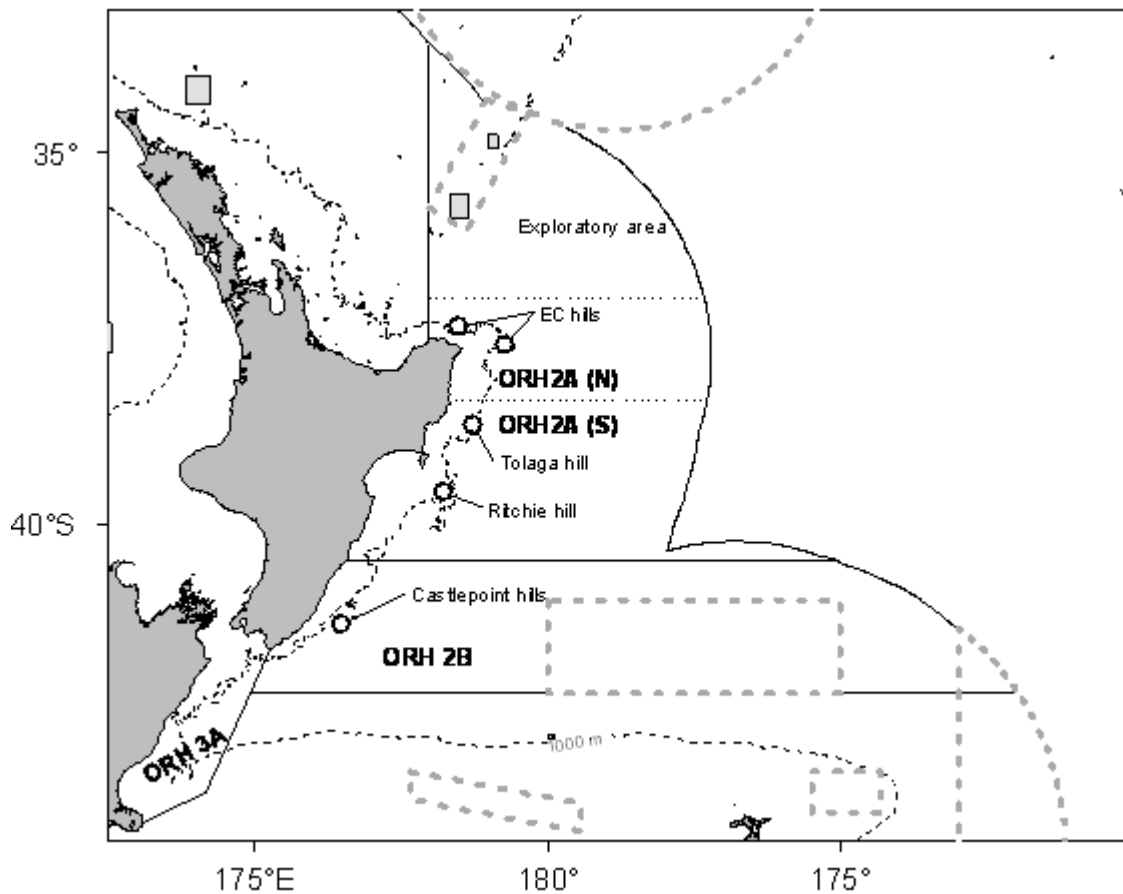


Figure 9: The Mid-East Coast and East Cape fishery area. Circles, location of the main features; solid black lines, QMA boundaries; dotted black lines, boundaries between the areas used for stock assessment and management (Ministry of Fisheries 2009); shaded rectangles, seamounts closed to trawling; dashed grey lines, perimeters of Benthic Protection Areas (BPAs) closed to bottom trawling.

Table 8: Reported landings (t), catch limits (t), percentage of landings recorded on TCEPR forms, and landings as a percentage of the total landings for the QMAs of the MEC stock, for 1981–82 to 2008–2009.

Fishing year	Landings	Catch limit	Estimated TCEPR as % of landings	% of total MEC landings
ORH 2AS				
1981–82*	–	–	–	0
1982–83*	–	–	–	0
1983–84†	162	–	0	2
1984–85†	1 858	–	27	22
1985–86†	2 778	4 576	42	35
1986–87‡	4 934	5 500	9	58
1987–88‡	6 203	5 500	32	64
1988–89‡	5 710	6 060	20	61
1989–90‡	6 239	6 106	46	59
1990–91‡	6 051	6 106	58	61
1991–92‡	6 329	6 286	70	63
1992–93‡	5 807	6 386	81	64
1993–94‡	3 173	6 666	94	48
1994–95‡	3 281	4 000	76	57
1995–96‡	1 033	1 261	79	55
1996–97‡	1 270	1 261	90	60
1997–98‡	#1 416	1 261	96	63
1998–99‡	#1 434	1 261	94	63
1999–00‡	#1 666	1 261	87	66
2000–01‡	#1 083	900	96	62
2001–02 ^o	#901	900	97	61
2002–03 ^o	#546	480	98	62
2003–04 ^o	#533	480	96	60
2004–05 ^o	#849	900	95	58
2005–06 ^o	#858	900	96	59
2006–07 ^o	#902	900	91	60
2007–08 ^o	#868	900	95	58
2008–09 ^o	#884	900	116	55
ORH 2B				
1981–82*	554	–	95	100
1982–83*	3 510	–	49	93
1983–84†	6 685	–	80	90
1984–85†	3 310	3 500	53	39
1985–86†	867	1 053	50	11
1986–87‡	963	1 053	38	11
1987–88‡	982	1 053	53	10
1988–89‡	1 236	1 367	34	13
1989–90‡	1 400	1 367	41	13
1990–91‡	1 384	1 367	78	14
1991–92‡	1 327	1 367	95	13
1992–93‡	1 080	1 367	107	12
1993–94‡	1 259	1 367	96	19
1994–95‡	754	820	115	13
1995–96‡	245	259	85	13
1996–97‡	272	259	100	13
1997–98‡	254	259	81	11
1998–99‡	257	259	91	11
1999–00‡	234	259	88	9
2000–01‡	190	185	82	11
2001–02 ^o	180	185	78	12
2002–03 ^o	105	99	90	12

Table 8 (cont.):

Fishing year	Landings	Catch limit	Estimated TCEPR as % of landings	% of total MEC landings
2004–05 ^φ	206	185	83	14
2005–06 ^φ	172	185	81	12
2006–07 ^φ	203	185	99	13
2007–08 ^φ	209	185	94	14
2008–09 ^φ	173	185	102	13
ORH 3A				
1981–82*	–	–	–	–
1982–83*	253	–	71	7
1983–84†	554	–	74	7
1984–85†	3 266	§	24	39
1985–86†	4 326	2 689	72	54
1986–87‡	2 555	2 689	52	30
1987–88‡	2 510	2 689	72	26
1988–89‡	2 431	2 839	44	26
1989–90‡	2 878	2 879	72	27
1990–91‡	2 553	2 879	90	26
1991–92‡	2 443	2 879	95	24
1992–93‡	2 135	2 879	95	24
1993–94‡	2 131	2 300	89	32
1994–95‡	1 686	1 840	58	29
1995–96‡	612	580	89	32
1996–97‡	580	580	86	27
1997–98‡	570	580	92	25
1998–99‡	582	580	81	26
1999–00‡	617	580	93	25
2000–01‡	479	415	84	27
2001–02 ^φ	400	415	93	27
2002–03 ^φ	235	221	99	27
2003–04 ^φ	250	221	138	28
2004–05 ^φ	416	415	112	28
2005–06 ^φ	415	415	102	29
2006–07 ^φ	401	415	109	27
2007–08 ^φ	432	415	129	28
2008–09 ^φ	414	415	140	32

* MAF data; † FSU data; ‡ QMS data; φ MHR data; #Based on ORMC figures or estimated catches for ORH 2AN and ORH 2AS (pro-rated to QMS data for ORH 2A where necessary); §Included in QMA 3B TACC.

5.3 Distribution of catch and effort, and catch rates

5.3.1 Mid-East Coast

In the Mid-East Coast fishery, the distribution of effort has remained fairly constant from year to year, with tow positions following the 1000 m contour along much of the extent of the three QMAs (Figure 10). There have been, however, sections of mostly unfished grounds near the boundary between ORH 2A North and ORH 2A South, and also between ORH 2A South and ORH 2B, providing a convenient and natural separation between the management areas.

An increase in fishing effort and catch near the southern limit of ORH 2A South over the last nine years has reduced the extent of this unfished area, with occasional large catches being made (Figure 10). Other places where large catches (greater than 20 t) have been made include Tolaga Hill, Ritchie Hill, and the Rockgarden in ORH 2A South, the Castlepoint Hills in ORH 2B, and the Mernoo Gap Hill and nearby locations in the southern parts of ORH 3A. The largest catches in the MEC were

in the vicinity of the Mernoo Gap Hill in 2006–07 (43 t), on the Castlepoint Hills in 2007–08, and in the Rockgarden in 2008–09.

Table 9: MEC and EC. Reported landings (t), catch limits (t), and percentage of landings recorded on TCEPR forms for 1981–82 to 2008–09.

Fishing year	MEC			EC		
	Landings	Catch limit	Estimated TCEPR as % of landings	Landings	Catch limit	Estimated TCEPR as % of landings
1981–82*	554	–	95	–	–	–
1982–83*	3 763	–	35	–	–	–
1983–84†	7 401	–	78	–	–	–
1984–85†	8 434	–	66	4	–	–
1985–86†	7 971	8 318	62	41	§	–
1986–87‡	8 452	9 242	31	253	§	–
1987–88‡	9 695	9 242	52	36	§	–
1988–89‡	9 377	10 266	15	143	§	–
1989–90‡	10 517	10 352	48	20	§	–
1990–91‡	9 988	10 352	53	13	§	–
1991–92‡	10 099	10 532	67	18	§	–
1992–93‡	9 022	10 632	72	30	§	–
1993–94‡	6 563	10 333	90	3 437	§	84
1994–95‡	5 721	6 660	74	2 921	3 000	96
1995–96‡	1 890	2 100	81	3 235	3 000	89
1996–97‡	2 122	2 100	89	2 491	3 000	77
1997–98‡	#2 240	2 100	91	#2 411	3 000	78
1998–99‡	#2 273	2 100	88	#1 901	2 500	89
1999–00‡	#2 517	2 100	86	#1 456	2 500	88
2000–01‡	#1 752	1 500	89	#302	200	97
2001–02 ^φ	#1 480	1 500	90	#186	200	85
2002–03 ^φ	#886	800	95	#173	200	75
2003–04 ^φ	#886	800	108	#170	200	95
2004–05 ^φ	#1 471	1 500	98	#271	200	89
2005–06 ^φ	#1 445	1 500	96	#216	200	97
2006–07 ^φ	#1 506	1 500	97	#229	200	94
2007–08 ^φ	#1 509	1 500	107	#200	200	98
2008–09 ^φ	#1 471	1 500	108	#230	200	94

*MAF data, †FSU data, ‡QMR data, ^φMHR data, §Included in MEC Catch Limit, #Based on ORMC figures or estimated catches for allocation of catch between ORH 2AN and ORH 2AS (pro-rated to QMS data for ORH 2A where necessary).

Effort in the MEC stock declined sharply after a 30% reduction in the catch limit in 2000–01, and also after the further reduction two years later, and since 2004–05 remained at about 600–800 tows per year (Table 10).

The catch has tended to accumulate evenly throughout the year in the MEC, with generally only a moderate increase in effort and catch during May and June, and little fishing between July and September (Figure 11). The last three years were quite typical, although in each year there was slightly more of the catch taken in October than usual, and the catch was more rapidly accumulated in the early part of the 2006–07 fishing year. These catch uptake trajectories were more diverse when analysed for individual MEC subareas, and show a steep rise in catch and effort associated with the spawning fishery in ORH 2A South in May and June, and the absence of effort in ORH 2B and ORH 3A at the same time, suggesting no significant spawning fisheries or aggregations in these latter areas (Figure 12).

Large individual catches are strongly influential in the uptake of catch in the smaller ORH 2B fishery. For example, one catch of 46 t in February 2008 accounted for 25% of the ORH 2B TACC in 2007–08 (Figure 12) and other large catches were made in this fishery in several other months but not, in recent

years at least, during the winter. A few large catches are also evident in ORH 3A and ORH 2A South (Figure 12), but these are less pronounced because of the larger TACCs in those fisheries.

Table 10: MEC. Summary of effort, estimated catch, catch rates, tow duration, and frequency of large catches for 1982–83 to 2008–2009. Number of tows, total catch, and catch rate columns are derived from a combination of all records types (daily summary and tow-by-tow); the remaining columns are derived from TCEPR-type (tow-by-tow) records only.

Fishing year	Number of vessels	Total number of tows	Total estimated catch	Mean catch rate (t/tow)	Mean catch rate (t/h)	Median tow duration (h)	Proportion of tows > 10 t
1982–83	11	256	1 331	5.2	5.1	1.4	0.31
1983–84	11	1 513	6 518	4.3	3.2	1.3	0.14
1984–85	18	2 280	7 818	3.4	1.4	1.5	0.06
1985–86	20	2 390	7 458	3.1	2.9	1.0	0.10
1986–87	19	1 952	5 107	2.6	1.6	1.2	0.05
1987–88	14	1 709	7 193	4.2	2.7	1.3	0.11
1988–89	20	779	1 590	2.0	3.4	1.0	0.11
1989–90	16	2 941	8 391	2.9	3.8	0.9	0.11
1990–91	17	3 304	7 653	2.3	3.8	0.8	0.10
1991–92	16	3 983	8 368	2.1	2.5	0.9	0.06
1992–93	27	4 303	7 801	1.8	1.8	1.0	0.04
1993–94	30	4 490	6 430	1.4	1.2	1.1	0.03
1994–95	34	4 163	4 844	1.2	1.0	1.1	0.02
1995–96	27	1 473	1 637	1.1	0.9	1.1	0.02
1996–97	29	1 539	2 012	1.3	1.1	1.1	0.03
1997–98	30	2 017	2 214	1.1	0.9	1.0	0.02
1998–99	30	2 609	2 262	0.9	0.6	1.1	0.01
1999–00	25	2 390	2 395	1.0	0.7	1.0	0.02
2000–01	24	1 204	1 645	1.4	0.9	1.1	0.03
2001–02	18	714	1 471	2.1	1.5	1.0	0.05
2002–03	18	637	846	1.3	1.0	0.9	0.02
2003–04	17	555	967	1.7	1.2	1.0	0.04
2004–05	14	816	1 528	1.9	1.3	1.0	0.04
2005–06	11	757	1 568	2.1	1.8	0.8	0.05
2006–07	11	616	1 538	2.5	2.5	0.6	0.07
2007–08	13	669	1 608	2.4	2.6	0.5	0.06
2008–09	10	700	1 588	2.3	1.8	0.8	0.06

In the MEC region, the fishery progressed spatially in a series of steps, with relatively stable geographical distributions of fishing between each step (Figure 13). This progression can be characterised as the Wairarapa period (up to 1985), the Ritchie Banks and Kaikoura period (1986–1990), the Rockgarden period (1990–1998), followed by the development of the southern portion of ORH 2A South, beginning in the late-1990s. There were a few lightly fished areas where catches of orange roughy were not taken (areas with an index value above 500 in Figure 13). The pattern of effort is subtly different to that of catch, with more persistent effort than catch across years for the areas that had been productive, indicating continued effort in known locations after catch rates had declined.

Unstandardised annual catch rates for the MEC stock as a whole (calculated as median catch per tow or median catch per hour) were greatest at the beginning of the fishery, but peaked again in the early 1990s and then declined over the following years to a low point at about 1998–99 (Figure 14). The low CPUE in the late 1990s was followed by a period of gradually increasing catch rates, coinciding with the development of a number of new areas (see Figure 13), and by 2008–09 both t/tow and t/h measures were higher than recorded since 1991–92. This improvement was associated with increased catch rates in all three QMAs, but was especially pronounced in catch per tow for ORH 3A. In 2008–09, the overall catch rate had remained steady or increased, at about 0.8 t/tow and 0.6 t/h.

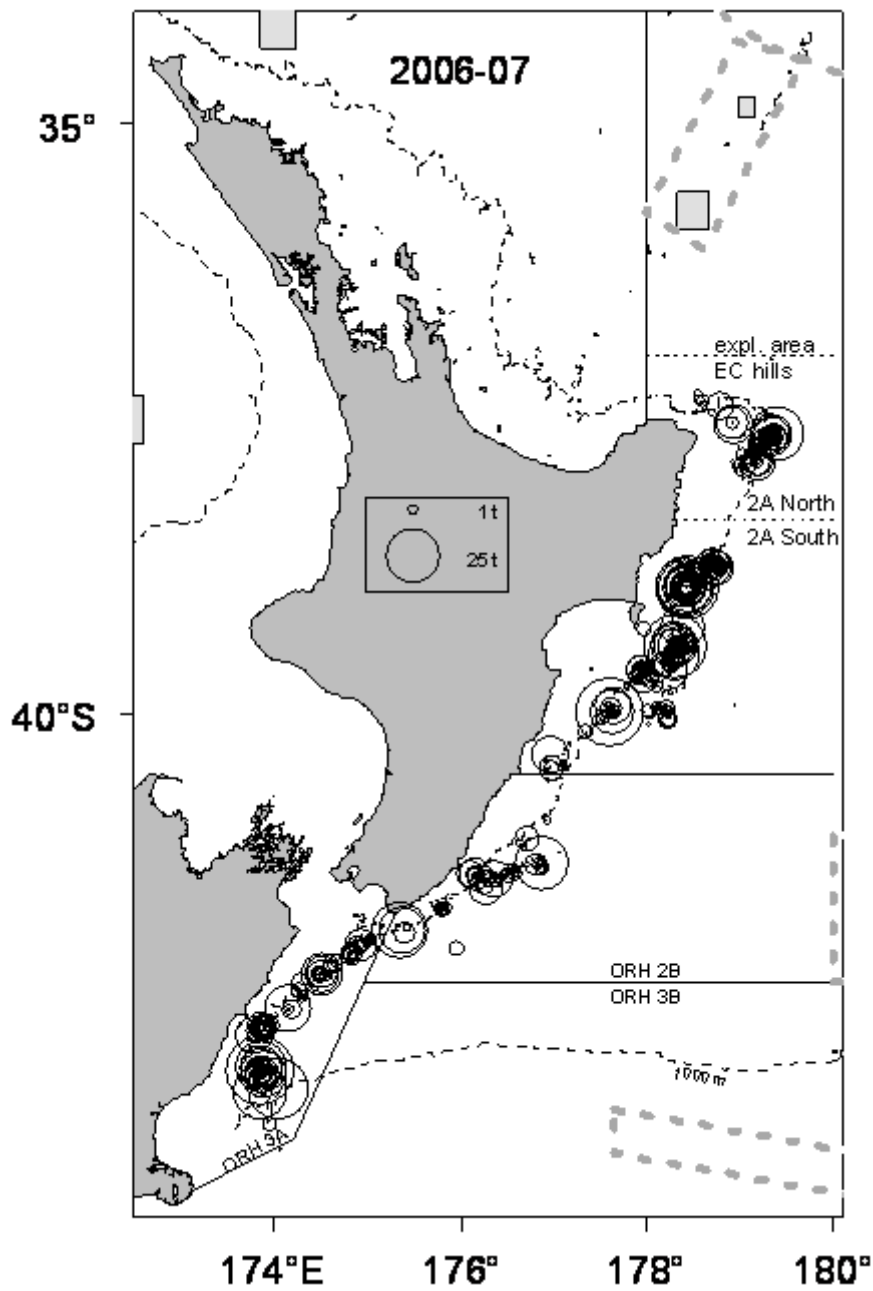


Figure 10: Catch (t) per tow of orange roughy in the EC and MEC fish stocks for the 2006–07 fishing year. Largest catches: ORH 2A north, 27 t; ORH 2A south, 40 t; ORH 2B, 28 t; ORH 3A, 43 t. Perimeters of Benthic Protection Areas (BPAs) closed to bottom trawling are marked with dashed grey lines, and seamounts closed to trawling are marked as shaded rectangles.

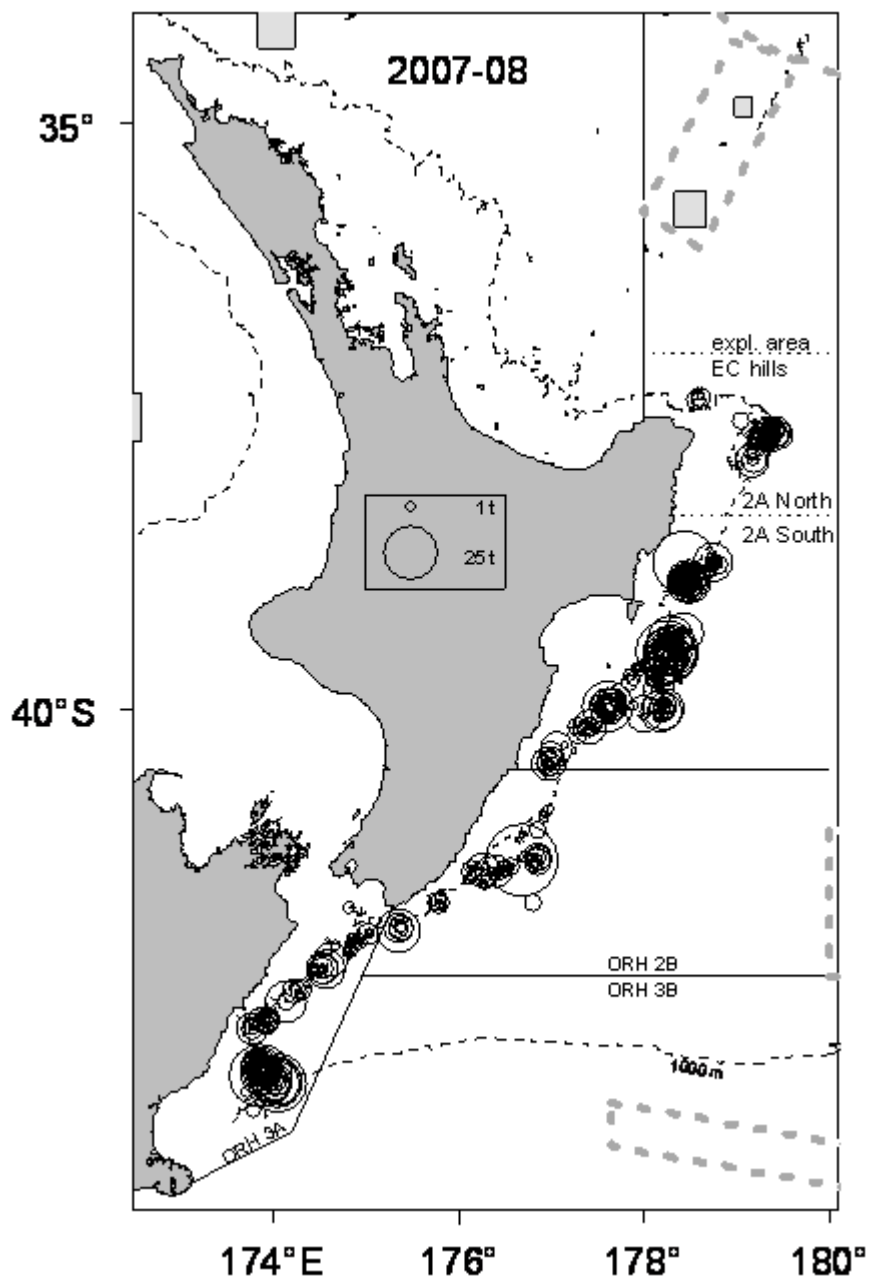


Figure 10 (cont.): Catch (t) per tow of orange roughy in the EC and MEC fish stocks for the 2007–08 fishing year. Largest catches: ORH 2A north, 10 t; ORH 2A south, 36 t; ORH 2B, 46 t; ORH 3A, 35 t. Perimeters of Benthic Protection Areas (BPAs) closed to bottom trawling are marked with dashed grey lines, and seamounts closed to trawling are marked as shaded grey rectangles.

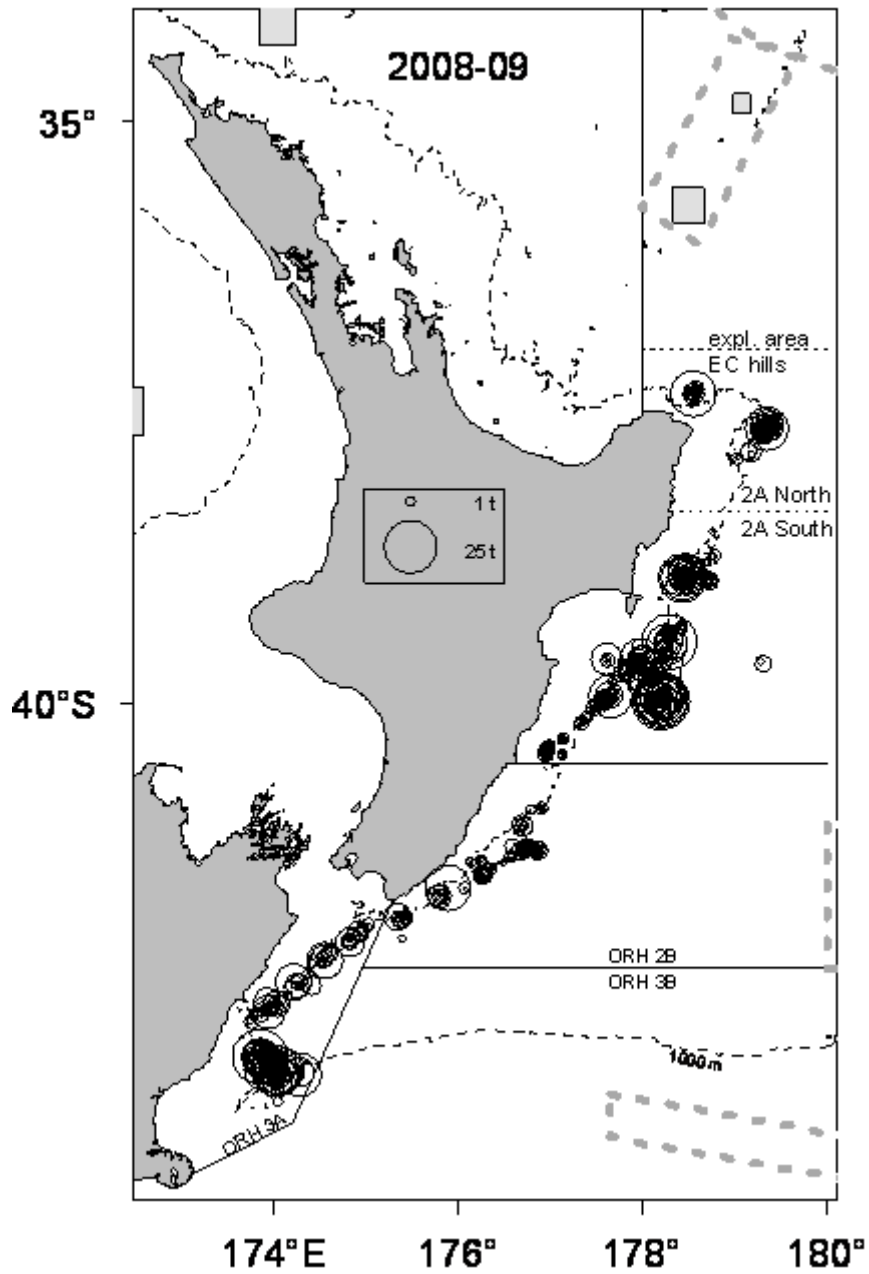


Figure 10 (cont.): Catch (t) per tow of orange roughy in the EC and MEC fish stocks for the 2008–09 fishing year. Largest catches: ORH 2A north, 19 t; ORH 2A south, 30 t; ORH 2B, 19 t; ORH 3A, 28 t. Perimeters of Benthic Protection Areas (BPAs) closed to bottom trawling are marked with dashed grey lines, and seamounts closed to trawling are marked as shaded rectangles.

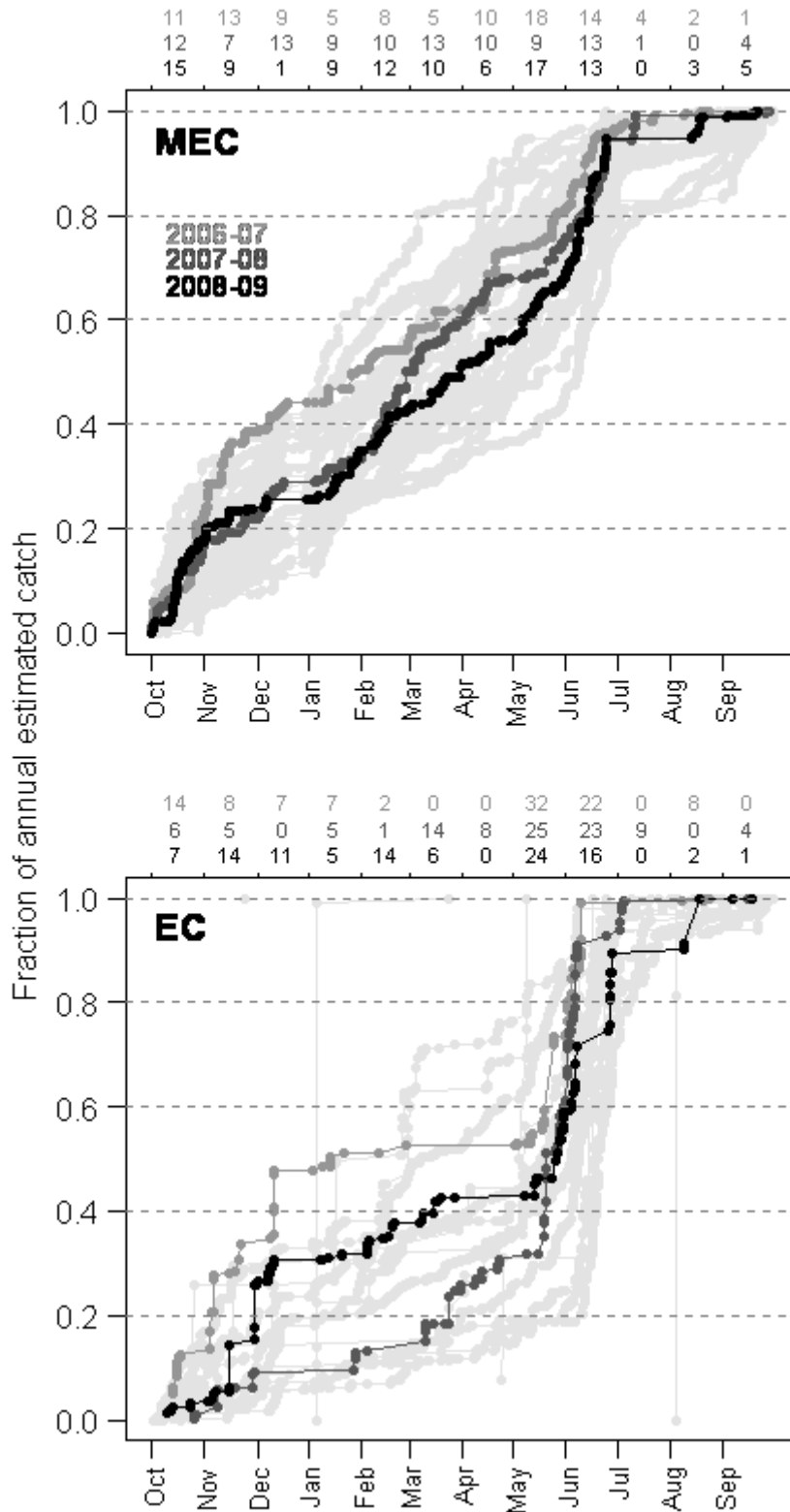


Figure 11: Cumulative catches and effort in the MEC and EC (ORH 2A North) stocks. Catches are summed in chronological order through the fishing year, and scaled to the total estimated catch for the year. Each point represents the relative accumulated catch after the addition of the catch from each new trawl. The 2006–07, 2007–08, and 2008–09 fishing years are shown individually in grey (2006–07), dark grey (2007–08), and black (2008–09). The percentage of trawls by month is shown above each panel, using the same shading to represent years. Cumulative catches for all previous years are shown in light grey.

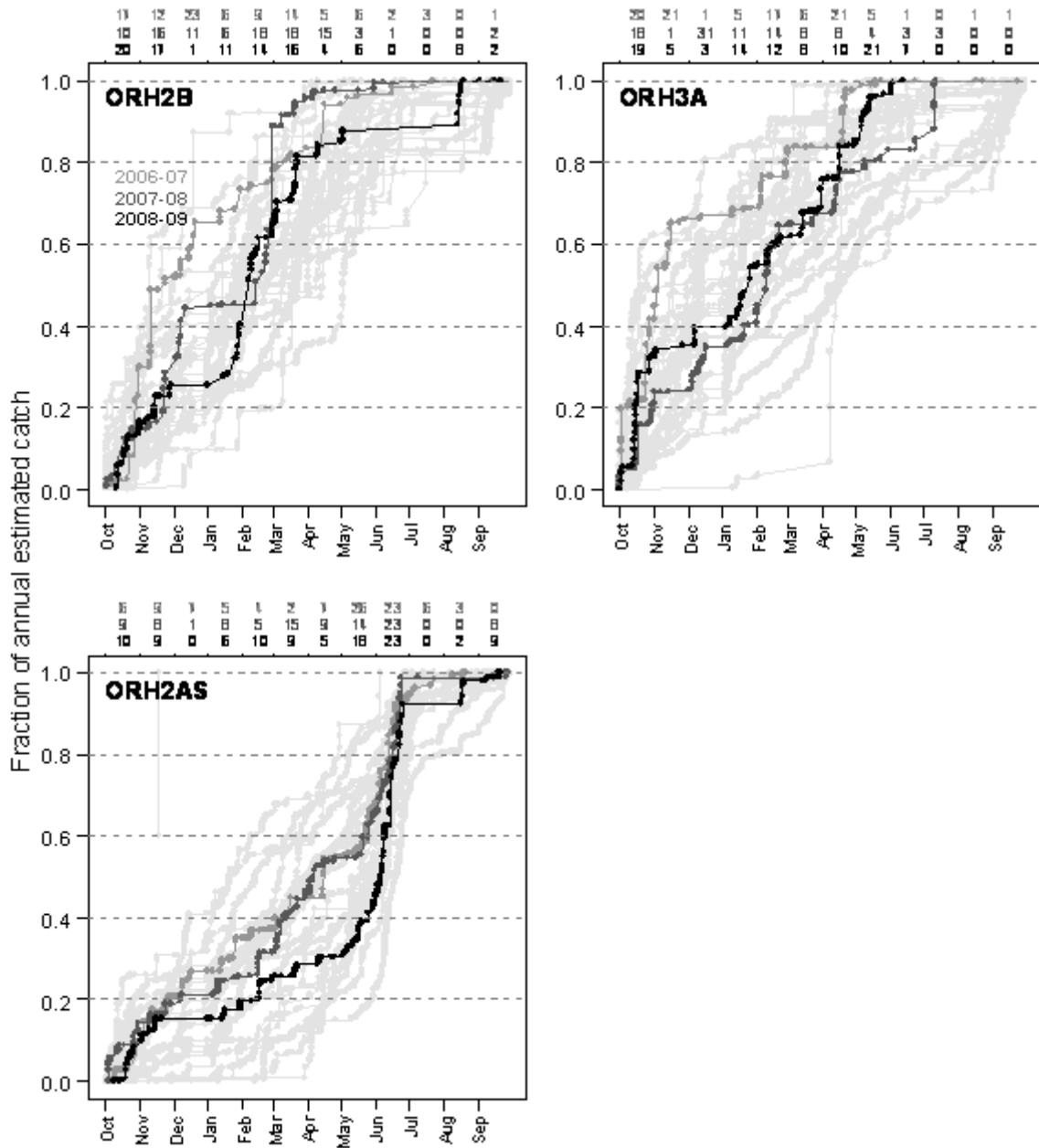


Figure 12: Cumulative catches and effort in ORH 2B, ORH 3A, and ORH 2AS. Catches are summed in chronological order through the fishing year, and scaled to the total estimated catch for the year. Each point represents the relative accumulated catch after the addition of the catch from each new trawl. The 2006–07, 2007–08, and 2008–09 fishing years are shown individually in grey (2006–07), dark grey (2007–08), and black (2008–09). The percentage of trawls by month is shown above each panel, using the same shading to represent years. Cumulative catches for all previous years are shown in light grey.

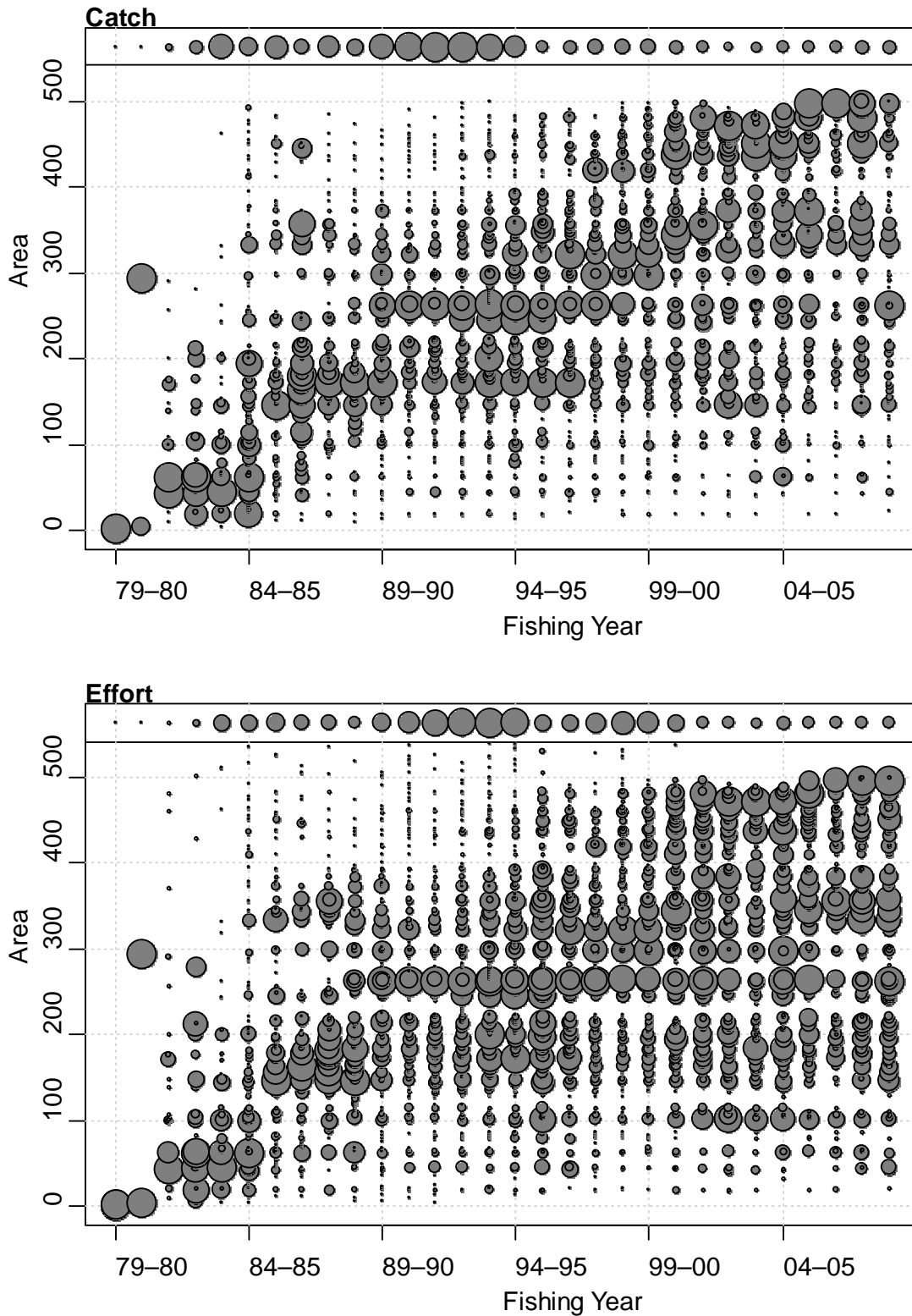


Figure 13: The distribution of orange roughy estimated catch (top panel) and effort (number of tows, bottom panel) by fishing year and area (where area is a square of 1/10th of a degree latitude and longitude) for the MEC fishery. Catch and effort are proportional to circle size. The maximum circle size in each year is set to be equal. Areas were ordered, in both plots, by the mean year in which the catch was taken. The top panel in each plot shows the (relative) total catch (upper) and total effort (lower) by year.

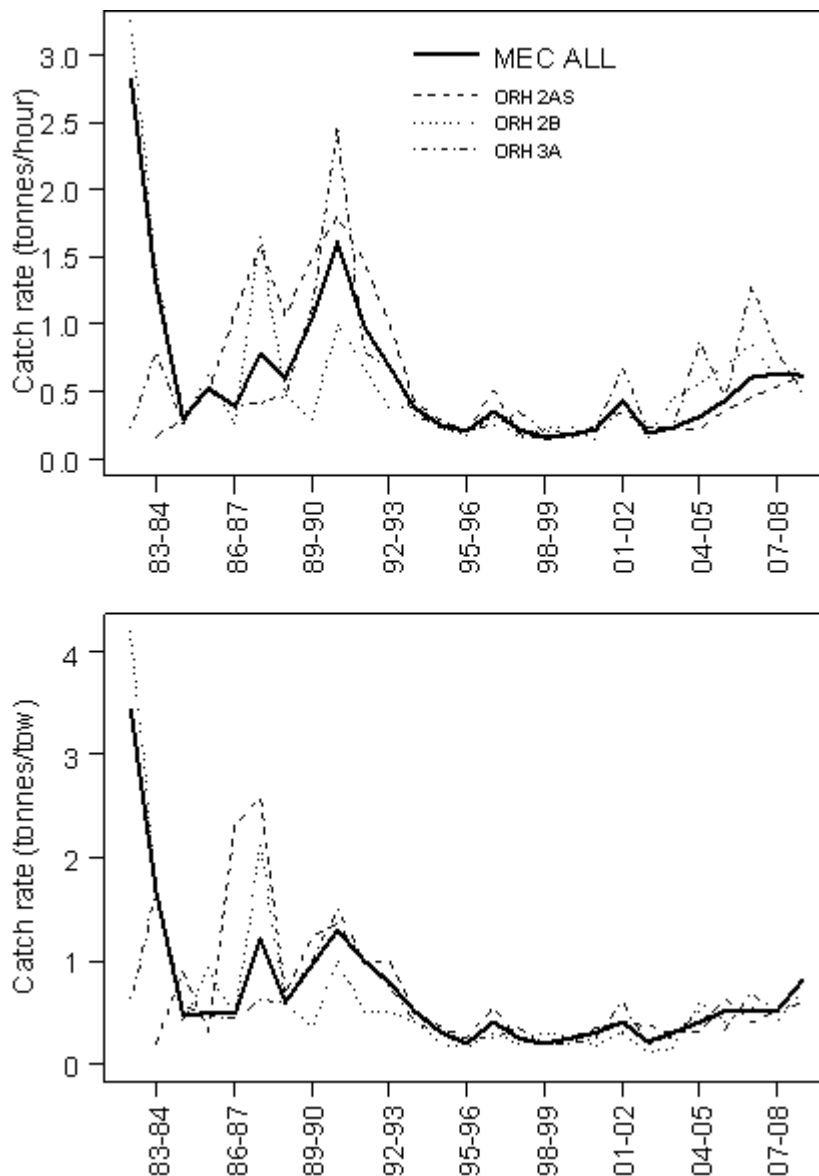


Figure 14: MEC and subareas. Median catch rates of orange roughy for the years 1983–84 to 2008–2009. Catch rates are not shown for area/year combinations where the number of tows was less than 10.

5.3.2 East Cape

Over the last three years the spatial distribution of effort in the East Cape fishery has been spread amongst the previously described fishing locations, namely the central area (“Main Hill”) and other features to the southwest, and the “Twin Peaks” hill feature in the northwest (Anderson & Dunn 2008). A few large catches were also reported from the area between Main hill and Twin Peaks in 2006–07, but large catches on Twin Peaks itself were restricted to 2008–09 (Figure 10). There has been no fishing recorded in the (former) exploratory area of ORH 2A North during the past seven years.

Annual effort dropped considerably in 2000–01, in line with the TACC reduction, levelling out at about 120–160 tows per year during the last eight fishing years (Table 11). The estimated annual catch decreased from about 1400–3300 t before 2000–01, to about 130–290 t since.

In the ORH 2A North fishery, fishing has typically occurred in most months in most years, but while levels of effort and catch have been variable between years for the first half of the year, they have consistently increased during May and June (Figure 11). The accumulation of catch during the first half of the fishing year has varied greatly over last three fishing years. In 2006–07, nearly half the catch was taken by mid-December, a considerably higher fraction at this point than in any previous year, whereas in 2007–08 the annual catch accumulated much more slowly, the equivalent level not being reached until well into May. In 2008–09, the catch accumulated more steadily. Because of the small size of this fishery, single large catches can contribute significantly to the catch uptake. One catch in May 2007 caught about 13% (27 t) of the catch limit. Other large catches can be seen in Figure 11 at various times of the year, including November, December, June, and August.

Table 11: EC. Summary of effort, estimated catch, catch rates, tow duration, and frequency of large catches for 1993–94 to 2008–2009. Unless stated, figures are based on TCEPR records only.

Fishing year	Number of Vessels	Total Number of tows	Total estimated catch (TCEPR + CELR)	Mean catch rate (t/tow)	Mean catch rate (t/h)	Median tow duration	Proportion of tows > 10 t
1993–94	15	538	3281	5.4	6.0	0.9	0.15
1994–95	17	1226	3148	2.4	2.8	0.8	0.05
1995–96	17	1043	3155	2.8	4.2	0.5	0.07
1996–97	18	851	2170	2.3	3.6	0.5	0.06
1997–98	17	1638	1995	1.3	1.6	0.7	0.02
1998–99	17	1121	1775	1.5	1.7	0.7	0.03
1999–00	15	757	1430	1.8	2.3	0.6	0.04
2000–01	10	193	291	1.5	2.1	0.6	0.03
2001–02	8	165	158	1.0	1.5	0.5	0.02
2002–03	9	136	129	1.0	1.6	0.5	0.01
2003–04	7	117	162	1.4	1.7	0.5	0.03
2004–05	8	114	241	2.1	2.7	0.5	0.06
2005–06	8	124	214	1.7	3.3	0.4	0.02
2006–07	6	120	215	1.8	3.5	0.4	0.04
2007–08	6	153	197	1.3	2.6	0.4	0.01
2008–09	5	151	217	1.4	2.8	0.4	0.02

A number of the EC areas were only lightly fished, indicative of exploratory fishing (Figure 15). The fishery has focussed on a few key locations, especially Main Hill, Twin Peaks (developed in about 1995–96), and a feature in the south of the region that was fished briefly in 2000–01. The level of effort was relatively stable over time, and the plot indicates that exploratory fishing was more prevalent prior to 1999–2000.

The unstandardised catch rates for East Cape are described using the three subareas defined by Anderson (2000): MAIN (Main Hill), a feature due east of East Cape which was first and almost exclusively fished in the first year of the fishery, and fished consistently in each year since; NORTH, the northwest quadrant of the fishery including Twin Peaks—fished consistently since 1995–96; 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.

Median catch rates in the EC fishery as a whole declined steadily from the start of the fishery to a low in about 2001–02, but then increased to a peak between 2005–06 and 2006–07, with a slight decline in the final two years in t/h, and a greater decline in t/tow (Figure 16). Catch rates were usually highest in MAIN, especially in tonnes per tow, and were highly variable in NORTH and OTHER, particularly in tonnes per hour. Catch rates in OTHER tended to be lower than in the other two areas in most years, but peaked strongly in 2006–07. Catch rates between the three areas have been relatively similar in the last two years.

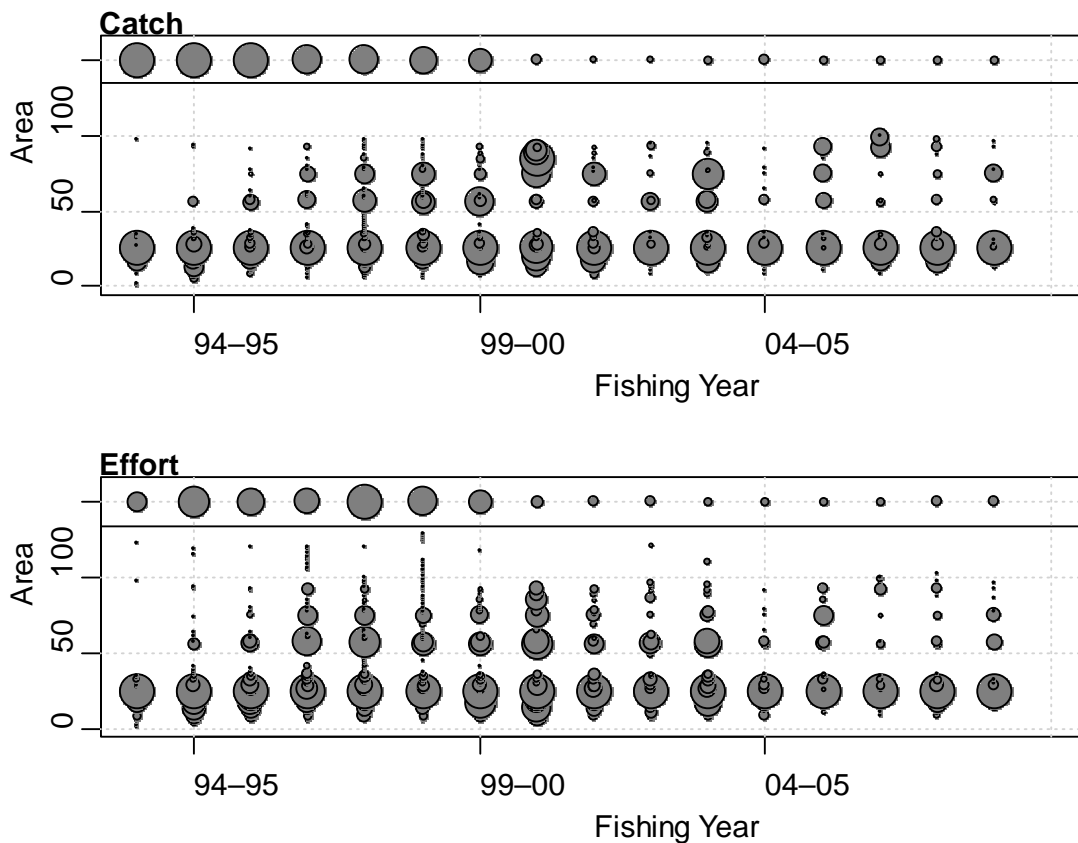


Figure 15: The distribution of orange roughy estimated catch (top panel) and effort (number of tows, bottom panel) by fishing year and area (where area is a square of 1/10th of a degree latitude and longitude) for the EC fishery. Catch and effort are proportional to circle size. The maximum circle size in each year is set to be equal. Areas were ordered, in both plots, by the mean year in which the catch was taken. The top panel in each plot shows the (relative) total catch (upper) and total effort (lower) by year.

5.4 Vessel sizes and numbers

Vessels operating in the EC fishery have mainly been small (150–800 t) and since 2004–05 all have been less than 500 t, with the median vessel size less than 350 t. The number of vessels operating in the fishery has steadily decreased, from a peak of 18 in 1996–97 to 5 in 2008–09 (see Table 11).

In the MEC fishery, there has been occasional fishing by large vessels (2000–3000 t) in most years, but otherwise vessels have been of a similar size to those in the EC fishery. The number of vessels has also decreased in this fishery, to an historic low of just ten in 2008–09 (see Table 10). See Dunn et al. (2008) for a more detailed summary of vessel sizes in these fisheries.

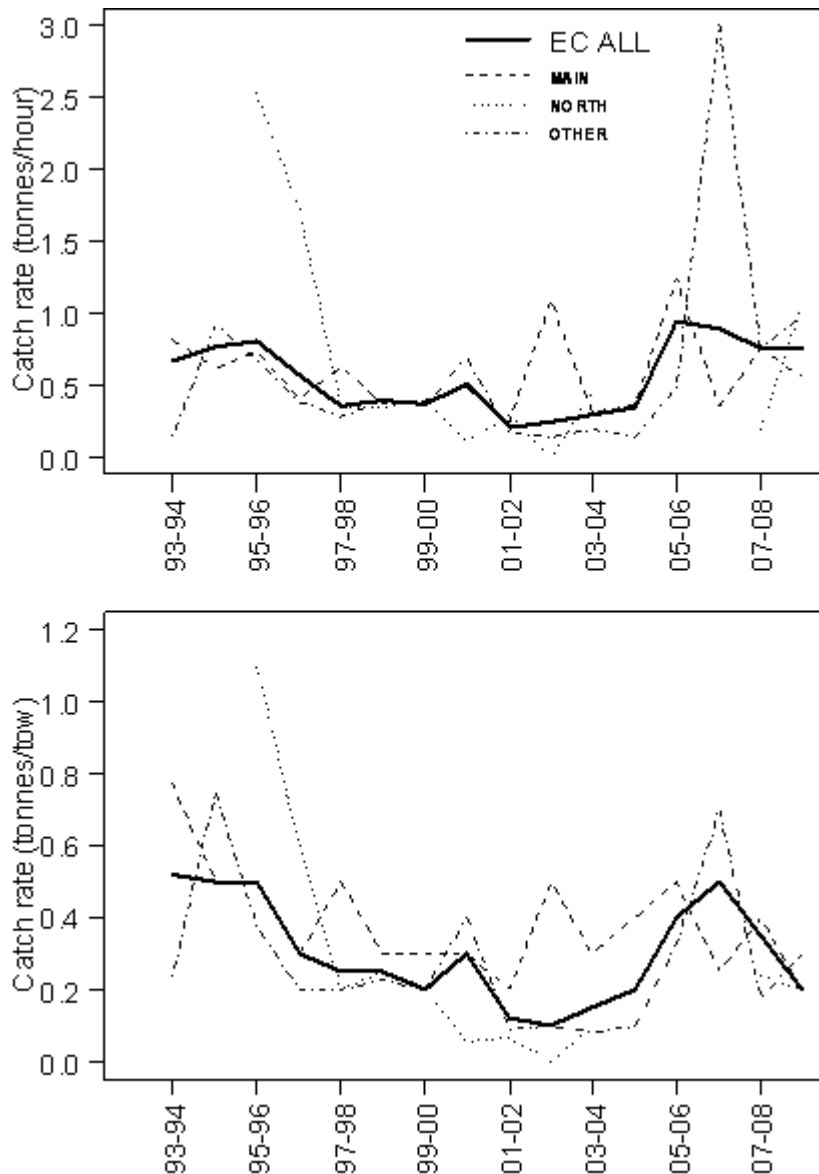


Figure 16: EC and subareas. Median catch rates of orange roughy for the years 1993–94 to 2008–2009. Catch rates are not shown for area/year combinations where the number of tows was less than 10.

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

6.1 Summary for 2007–08 and 2008–09

- The TACC for ORH 3B was reduced, from 11 500 t in 2006–07 to 10 500 t in 2007–08, and to 9420 t in 2008–09. The TACC was under-caught, by 209 t in 2007–08, and 662 t in 2008–09. The Puysegur area remained effectively closed.
- The overall fishing pattern on Chatham Rise was largely unchanged from recent years, with no new substantial areas being developed. The Northwest Chatham Rise continued to be dominated by the Graveyard Complex fishery. The East and South Chatham Rise continued to be dominated by the Spawning Box fishery. Catches from the Andes, historically the centre of the East and South Chatham Rise non-spawning fishery, declined dramatically during the last two years. The Hegerville area on the south Chatham Rise was revisited in 2008–09, providing a moderate catch.

- The steady spatial progression of the Sub-Antarctic fishery continued, with effort relatively widespread in 2008–09. One new fishery area was developed on north Pukaki. Catches from north Pukaki continued to dominate the non-Chatham catch. However, the catch from the Priceless area on north Pukaki continued to decline.
- Most catch on the Chatham Rise was taken just prior to, or during, the spawning season (July). The fishery on the Northwest Chatham Rise extended to include the period just before and after the spawn. The fishery in the Sub-Antarctic shifted to later in the year, and in 2008–09 most effort and catch was during July and August.
- Unstandardised catch rates from the Northwest Chatham Rise showed no trend. On the East and South Chatham Rise, catch rates from the Andes, Chiefs, and Northeast Hills were relatively low with no recent trend, or declined to an historical low. Catch rates in the Sub-Antarctic were relatively low, and declined dramatically for Priceless and north Pukaki.

6.2 Total catch

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 17). The area has been subdivided at 46° S for some years now, separating the Chatham Rise from areas to the south. Although further subdivisions have taken place, the QMA is generally treated as these two large areas.

Commercial fisheries for orange roughy started on the Chatham Rise in the late 1970s. Initial catches were largely taken from the northern slopes of the Chatham Rise, in particular the subarea of the East Chatham Rise (formerly referred to as the Northeast Chatham Rise) known as the Spawning Box, 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 the Spawning Box fishery declined in the early 1990s. The East Chatham Rise, and the Spawning Box in particular, has been the site of the largest orange roughy fisheries in New Zealand.

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.

In 2008–09, the TACC for ORH 3B was reduced by 1080 t to 9420 t (Table 12). The total catch during 2008–09 was 8 758 t, which was 662 t below the TACC. The estimated TCEPR catches have typically accounted for more than 90% of the reported landings, and so TCEPR data can be considered representative of the fishery (Table 12).

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 2006–07, the area quotas were reduced by 1000 t for the Arrow Plateau, effectively closing this area, which then became a designated Benthic Protected Area in November 2007. All of the area quotas were under-caught in 2008–09 (Tables 13 and 14).

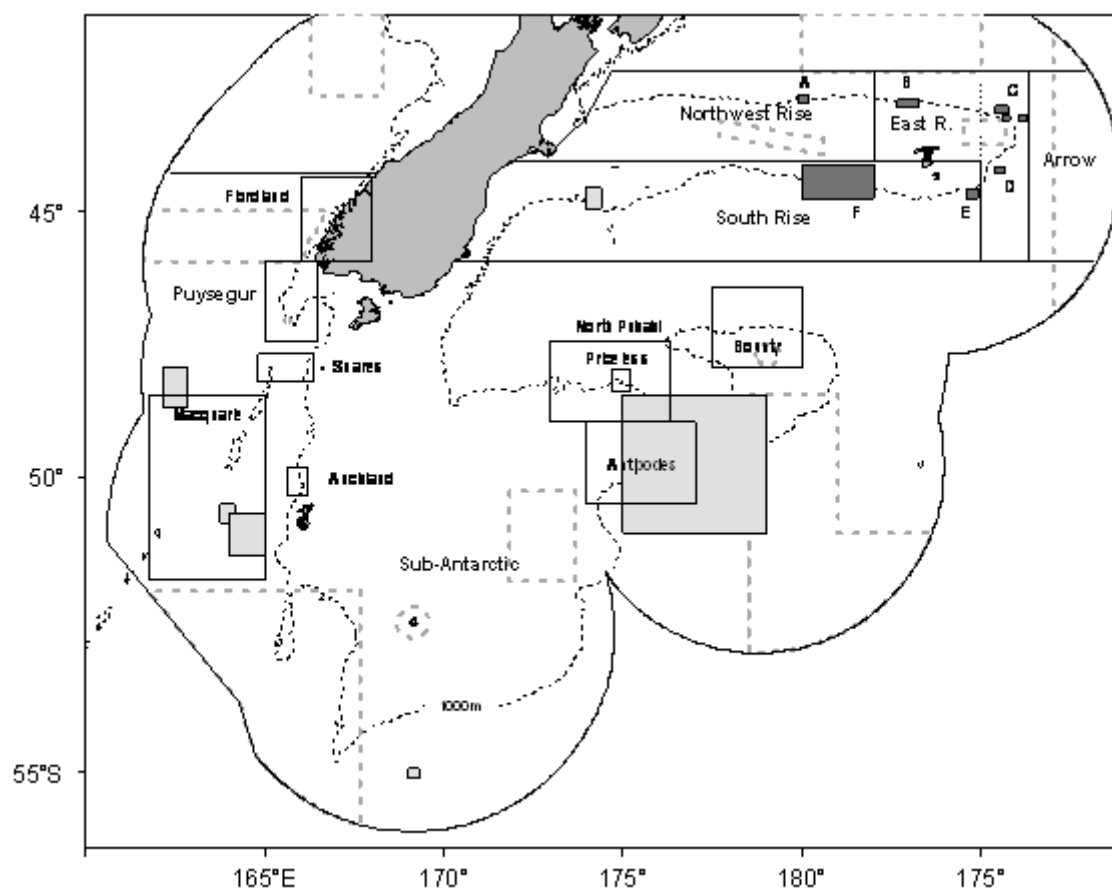


Figure 17: Map of locations of fisheries within ORH 3B. The broken vertical line on the East Rise is the eastern boundary of the Spawning Box. The dark grey shaded areas on Chatham Rise are: A, 180 Hills; B, Spawning plume; C, Smith's City & neighbours; D, Andes; E, Big Chief & neighbours; F, Hegerville & surrounds. Perimeters of Benthic Protection Areas (BPAs) closed to bottom trawling are marked with dashed grey lines, and seamounts closed to trawling are marked as light grey shaded rectangles.

Table 12: ORH 3B. Reported landings (t), TACC (t), and percentage of landings recorded on TCEPR-type (tow-by-tow) estimated catch forms, for 1989–90 to 2008–09.

Fishing year	Landings	TACC	Estimated catch as % of landings	Landings as % of TACC
1979–80†	11 800	–	173	–
1980–81†	31 100	–	99	–
1981–82†	28 200	23 000	49	123
1982–83*	32 605	23 000	81	142
1983–84*	32 535	30 000	76	108
1984–85‡	29 340	30 000	92	98
1985–86‡	30 075	29 865	96	101
1986–87‡	30 689	38 065	98	81
1987–88‡	24 214	38 065	101	64
1988–89‡	32 785	38 300	81	86
1989–90‡	31 669	32 787	72	97
1990–91‡	21 521	23 787	92	90
1991–92‡	23 269	23 787	95	98
1992–93‡	20 048	21 300	91	94
1993–94‡	16 960	21 300	92	80
1994–95‡	11 891	14 000	93	85
1995–96‡	12 501	12 700	97	98
1996–97‡	9 278	12 700	96	73

Table 12 (cont.):

1997–98‡	9 638	12 700	110	76
1998–99‡	9 372	12 700	114	74
1999–00‡	8 663	12 700	97	68
2000–01‡	9 274	12 700	100	73
2001–02‡	11 324	12 700	98	89
2002–03‡	12 333	12 700	101	97
2003–04‡	11 254	12 700	95	89
2004–05‡	12 369	12 700	97	97
2005–06‡	12 554	12 700	93	99
2006–07‡	11 271	11 500	90	98
2007–08‡	10 291	10 500	91	98
2008–09‡	8 758	9 420	92	93

† 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 an October–September fishing year.

In the first few years of the fishery, catches came mostly from the Spawning Box (Table 13). Landings from the western parts of the north Rise and the south Rise grew rapidly during the early 1980s, and these three areas were responsible for most of the landings for several years. Catches from other areas of 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. In recent years, the relative contribution of the Northwest Rise has been steadily decreasing, the East Rise, and the Spawning Box in particular, have been increasing, and other areas have been variable or remained about the same (Table 13).

Table 13: ORH 3B: Derived catches by area, to the nearest 100 t, and by percentage (to the nearest percent) of the total ORH 3B reported catch. Catches are allocated to area using the ratio of estimated catches, and revised such that all years are 1 October–30 September. NB: catches for the East Rise are given by the sum of Spawning Box and Rest of East Rise.

Fishing year	Northwest Rise		South Rise		Spawning Box		Rest of East Rise		Non-Chatham	
	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	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	1 700	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	2 600	27	1 700	18	1 200	13	2 300	24	1 500	17
2001–02	2 200	19	1 100	10	3 100	28	3 600	31	1 300	12

Table 13 (cont.):

Fishing year	Northwest Rise		South Rise		Spawning Box		Rest of East Rise		Non-Chatham	
	t	%	t	%	t	%	t	%	t	%
2002–03	2 200	19	1 500	13	3 200	27	3 900	33	1 500	7
2003–04	2 000	18	1 400	12	4 300	38	2 600	23	1 000	9
2004–05	1 600	13	1 700	14	4 100	33	3 000	24	2 000	16
2005–06	1 400	11	1 300	10	3 900	31	3 900	31	2 100	16
2006–07	700	7	1 200	11	4 200	37	3 700	32	1 500	16
2007–08	800	8	1 300	13	3 800	37	2 700	26	1 600	16
2008–09	700	8	1 200	14	3 400	39	2 200	25	1 300	15

Table 14: Catch limits (t) by designated sub-area within ORH 3B, as agreed between the industry and Minister of Fisheries since 1992–93. Note that East Rise includes the Spawning Box, closed between 1992–93 and 1994–95; Sub-area boundaries have varied somewhat between years. * South Rise included in East Rise catch limit. ** Arrow Plateau included in Sub-Antarctic.

Year	Chatham Rise			Non-Chatham Rise		
	Northwest Rise	South Rise	East Rise	Puysegur	Arrow Plateau	Sub-Antarctic
1992–93	3 500	6 300	4 500	5 000	–	2 000
1993–94	3 500	6 300	4 500	5 000	–	2 000
1994–95	2 500	2 000	3 500	2 000	3 000	1 000
1995–96	2 250	*	4 950	1 000	**	4 500
1996–97	2 250	*	4 950	500	**	5 000
1997–98	2 250	*	4 950	0	1 500	4 000
1998–99	2 250	*	4 950	0	1 500	4 000
1999–00	2 250	*	4 950	0	1 500	4 000
2000–01	2 250	*	4 950	0	1 500	4 000
2001–02	2 000	1 400	7 000	0	1 000	1 300
2002–03	2 000	1 400	7 000	0	1 000	1 300
2003–04	2 000	1 400	7 000	0	1 000	1 300
2004–05†	1 500	1 400	7 250	0	1 000	1 300
2005–06†	1 500	1 400	7 250	0	1 000	1 300
2006–07†	750	*	8 650‡	0	0	1 850
2007–08†	750	*	7 650#	0	0	1 850
2008–09†	750	*	6 570§	0	0	1 850

† 250 t set aside for industry research surveys.

‡ 8 650 t allocated to the East and South Chatham Rise combined, with no more than 2 000 t from the South Rise, and no more than 7 250 t from the East Rise.

Combined East and South Rise catch not to exceed 7650 t; East Rise (Spawning Box, NE Rise and SE Rise) not to exceed 6500 t; South Rise catch not to exceed 1750t. A catch limit of 1650 t applies to each of the NE Rise and SE Rise; a catch limit of 3200 t applies to the Spawning Box from 1 June – 31 August. Outside of June–August, this subarea component is part of the NE Rise sub-area and subject to the 1650 t catch limit.

§ East & South Rise managed as a single sub-area. The catch from the spawning plume (1 June – 31 August) is not to exceed 3 285 t.

6.3 Distribution of catch and effort, and catch rates

The main fishing areas of ORH 3B, with trawl positions and catch sizes, are shown in Figure 18. The distribution of catches during the last three fishing years was largely unchanged from recent years, with no new substantial fishing areas being developed.

On the **Northwest Chatham Rise**, the catches, effort, and number of vessels markedly declined in 2006–07 following catch quota reductions (Tables 15 and 16). Most orange roughy were caught in targeted tows. Unstandardised catch rates and the occurrence of large (greater than 10 t) catches declined steadily during the fishery, but improved slightly during the last three fishing years. Shorter tow duration since 2005–06 is consistent with more hill fishing or targeting of acoustic fish marks.

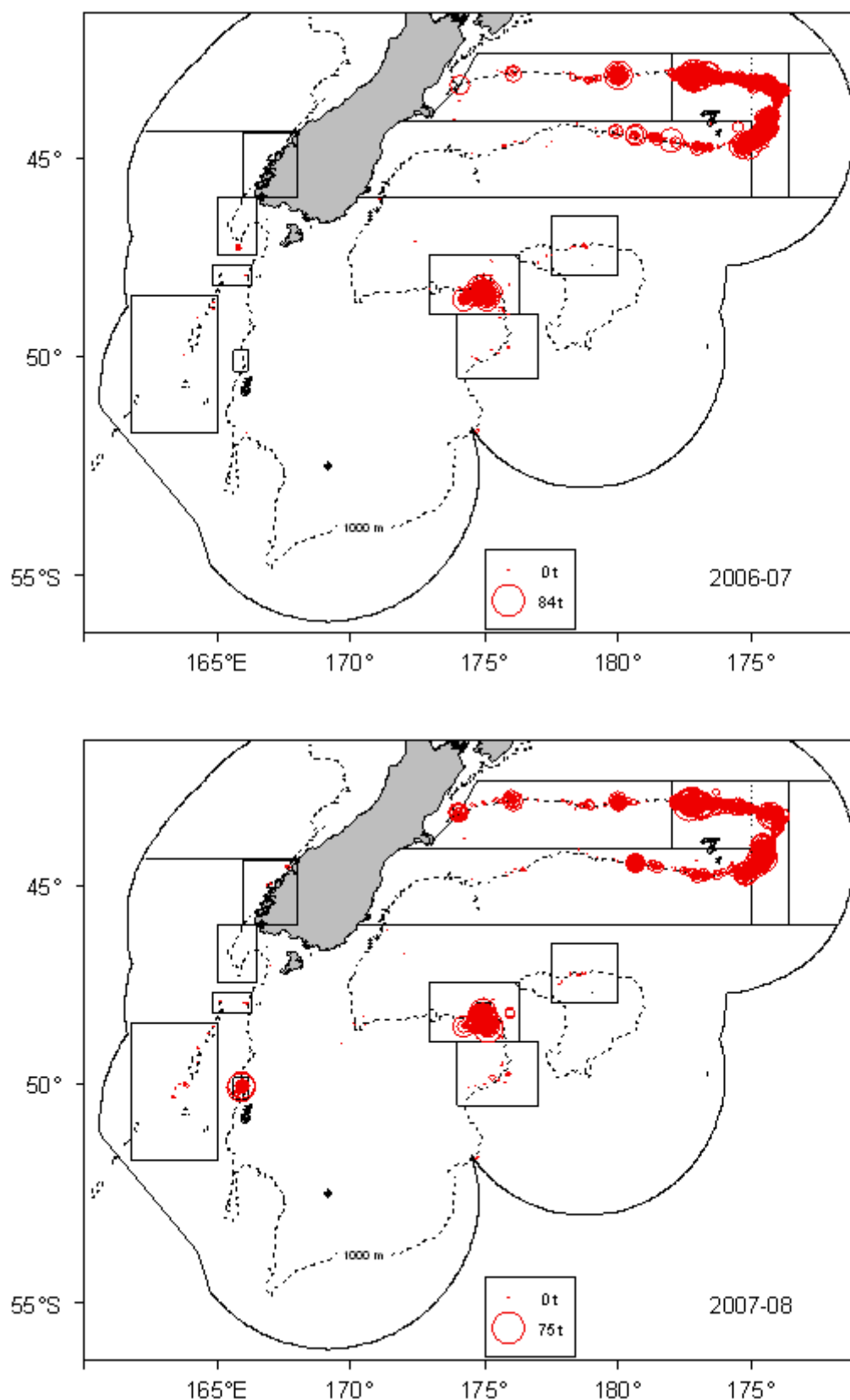


Figure 18: Distribution of unstandardised catch rates (t per tow) for orange roughy targeted or caught in ORH 3B during the last three fishing years (circle area proportional to catch rate, maximum). Area boundaries are the same as in Figure 17.

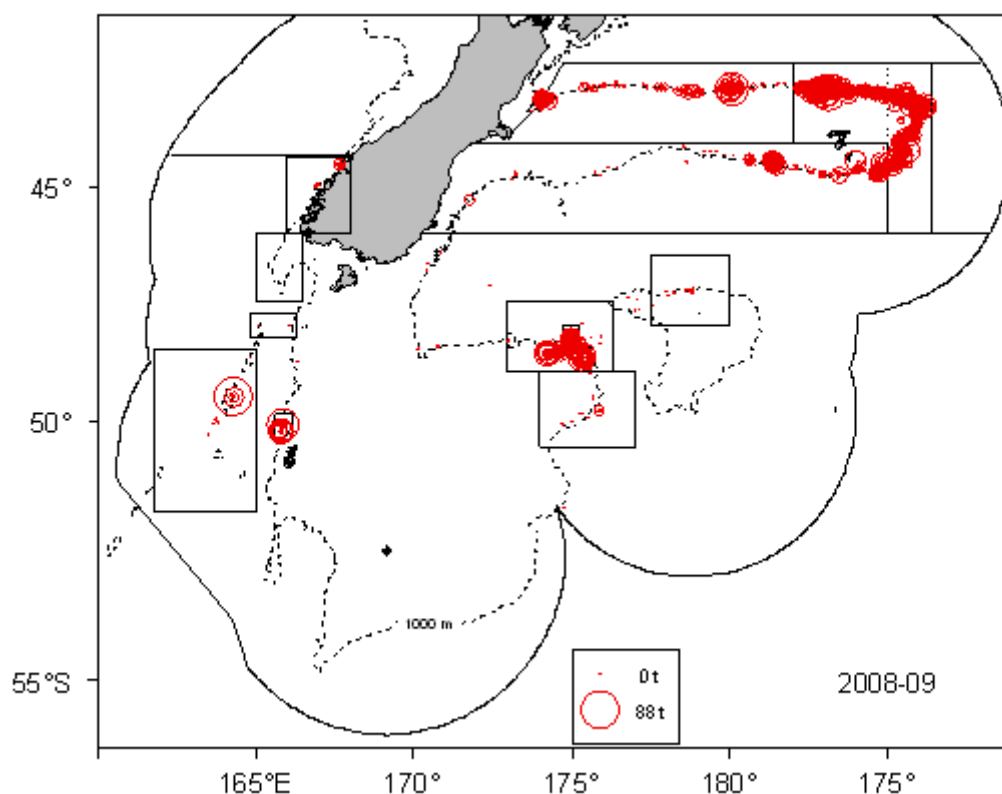


Figure 18 (cont.): Distribution of unstandardised catch rates (t per tow) for orange roughy targeted or caught in ORH 3B during the last three fishing years (circle area proportional to catch rate, maximum). Area boundaries are the same as in Figure 17.

On the **East Chatham Rise**, the catches, effort, and number of vessels markedly declined in the early 1990s after the main fishery in that area, the Spawning Box, was closed to fishing (Table 15). The fishery increased following a quota increase in 2000–01, but has decreased over the last two fishing years, in part due to quota reductions. Almost all orange roughy has been caught in targeted tows. In recent years about one in ten tows have resulted in large catches (greater than 10 t). Recent unstandardised catch rates have either shown no trend (t/tow) or decreased to an historical low (t/hour).

On the **South Chatham Rise**, effort increased slightly after a low in 2001–02, but catches have remained stable or perhaps decreased, and only four vessels remained in the fishery in 2008–09 (Table 15). Most orange roughy was caught in targeted tows, although about 20% was caught as a by-catch, mostly in the overlapping oreo fisheries. Unstandardised catch rates in 2008–09 were the lowest since 1999–2000, and large catches (greater than 10 t) have been relatively rare.

In the **Sub-Antarctic**, effort has decreased in recent years and only four vessels remained in the fishery in 2008–09 (Table 15). A substantial proportion of the orange roughy were caught as a by-catch, mostly in the overlapping oreo fisheries. Catches have declined in recent years after a peak in 2004–05, and unstandardised catch rates have declined and were relatively low in 2008–09. Unstandardised catch rates in the Sub-Antarctic remain lower than on the Chatham Rise. Nevertheless, large catches have consistently been made since 2004–05, at a rate higher than the South Chatham Rise.

Table 15: ORH 3B. Summary of effort, catch (t), catch rates, tow duration, and frequency of large catches for the fishing years 1979–80 to 2008–09, using tow-by-tow data. Catch rates and tow duration are calculated only for years in which there were ten or more tows.

Fishing year	Number of vessels	Total number of tows	% ORH target	Total estimated catch	Median catch rate (t/tow)	Median catch rate (t/h)	Median tow duration	Proportion of tows > 10 t
Northwest Chatham Rise								
1979–80	12	100	81	864	4.16	2.23	2.00	0.34
1980–81	34	2 416	86	9 075	2.26	0.79	3.00	0.08
1981–82	20	663	95	3 976	3.69	1.21	3.00	0.19
1982–83	27	1 512	99	8 674	3.61	1.06	3.42	0.17
1983–84	20	694	95	2 885	2.68	0.72	3.50	0.09
1984–85	21	379	84	1 717	2.53	0.72	3.67	0.15
1985–86	27	622	92	3 641	2.62	0.80	3.00	0.19
1986–87	26	718	93	2 962	2.04	0.71	3.00	0.09
1987–88	24	533	76	1 544	1.37	0.47	3.00	0.06
1988–89	23	834	97	2 926	1.75	0.54	3.00	0.08
1989–90	18	735	86	2 337	1.50	0.50	3.00	0.07
1990–91	21	459	57	1 361	1.00	0.24	4.00	0.07
1991–92	15	107	79	256	1.19	0.57	1.67	0.05
1992–93	17	390	94	3 475	3.80	16.30	0.19	0.29
1993–94	23	606	95	3 347	1.17	3.80	0.23	0.17
1994–95	16	645	98	2 241	1.00	1.84	0.25	0.07
1995–96	18	586	97	2 222	0.81	1.50	0.23	0.10
1996–97	19	688	93	2 103	1.20	0.68	2.85	0.05
1997–98	22	830	95	2 230	0.72	0.67	0.83	0.05
1998–99	25	788	93	2 543	1.00	0.45	2.00	0.07
1999–2000	25	744	80	2 019	0.60	0.55	0.33	0.08
2000–01	26	1 092	84	2 490	0.78	0.44	1.32	0.04
2001–02	22	939	91	2 031	0.68	0.39	2.32	0.04
2002–03	27	996	85	2 266	0.70	0.40	2.58	0.04
2003–04	22	892	80	1 952	0.80	0.24	4.00	0.04
2004–05	18	567	88	1 557	0.78	0.36	2.40	0.06
2005–06	13	448	95	1 342	0.60	0.46	0.50	0.06
2006–07	10	126	85	698	1.00	1.67	0.32	0.20
2007–08	9	307	93	711	0.60	1.09	0.30	0.05
2008–09	7	215	86	690	0.54	0.51	1.17	0.09
East Chatham Rise								
1979–80	23	2 076	97	18 971	6.76	3.84	2.00	0.41
1980–81	31	1 376	99	17 478	11.39	7.87	1.50	0.61
1981–82	17	1 168	100	9 615	4.55	1.78	2.50	0.26
1982–83	16	684	100	8 916	9.61	3.60	3.00	0.48
1983–84	19	1 374	99	16 503	9.00	2.69	3.00	0.45
1984–85	20	1 307	99	17 870	10.16	3.52	3.00	0.51
1985–86	26	1 889	99	19 876	8.06	2.15	3.50	0.40
1986–87	23	1 967	100	22 293	6.45	1.60	3.75	0.38
1987–88	26	1 693	100	16 002	5.79	1.41	3.58	0.30
1988–89	24	1 780	100	16 030	5.88	1.75	3.58	0.31
1989–90	20	1 117	100	12 329	7.00	2.00	3.50	0.36
1990–91	18	1 186	99	11 108	5.00	6.73	0.25	0.29
1991–92	9	1 469	99	12 453	4.50	15.00	0.18	0.26
1992–93	7	516	98	4 321	4.00	18.00	0.22	0.26
1993–94	11	850	98	4 475	2.00	8.00	0.22	0.14

Table 15 (cont.)

Fishing year	Number of vessels	Total number of tows	% ORH target	Total estimated catch	Median catch rate (t/tow)	Median catch rate (t/h)	Median tow duration	Proportion of tows > 10 t
1994-95	11	1 239	99	3 725	1.00	3.75	0.22	0.07
1995-96	12	841	100	3 489	1.00	2.50	0.25	0.11
1996-97	10	785	99	3 388	1.00	3.39	0.23	0.11
1997-98	13	1 153	100	4 191	0.50	1.50	0.25	0.09
1998-99	14	1 159	99	3 436	1.00	2.40	0.25	0.07
1999-2000	12	1 056	99	4 496	1.00	3.24	0.20	0.11
2000-01	11	887	99	3 454	1.29	4.28	0.23	0.09
2001-02	7	1 336	100	6 529	1.50	3.90	0.25	0.13
2002-03	11	1 781	100	7 074	1.00	2.80	0.27	0.11
2003-04	12	1 836	99	6 346	1.00	1.89	0.32	0.09
2004-05	13	1 712	99	6 532	1.29	1.90	0.32	0.10
2005-06	9	1 827	100	7 041	0.98	2.03	0.27	0.11
2006-07	11	1 885	100	7 048	1.00	1.50	0.32	0.09
2007-08	4	1 384	99	5 986	1.07	1.46	0.27	0.12
2008-09	6	1 314	100	5 115	1.00	1.16	0.23	0.10

South Chatham Rise

1979-80	17	206	7	561	1.88	1.82	1.00	0.03
1980-81	23	996	26	4 194	3.16	6.02	0.50	0.08
1981-82	8	218	17	306	0.27	0.19	1.50	0.02
1982-83	18	1 027	86	8 686	6.49	5.50	1.17	0.34
1983-84	17	1 021	57	5 384	2.50	2.48	1.17	0.17
1984-85	21	1 438	77	7 449	2.77	1.87	1.42	0.17
1985-86	24	1 443	72	5 097	1.08	0.98	1.17	0.09
1986-87	27	1 521	68	4 593	0.82	0.71	1.00	0.07
1987-88	24	2 330	69	6 946	0.73	0.60	1.00	0.08
1988-89	20	2 862	89	7 536	0.46	0.45	0.85	0.07
1989-90	18	2 181	87	7 949	1.00	1.58	0.47	0.09
1990-91	18	1 337	77	6 357	1.00	3.42	0.33	0.13
1991-92	16	743	67	2 482	1.00	2.28	0.27	0.09
1992-93	16	1 349	93	4 922	1.00	4.21	0.20	0.11
1993-94	18	2 035	96	4 657	0.25	0.91	0.23	0.06
1994-95	19	1 349	94	1 538	0.04	0.04	0.28	0.02
1995-96	16	897	90	1 159	0.03	0.05	0.33	0.02
1996-97	14	709	81	1 280	0.20	0.45	0.25	0.05
1997-98	17	991	85	1 561	0.15	0.30	0.30	0.03
1998-99	20	825	59	1 196	0.20	0.42	0.33	0.03
1999-2000	17	534	57	1 114	0.20	0.56	0.30	0.05
2000-01	12	636	69	1 665	0.40	1.26	0.25	0.07
2001-02	11	500	88	1 070	0.50	2.22	0.20	0.05
2002-03	16	626	83	1 401	0.50	1.80	0.21	0.05
2003-04	15	774	79	1 245	0.30	1.11	0.23	0.03
2004-05	11	719	78	1 535	0.48	2.00	0.23	0.05
2005-06	13	797	80	1 148	0.34	1.40	0.22	0.02
2006-07	10	702	72	1 091	0.30	1.20	0.22	0.03
2007-08	7	760	83	1 221	0.43	1.58	0.23	0.03
2008-09	4	801	81	1 074	0.20	0.78	0.23	0.03

Table 15 (cont.)

Fishing year	Number of vessels	Total number of tows	% ORH target	Total estimated catch	Median catch rate (t/tow)	Median catch rate (t/h)	Median tow duration	Proportion of tows > 10 t
Sub-Antarctic								
1980–81	2	2	50	0	–	–	3.17	0.00
1981–82	2	5	20	6	–	–	3.00	0.00
1982–83	1	5	20	6	–	–	5.83	0.00
1983–84	4	14	21	4	0.05	0.02	2.96	0.00
1984–85	0	–	–	–	–	–	–	–
1985–86	5	33	30	3	0.05	0.02	3.00	0.00
1986–87	2	3	33	0	–	–	2.71	0.00
1987–88	1	1	100	0	–	–	4.75	0.00
1988–89	7	16	69	36	0.01	0.00	1.18	0.06
1989–90	6	94	82	158	0.25	0.93	0.38	0.02
1990–91	6	249	65	830	0.25	0.86	0.27	0.10
1991–92	21	694	90	6 821	5.00	13.13	0.33	0.33
1992–93	18	1 057	82	5 458	1.80	3.60	0.33	0.15
1993–94	14	1 864	98	2 689	0.00	0.00	0.44	0.03
1994–95	16	561	72	2 782	0.50	1.76	0.23	0.14
1995–96	19	1 225	92	5 060	0.30	0.60	0.23	0.12
1996–97	13	1 234	92	1 862	0.05	0.16	0.22	0.03
1997–98	20	1 135	90	2 272	0.00	0.00	0.22	0.05
1998–99	21	1 170	81	2 741	0.15	0.53	0.25	0.06
1999–2000	19	770	72	515	0.03	0.07	0.27	0.01
2000–01	16	927	76	1 514	0.20	0.40	0.37	0.04
2001–02	16	504	65	1 353	0.17	0.50	0.33	0.06
2002–03	15	488	49	1 449	0.15	0.46	0.33	0.08
2003–04	15	572	70	1 049	0.06	0.13	0.42	0.04
2004–05	19	623	70	2 266	0.15	0.30	0.33	0.10
2005–06	8	514	73	2 025	0.15	0.37	0.32	0.11
2006–07	7	356	65	1 302	0.17	0.59	0.40	0.11
2007–08	4	434	71	1 488	0.20	0.72	0.30	0.10
2008–09	4	369	60	1 184	0.05	0.14	0.37	0.09

On the **East Chatham Rise** since the early 1990s, the fishing effort in the first eight months of the fishing year focused on hill complexes and other features. Between June and August the fishery focused on the flat area where spawning aggregations occurred in the Spawning Box, with little fishing taking place after August (Figure 19). The seasonal uptake of the catch in recent years was quite similar, with about 40% of the catch taken by the start of the spawning season (Figure 19). However, the uptake of catch was slower compared with previous years, such that the proportion of the quota caught during June and July continued to slowly increase. In all of the last four fishing years the East Rise quota was slightly exceeded, although the ORH 3B TACC was not exceeded (Tables 12 to 14).

On the **South Rise**, the seasonal uptake of the catch has been variable, with effort usually stopping by the end of May, and the catch uptake during the last three fishing years was within the historical range (Figure 19).

On the **Northwest Rise**, the effort and catch in recent years have become focused on the spawning period (June), and this pattern continued following the quota reduction in 2006–07 (Figure 19). Catch uptake during 2008–09 was slightly earlier because more effort took place during March and April. In the last two fishing years about one fifth (17–23%) of the effort took place after the spawning season, during July–September, presumably in order to reach the catch quota (Tables 13 and 14).

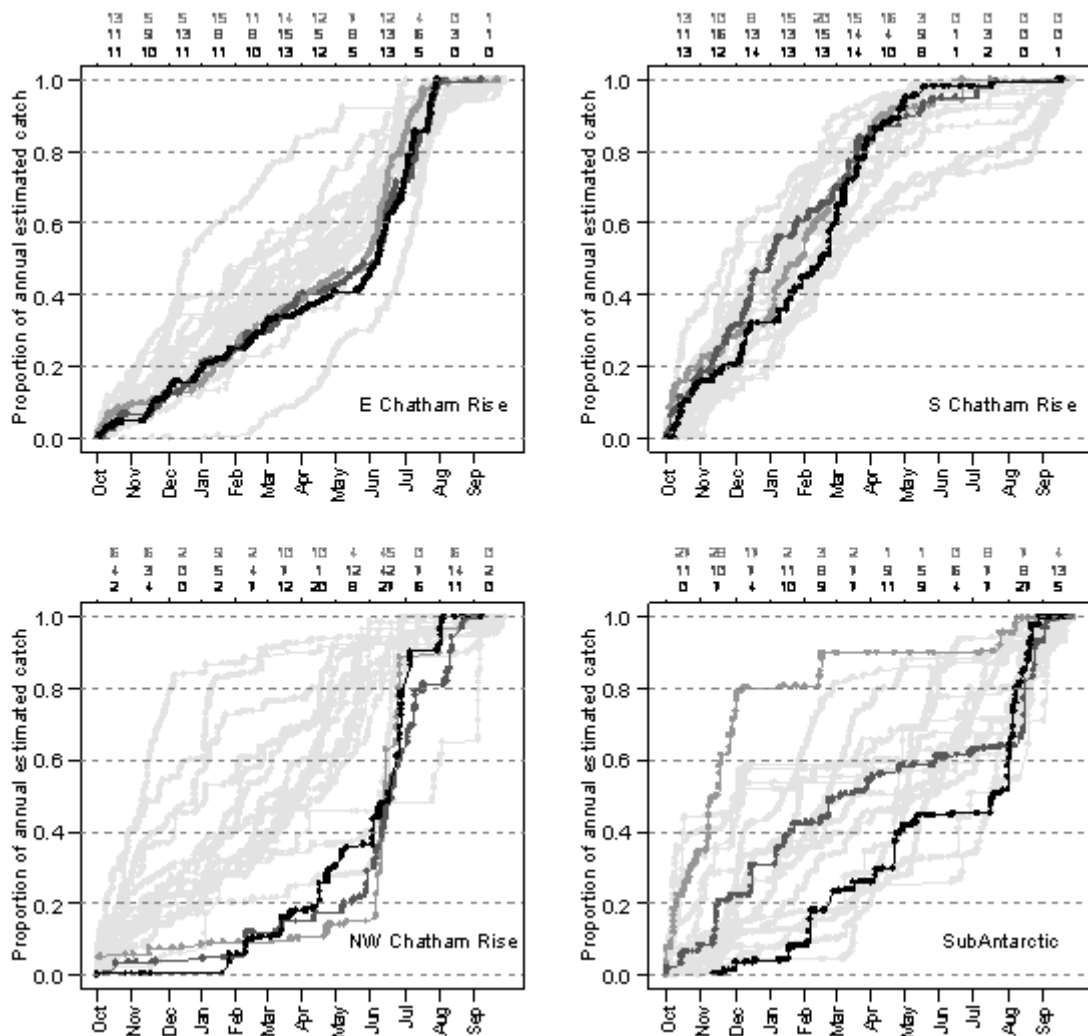


Figure 19: Cumulative catches and effort in subareas of ORH 3B. Catches are summed in chronological order through the fishing year, and scaled to the total estimated catch for the year. Each point represents the relative accumulated catch after the addition of the catch from each new trawl. The 2006–07, 2007–08, and 2008–09 fishing years are shown individually in grey (2006–07), dark grey (2007–08), and black (2008–09). The percentage of trawls by month is shown above each panel, using the same shading to represent years. Cumulative catches for all previous years are shown in light grey.

In the **Sub-Antarctic** fishery, most catch and effort from 2001–02 until 2006–07 occurred during the first few months of the fishing year. In 2007–08 and 2008–09 effort and catches occurred through most of the year, but the focus of effort and catch shifted to later in the year, such that in 2008–09 most effort (34%) and catch (about 50%) was during July and August (Figure 19).

On the **Northwest Chatham Rise**, the fishery changed from tows over a relatively wide area of flat grounds, to tows on the 180 Hills, in the early 1990s (Figure 20). Since 1992–93, catch and effort has been focused on and around the 180 Hills, and since 2001–02 also at the western end of the Northwest Chatham Rise (on and around Mernoo Gap Hill). Few new fishing areas have been developed since the early 1990s, although one new area was found in 2008–09. Most areas of the Northwest Rise have been fished at some point, and effort was relatively widely spread during 2003–04 and 2004–05, but with little catch resulting, just before the quota reduction in 2006–07. Since 2006–07 effort has been reduced, and fewer areas have been fished.

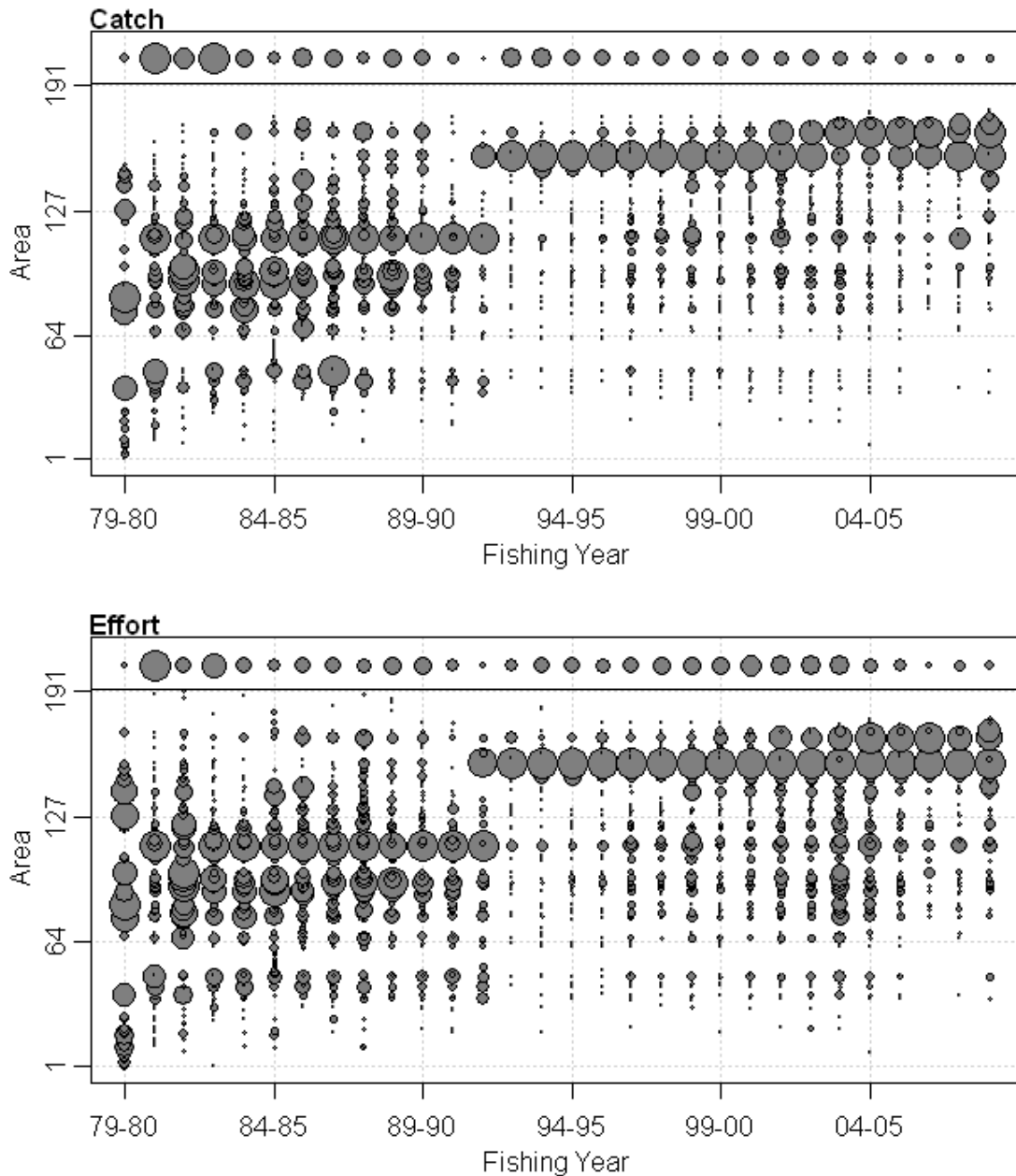


Figure 20: Northwest Chatham Rise (part of ORH 3B). The distribution of orange roughly estimated catch (top panel) and effort (number of tows, bottom panel) by fishing year and area (where area is a square of 1/5th of a degree latitude and longitude). Catch and effort are standardised in each year and proportional to circle size; the maximum circle size in each year is set to be equal. Areas have been ordered, in both plots, by the mean year in which the catch was taken. The top panel in each plot shows the (relative) total catch (upper) and total effort (lower) by year.

On the **East Chatham Rise**, the fishery switched from predominantly fishing in the Spawning Box and eastern flats, to fishing on hill features, when the Spawning Box was closed in the early 1990s (Figure 21). Catches in the last three fishing years have predominantly come from the Spawning Box, and two areas that were fished occasionally in the 1980s but were not the focus of the fishery at that time. New fishing areas were developed from 2000–01, and have continued to be fished, although catches have declined. Fishing effort was relatively dispersed during 2008–09. Although effort has continued to be directed at hill complexes fished since the early 1990s, catches from these areas have declined in the last two fishing years.

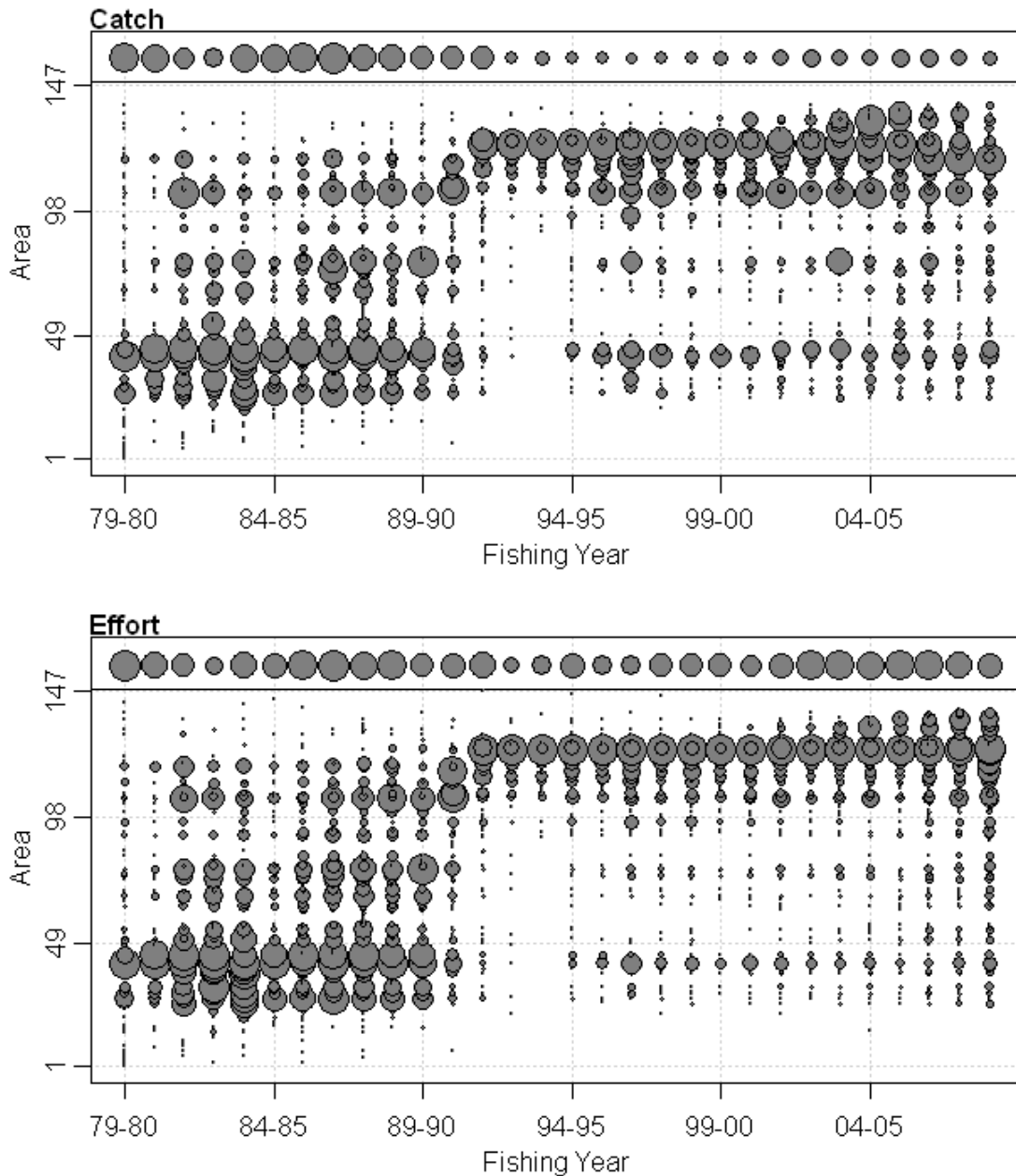


Figure 21: East Chatham Rise (part of ORH 3B). The distribution of orange roughy estimated catch (top panel) and effort (number of tows, bottom panel) by fishing year and area (where area is a square of 1/5th of a degree latitude and longitude). Catch and effort are standardised in each year and proportional to circle size; the maximum circle size in each year is set to be equal. Areas have been ordered, in both plots, by the mean year in which the catch was taken. The top panel in each plot shows the (relative) total catch (upper) and total effort (lower) by year.

On the **South Chatham Rise**, effort was relatively high until the early 1990s. During the 1980s there was a progression of catches and effort, from east to west, culminating in a fishery focused on the Chiefs area at the eastern end of the South Rise which persisted until 2008–09 (Figure 22). Several areas have been fished that yielded few catches of orange roughy. In recent years, fishing effort has extended over a number of areas, but catches have come predominantly from one area (the Chiefs). In 2008–09 substantial effort and catches were also taken in an area that had not been fished since the 1980s (Hegerville), with a moderate catch resulting.

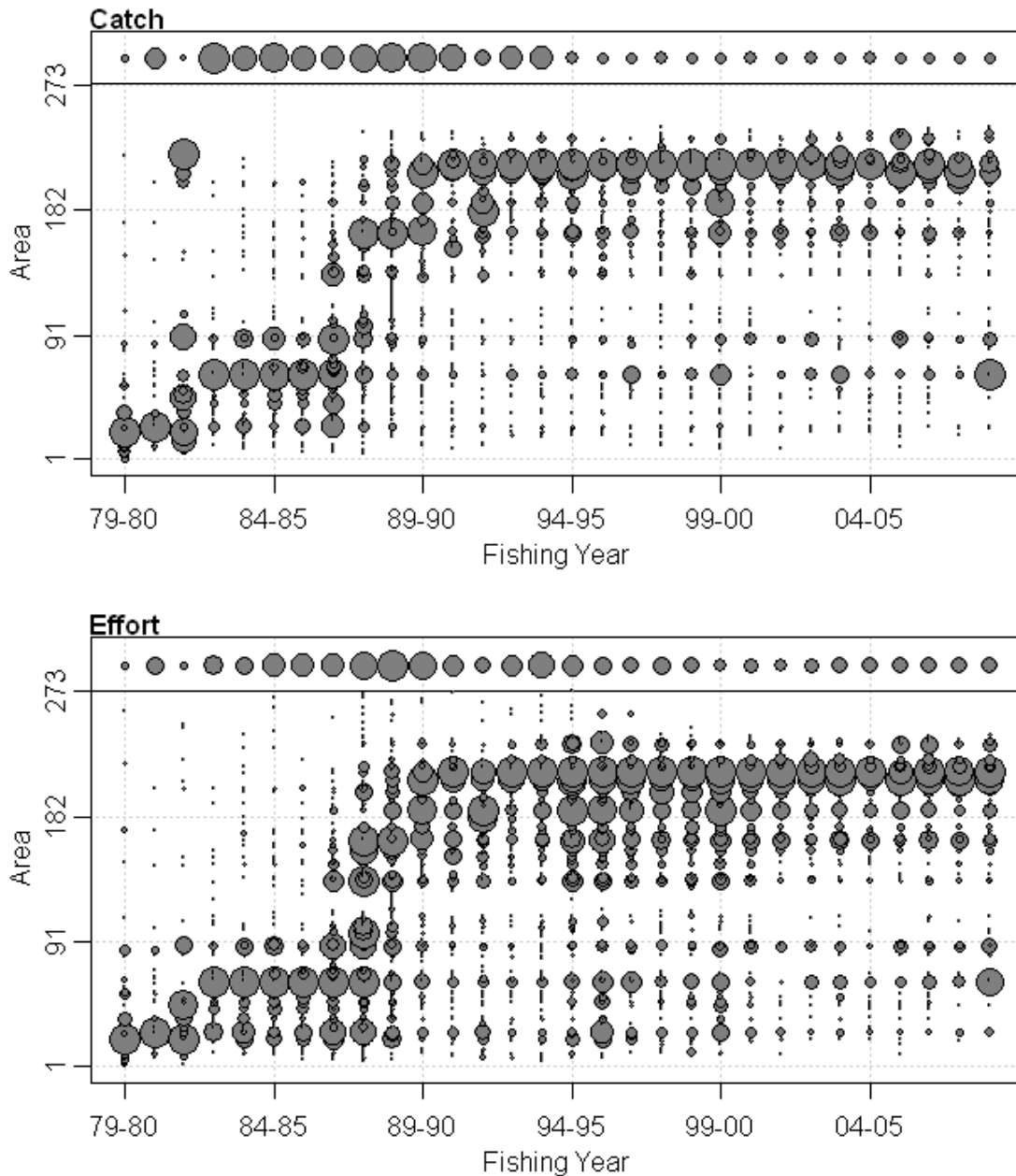


Figure 22: South Chatham Rise (part of ORH 3B). The distribution of orange roughy estimated catch (top panel) and effort (number of tows, bottom panel) by fishing year and area (where area is a square of 1/5th of a degree latitude and longitude). Catch and effort are standardised in each year and proportional to circle size; the maximum circle size in each year is set to be equal. Areas have been ordered, in both plots, by the mean year in which the catch was taken. The top panel in each plot shows the (relative) total catch (upper) and total effort (lower) by year.

In the **Sub-Antarctic**, about one third of the areas fished have never yielded catches of orange roughy (Figure 23). There was a steady sequential fishing of locations since the early 1990s, with large catches rarely persisting in any area for more than 4 or 5 years, and the most persistent fishery area starting in 2001–02 and lasting until 2008–09 (Priceless and north Pukaki). In 2008–09, many of the areas that had been previously fished but were then abandoned or fished infrequently were revisited, and one new area was developed (on north Pukaki).

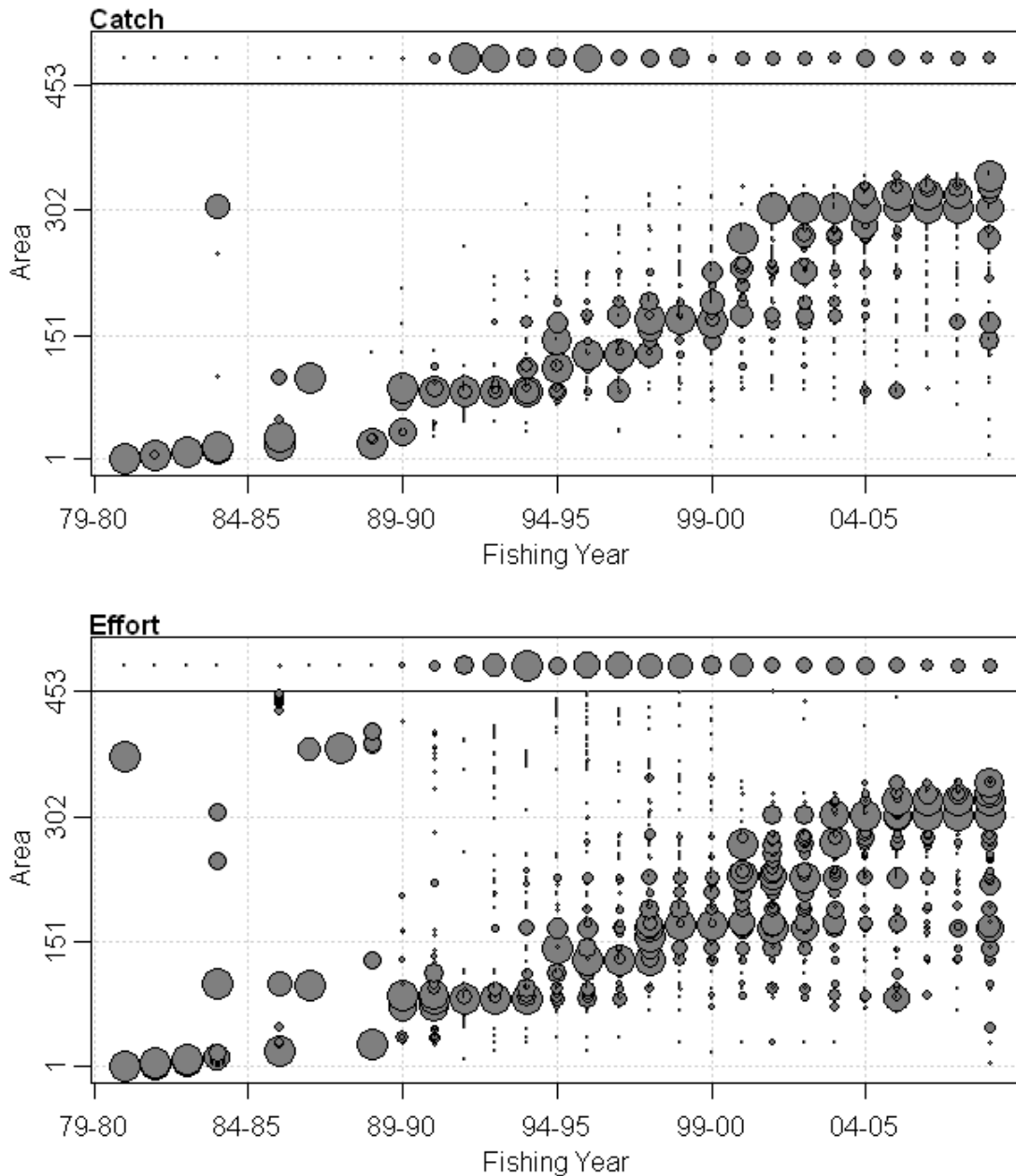


Figure 23: Sub-Antarctic (part of ORH 3B). The distribution of orange roughy estimated catch (top panel) and effort (number of tows, bottom panel) by fishing year and area (where area is a square of 1/5th of a degree latitude and longitude). Catch and effort are standardised in each year and proportional to circle size; the maximum circle size in each year is set to be equal. Areas have been ordered, in both plots, by the mean year in which the catch was taken. The top panel in each plot shows the (relative) total catch (upper) and total effort (lower) by year.

The main areas of the Chatham Rise have previously been divided and examined as individual features, or groups of spatially related features. Of these, the 180 Hills (Graveyard hills), the Northeast hills (Smith's City & neighbours) and Andes, Big Chief & neighbours, and the Spawning Box have contributed the largest proportion of the total catch on the Chatham Rise (Table 16). The following subareas have been defined as follows for Chatham Rise:

- **180 Hills.** Also known as the Graveyard hill complex. The area of hills within the limits 179.88°E–178.80°W and 42.67–42.83° S. The 180 hills are close together, and it is therefore difficult to allocate tows to specific hills.

- **Northwest Chatham Rise flat.** The northwest Chatham Rise subarea, but excluding the 180 hills.
- **Spawning Box.** The area of largely flat seabed within the limits 42.17°–44° S and 178°–175° W. A number of fisheries have been described, most notably the fishery on spawning plumes in winter, and pre-spawning fisheries at the eastern and western ends of the Spawning Box (Anderson & Dunn 2008). The following subdivisions are used here:
 - **Spawning Plume.** The area of the Spawning Box within the limits 42.75–42.9° S and 176.72–177.36° W, and in June, July and August.
 - **Spawning Box background.** The area within the Spawning Box but not in the Spawning Plume.
- **Smith’s City & neighbours.** This area contains the fishing hills Smith’s City, Camerson, and Erebus, and is defined as the area inside three boxes having the limits: 174.25–174.59°W and 43.02–42.89°S; 173.70–173.98°W and 43.09–43.22°S; 174.18–174.41°W and 43.10–43.17°S.
- **Eastern Flats.** The area is the East Chatham Rise excluding the Spawning Box, Smith’s City & neighbours, and Andes. The area includes a number of specific fisheries, notably the hill fisheries Not Till Sunday and Kenwood, and the Middle-ground fishery (Anderson & Dunn 2008). The following subdivisions are used here:
 - **Kenwood.** The area around the hills known as Kenwood, Harrisville, and Dickman, to the north and west of the Andes, within the limits 174.44–174.7°W and 43.88–44.02°S.
 - **Middle ground.** The area to the west and south of the Andes within the limits 174.6–175°W and 44.35–44.63°S.
- **Andes.** The area of hills within the limits 174.33–174.58°W and 44.1–44.25° S. Hills in the Andes complex are close together, and it is difficult to allocate tows to specific hills.
- **Big Chief & neighbours.** The area of hills within the limits 175.08–175.42°W and 44.58–44.75° S. Hills in the Chiefs area are close together, and it is difficult to allocate tows to specific hills.
- **Hegerville & surrounds.** The Hegerville hill and surrounding area within the limits 180°–178°W and 43.74–46.00° S.

The following subareas have been defined for the Sub-Antarctic:

- **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.
- **North Pukaki.** An area of the northern edge of the Pukaki Rise, within the boundary of 47° 30’ – 49° S and 173° – 176° 18’ E, but not including the area known as Priceless.
- **Priceless.** An area within North Pukaki, with the boundaries 48° 5.5’ – 48° 26.5’ S and 174° 42’ – 175° 13’ E.
- **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.
- **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.
- **Fiordland.** An area of the west coast of the South Island, lying between the boundaries 44° 20' – 46° S and 166° – 168° E
- **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.
- **Arrow.** A small plateau to the northeast of the Chatham Rise, lying between latitudes 42° 10' S and 46° S and bounded in the west at 173° 40' W and in the east by the perimeter of the EEZ.

The catches on the Northwest Chatham during 2007–08 and 2008–09 were roughly equally split between the 180 Hills and the northwest Chatham Rise flat (Table 16). Effort and catch on the 180 Hills was variable during the last three fishing years, and catches in 2007–08 and 2008–09 were relatively low.

Recent targeted orange roughy fishing effort on Chatham Rise was consistently greatest in the Andes area, until 2007–08 (Table 16). The Andes is a complex of hills within an area of about 10 nautical square miles, within which a total of 9546 tows were completed between 1988–89 and 2008–09. During 2007–08 and 2008–09, effort on the Andes declined, and targeted effort on Chatham Rise was greatest on the Eastern Flats and in the Spawning Box, followed by the Andes, and Big Chief & Neighbours. During 2007–08 and 2008–09, catches from the Andes declined dramatically (by 72%). Catches in 2007–08 from Smith's City & Neighbours, and in 2008–09 from Big Chief & Neighbours, were at historical lows. During 2007–08 and 2008–09, catches from Hegerville & surrounds on the south Chatham Rise increased, although they remain low compared to other areas. Within the Eastern Flats, effort, catches, and unstandardised catch rates from the Middle Ground declined substantially during 2007–08 and 2008–09. Effort in Kenwood was lower in 2008–09, and catches declined substantially.

The highest unstandardised catch rates have historically been achieved in the Spawning Box, where spawning plumes, or pre- and post-spawning aggregations, have been targeted (Table 16). Unstandardised catch rates in the Spawning Box in recent years remained steady or increased. Unstandardised catch rates on the 180 Hills also remained relatively high.

Table 16: ORH 3B subareas (Chatham Rise). Summary of effort, catch (t), catch rates, tow duration, and frequency of large catches for the fishing years 1979–80 to 2008–09, using tow-by-tow data. Catch rates and tow duration are calculated only for years in which there were ten or more tows. * tows were within the defined areas and therefore close to, but not on, the hills; tows on the hills have shorter tow duration.

Fishing year	Number of vessels	Total number of tows	% ORH target	Total estimated catch	Median catch rate (t/tow)	Median catch rate (t/h)	Median tow duration	Proportion of tows > 10 t
180 Hills								
1980–81*	4	7	100	49	–	–	–	0.14
1981–82*	3	12	100	87	6.37	2.04	3.04	0.33
1982–83*	5	12	92	88	5.04	1.53	3.50	0.17
1983–84*	0	–	–	–	–	–	–	–
1984–85*	0	–	–	–	–	–	–	–
1985–86*	3	11	100	32	2.51	0.72	4.00	0.00
1986–87*	5	11	100	27	2.02	0.67	3.22	0.00
1987–88*	4	19	100	126	4.66	1.88	3.00	0.21
1988–89*	4	25	100	125	3.21	1.13	3.00	0.08
1989–90*	3	28	100	160	5.50	1.93	2.96	0.07
1990–91*	1	2	100	8	–	–	–	0.00
1991–92	2	25	100	68	1.29	7.11	0.10	0.04
1992–93	8	297	100	3 298	5.13	36.29	0.17	0.38
1993–94	11	367	99	2 209	1.90	10.00	0.18	0.19
1994–95	8	368	99	1 512	1.00	4.56	0.20	0.09
1995–96	10	356	100	1 790	1.00	4.62	0.17	0.15
1996–97	12	247	98	877	0.49	2.07	0.18	0.09
1997–98	10	305	100	829	0.40	2.05	0.18	0.07
1998–99	8	189	98	937	0.80	3.75	0.17	0.14
1999–2000	9	245	98	634	0.50	3.00	0.17	0.06
2000–01	10	301	100	1 014	0.50	2.52	0.22	0.08
2001–02	9	206	100	729	0.87	3.20	0.25	0.09
2002–03	14	253	100	1 080	0.80	3.00	0.20	0.09
2003–04	11	129	98	748	0.75	2.09	0.23	0.13
2004–05	6	171	99	919	1.14	5.45	0.20	0.14
2005–06	8	188	100	958	0.57	2.00	0.20	0.11
2006–07	3	78	100	591	1.75	9.30	0.23	0.29
2007–08	5	176	100	386	0.63	2.52	0.25	0.05
2008–09	5	75	100	385	1.28	4.50	0.18	0.13
Northwest Chatham Rise Flat								
1979–80	12	100	81	864	4.16	2.23	2.00	0.34
1980–81	34	2 409	86	9 026	2.26	0.79	3.00	0.08
1981–82	20	651	95	3 889	3.67	1.20	3.00	0.19
1982–83	27	1 500	99	8 586	3.61	1.05	3.42	0.17
1983–84	20	694	95	2 885	2.68	0.72	3.50	0.09
1984–85	21	379	84	1 717	2.53	0.72	3.67	0.15
1985–86	27	611	92	3 608	2.62	0.80	3.00	0.19
1986–87	26	707	93	2 934	2.04	0.71	3.00	0.09
1987–88	24	514	75	1 418	1.33	0.45	3.00	0.06
1988–89	23	809	97	2 802	1.70	0.51	3.00	0.08
1989–90	18	707	85	2 177	1.30	0.46	3.00	0.07
1990–91	21	457	57	1 353	1.00	0.23	4.00	0.07
1991–92	15	82	73	189	1.09	0.50	2.42	0.05
1992–93	15	93	74	177	0.75	0.29	2.50	0.02
1993–94	22	239	89	1 138	1.00	0.55	1.00	0.13

Table 16 (cont.)

Fishing year	Number of vessels	Total number of tows	% ORH target	Total estimated catch	Median catch rate (t/tow)	Median catch rate (t/h)	Median tow duration	Proportion of tows > 10 t
1994-95	16	277	97	729	1.00	0.79	1.28	0.04
1995-96	17	230	92	432	0.60	0.40	2.00	0.03
1996-97	18	441	91	1 226	1.70	0.52	3.97	0.02
1997-98	22	525	93	1 402	1.00	0.50	2.65	0.04
1998-99	25	599	92	1 606	1.00	0.33	3.00	0.05
1999-2000	25	499	71	1 386	0.60	0.25	2.47	0.08
2000-01	26	791	77	1 476	0.80	0.32	3.83	0.03
2001-02	22	733	88	1 303	0.60	0.27	3.25	0.03
2002-03	27	743	80	1 185	0.70	0.26	3.92	0.02
2003-04	22	763	77	1 204	0.80	0.19	4.33	0.02
2004-05	18	396	84	638	0.60	0.17	4.00	0.03
2005-06	13	260	92	383	0.60	0.22	3.26	0.03
2006-07	10	48	60	107	0.44	0.28	2.10	0.04
2007-08	9	131	83	325	0.50	0.39	1.93	0.06
2008-09	6	140	79	305	0.40	0.20	2.52	0.06
Spawning Plume								
1979-80	18	999	97	10 574	11.26	8.45	1.25	0.53
1980-81	24	898	99	11 148	11.52	8.19	1.50	0.65
1981-82	17	470	100	4 752	4.50	2.50	1.83	0.35
1982-83	9	227	100	3 980	13.44	7.07	2.00	0.60
1983-84	17	378	100	6 591	13.44	3.76	3.00	0.57
1984-85	20	676	100	9 316	10.44	3.71	3.00	0.54
1985-86	23	659	100	8 521	9.97	2.96	3.00	0.50
1986-87	21	597	100	8 089	8.91	2.26	3.32	0.47
1987-88	24	624	100	7 899	7.96	2.01	3.29	0.45
1988-89	22	598	100	7 067	9.63	3.23	2.50	0.43
1989-90	17	403	100	6 829	12.50	4.00	3.00	0.57
1990-91	9	238	100	2 819	8.00	2.83	3.00	0.36
1991-92	5	85	100	653	6.00	1.57	4.17	0.15
1992-93	1	2	100	54	–	–	–	0.50
1993-94	0	–	–	–	–	–	–	–
1994-95	1	86	100	487	0.30	0.43	0.52	0.22
1995-96	4	127	100	1 356	5.00	3.59	1.17	0.32
1996-97	6	101	100	934	3.00	2.11	1.17	0.23
1997-98	6	118	100	1 579	6.00	6.86	0.53	0.39
1998-99	4	73	100	505	2.70	4.36	0.50	0.22
1999-2000	2	34	100	914	25.00	200.89	0.11	0.71
2000-01	3	59	100	814	5.50	21.36	0.30	0.37
2001-02	4	159	100	2 118	4.00	8.12	0.35	0.37
2002-03	6	166	100	2 154	8.00	15.00	0.30	0.47
2003-04	5	163	100	1 880	6.00	7.40	0.67	0.40
2004-05	9	214	100	1 912	4.36	3.91	0.93	0.30
2005-06	6	118	99	1 634	8.70	5.25	0.57	0.47
2006-07	7	121	100	1 975	11.20	6.00	0.68	0.51
2007-08	3	200	100	2 545	5.00	15.43	0.25	0.43
2008-09	3	121	100	2 019	18.00	49.97	0.23	0.58

Table 16 (cont.)

Fishing year	Number of vessels	Total number of tows	% ORH target	Total estimated catch	Median catch rate (t/tow)	Median catch rate (t/h)	Median tow duration	Proportion of tows > 10 t
Spawning Box Background								
1979–80	23	835	96	7 734	5.77	2.82	2.42	0.37
1980–81	25	466	100	6 301	11.52	7.12	1.50	0.56
1981–82	17	610	100	4 462	4.84	1.72	2.83	0.21
1982–83	16	392	99	3 875	8.06	2.62	3.17	0.42
1983–84	19	843	99	8 653	7.68	2.46	3.00	0.43
1984–85	19	548	98	7 550	9.94	3.42	3.00	0.49
1985–86	24	872	99	7 663	5.99	1.63	3.50	0.31
1986–87	22	1 040	100	12 045	6.18	1.54	3.83	0.38
1987–88	26	708	100	5 835	5.03	1.19	3.50	0.25
1988–89	23	816	100	6 543	5.00	1.43	3.37	0.27
1989–90	18	606	100	5 018	5.25	1.45	3.71	0.27
1990–91	12	206	100	2 806	8.00	2.60	3.00	0.43
1991–92	8	57	98	308	5.50	1.31	4.08	0.07
1992–93	0	–	–	–	–	–	–	–
1993–94	0	–	–	–	–	–	–	–
1994–95	3	25	100	5	0.10	0.19	0.52	0.00
1995–96	7	28	100	155	0.91	1.22	0.63	0.18
1996–97	4	133	100	617	2.00	1.46	2.00	0.14
1997–98	7	151	100	629	1.40	0.90	1.82	0.09
1998–99	9	140	99	486	1.55	0.73	2.67	0.07
1999–2000	5	111	100	511	2.00	1.48	1.73	0.12
2000–01	8	124	99	434	2.00	1.01	2.00	0.10
2001–02	6	224	100	986	2.00	0.95	3.00	0.09
2002–03	8	216	100	995	1.80	1.11	2.50	0.11
2003–04	11	430	100	2 076	2.80	1.11	2.54	0.12
2004–05	11	430	100	1 886	2.69	0.98	2.76	0.11
2005–06	9	322	100	1 893	3.00	1.07	3.45	0.17
2006–07	11	399	100	1 795	2.45	0.76	3.97	0.09
2007–08	3	247	100	933	2.25	0.81	3.07	0.07
2008–09	3	248	100	1 115	2.82	0.85	3.90	0.09
Smith's City and Neighbours								
1979–80*	5	36	100	108	3.06	0.67	4.54	0.00
1980–81*	2	2	100	2	–	–	–	0.00
1981–82*	4	11	100	42	3.63	1.77	0.75	0.00
1982–83*	2	2	100	36	–	–	–	0.50
1983–84*	3	7	100	58	–	–	–	0.29
1984–85*	2	3	100	13	–	–	–	0.00
1985–86*	6	52	100	665	11.44	3.59	3.50	0.58
1986–87*	9	34	100	210	3.94	0.94	3.96	0.18
1987–88*	13	33	100	163	4.52	1.08	4.00	0.06
1988–89*	9	48	100	309	3.92	0.85	4.82	0.21
1989–90*	4	9	100	42	–	–	–	0.11
1990–91	6	642	99	4 928	3.50	23.08	0.15	0.24
1991–92	5	222	100	1 272	2.00	12.50	0.15	0.16
1992–93	4	84	100	598	2.00	15.00	0.21	0.27
1993–94	5	110	99	621	2.85	13.51	0.18	0.15
1994–95	7	345	100	1 136	1.00	4.62	0.20	0.08
1995–96	7	145	100	405	1.00	5.60	0.22	0.05
1996–97	7	166	99	721	1.00	7.50	0.17	0.11

Table 16 (cont.)

Fishing year	Number of vessels	Total number of tows	% ORH target	Total estimated catch	Median catch rate (t/tow)	Median catch rate (t/h)	Median tow duration	Proportion of tows > 10 t
1997-98	9	146	100	396	0.40	1.99	0.17	0.05
1998-99	8	272	100	809	1.00	3.32	0.20	0.07
1999-2000	8	210	100	675	0.78	3.75	0.17	0.10
2000-01	7	191	100	650	1.00	6.00	0.18	0.08
2001-02	5	167	100	492	0.90	4.50	0.18	0.09
2002-03	6	124	100	404	0.52	3.60	0.17	0.09
2003-04	6	160	100	364	0.80	3.00	0.20	0.04
2004-05	7	127	100	306	0.90	3.00	0.20	0.06
2005-06	6	119	100	366	0.72	4.18	0.18	0.11
2006-07	6	201	100	569	0.68	3.00	0.22	0.09
2007-08	1	77	100	286	1.00	2.14	0.22	0.09
2008-09	1	171	100	465	0.50	1.50	0.18	0.06
Eastern Flats								
1979-80	9	206	100	555	2.23	0.55	4.32	0.02
1980-81	4	10	100	28	-	-	-	0.00
1981-82	7	77	100	359	3.99	1.68	2.58	0.09
1982-83	6	63	100	1 025	8.49	4.65	3.00	0.48
1983-84	9	146	95	1 202	6.36	1.74	3.33	0.32
1984-85	7	80	100	991	9.47	3.15	3.00	0.46
1985-86	12	306	100	3 027	8.12	2.36	3.50	0.39
1986-87	12	296	100	1 948	4.56	1.17	4.00	0.20
1987-88	17	328	99	2 105	5.27	1.27	4.00	0.17
1988-89	16	300	100	2 082	4.47	0.97	5.00	0.21
1989-90	12	86	100	356	3.00	0.76	4.00	0.07
1990-91	10	87	100	481	1.00	2.73	0.22	0.15
1991-92	6	366	100	3 045	5.00	17.56	0.19	0.27
1992-93	5	75	100	566	2.00	5.00	0.25	0.20
1993-94	11	126	97	506	1.90	6.00	0.25	0.11
1994-95	8	200	98	442	1.00	3.33	0.22	0.04
1995-96	9	122	98	452	0.50	2.09	0.27	0.11
1996-97	7	120	98	371	1.00	3.00	0.23	0.08
1997-98	11	260	100	446	0.27	1.09	0.25	0.03
1998-99	11	218	98	369	0.30	1.21	0.25	0.03
1999-2000	11	165	98	390	0.30	2.29	0.17	0.05
2000-01	8	155	100	575	1.00	4.33	0.18	0.09
2001-02	6	240	100	895	1.14	6.00	0.18	0.10
2002-03	8	400	99	1 289	0.78	3.29	0.23	0.08
2003-04	9	398	99	843	0.60	2.45	0.22	0.06
2004-05	8	408	99	1 330	0.92	3.00	0.22	0.08
2005-06	8	538	99	1 811	0.72	2.90	0.20	0.10
2006-07	7	578	99	1 544	0.91	1.71	0.25	0.06
2007-08	2	443	98	1 327	0.60	1.06	0.23	0.06
2008-09	4	447	99	1 169	1.00	1.04	0.23	0.05
Kenwood								
1997-98	1	1	100	6	-	-	-	0.00
1998-99	1	1	100	5	-	-	-	0.00
1999-2000	0	-	-	-	-	-	-	-
2000-01	0	-	-	-	-	-	-	-
2001-02	0	-	-	-	-	-	-	-

Table 16 (cont.)

Fishing year	Number of vessels	Total number of tows	% ORH target	Total estimated catch	Median catch rate (t/tow)	Median catch rate (t/h)	Median tow duration	Proportion of tows > 10 t
2002–03	1	3	100	3	–	–	–	0.00
2003–04	1	1	100	0	–	–	–	0.00
2004–05	0	–	–	–	–	–	–	–
2005–06	1	175	100	589	0.60	2.31	0.23	0.09
2006–07	2	106	100	236	0.94	3.39	0.25	0.04
2007–08	1	129	98	472	0.40	1.20	0.22	0.10
2008–09	1	75	97	85	0.30	1.20	0.18	0.01
Andes								
1988–89	2	18	100	28	0.31	0.45	0.42	0.00
1989–90	2	13	100	85	1.50	4.29	0.23	0.23
1990–91	3	13	92	75	2.58	15.50	0.17	0.15
1991–92	5	739	98	7 174	5.00	24.00	0.17	0.31
1992–93	6	355	97	3 103	5.00	21.82	0.22	0.26
1993–94	11	614	99	3 348	1.60	7.55	0.23	0.15
1994–95	10	583	98	1 655	1.00	4.05	0.23	0.06
1995–96	10	419	100	1 121	0.50	1.87	0.25	0.06
1996–97	9	265	98	746	1.00	3.65	0.22	0.06
1997–98	10	478	100	1 141	0.50	1.76	0.25	0.05
1998–99	10	456	98	1 267	1.00	3.00	0.25	0.07
1999–2000	10	536	99	2 007	1.00	4.01	0.22	0.10
2000–01	9	358	99	981	1.05	4.53	0.25	0.06
2001–02	6	546	100	2 038	1.50	5.74	0.25	0.10
2002–03	7	875	100	2 233	0.95	3.00	0.28	0.06
2003–04	8	685	99	1 183	0.52	1.88	0.30	0.02
2004–05	5	533	97	1 097	0.60	2.20	0.25	0.04
2005–06	5	730	100	1 337	0.53	2.00	0.25	0.03
2006–07	6	586	99	1 164	0.50	1.87	0.27	0.04
2007–08	1	417	99	896	0.50	1.84	0.22	0.06
2008–09	1	327	100	347	0.20	1.04	0.18	0.01
Middle ground								
1997–98	1	1	100	0	–	–	–	0.00
1998–99	0	–	–	–	–	–	–	–
1999–2000	1	2	100	2	–	–	–	0.00
2000–01	2	16	100	197	6.00	31.33	0.15	0.31
2001–02	2	24	100	100	1.00	7.41	0.16	0.17
2002–03	4	57	98	285	1.40	6.00	0.20	0.11
2003–04	4	126	100	380	0.65	4.65	0.17	0.10
2004–05	4	207	100	918	1.37	6.04	0.18	0.12
2005–06	6	128	100	602	1.94	10.46	0.17	0.18
2006–07	5	140	99	555	1.16	7.02	0.17	0.11
2007–08	1	99	96	244	0.30	1.29	0.23	0.07
2008–09	2	56	100	134	0.52	1.80	0.20	0.07
Big Chief and Neighbours								
1988–89	4	199	100	1 014	1.70	3.37	0.62	0.13
1989–90	8	543	98	2 913	1.50	4.50	0.42	0.15
1990–91	10	469	97	3 244	2.20	10.27	0.18	0.20
1991–92	5	140	99	829	2.70	15.00	0.17	0.18
1992–93	5	703	100	3 308	2.00	8.79	0.17	0.14

Table 16 (cont.)

Fishing year	Number of vessels	Total number of tows	% ORH target	Total estimated catch	Median catch rate (t/tow)	Median catch rate (t/h)	Median tow duration	Proportion of tows > 10 t
1993-94	10	698	100	2 353	0.58	3.33	0.18	0.10
1994-95	8	243	100	518	0.80	3.55	0.20	0.05
1995-96	7	153	99	579	1.00	5.00	0.20	0.08
1996-97	6	196	99	558	0.50	2.86	0.17	0.09
1997-98	10	287	99	953	0.40	1.90	0.20	0.07
1998-99	7	217	99	564	0.50	3.00	0.18	0.08
1999-2000	8	124	99	381	0.50	3.30	0.17	0.07
2000-01	7	214	100	1 018	0.78	5.45	0.17	0.14
2001-02	7	237	99	664	0.92	4.29	0.18	0.08
2002-03	9	280	99	669	0.50	2.14	0.18	0.06
2003-04	7	316	95	605	0.50	2.49	0.22	0.04
2004-05	5	323	95	841	0.53	2.82	0.20	0.07
2005-06	5	323	94	549	0.40	2.18	0.18	0.04
2006-07	4	301	94	590	0.38	2.06	0.18	0.04
2007-08	3	338	99	692	0.50	3.00	0.20	0.04
2008-09	3	323	95	379	0.23	1.15	0.20	0.03

Hegerville and Surrounds

1979-80	4	19	10	18	0.08	0.04	2.17	0.05
1980-81	5	606	39	2 545	3.47	7.29	0.50	0.05
1981-82	5	14	64	64	3.13	2.54	1.46	0.07
1982-83	17	982	87	8 484	6.91	5.72	1.17	0.34
1983-84	13	740	67	4 640	4	3.37	1.33	0.22
1984-85	18	1 038	79	6 394	3.84	2.63	1.50	0.20
1985-86	17	1 115	75	4 461	1.49	1.27	1.17	0.11
1986-87	18	798	75	2 832	1.22	1.09	1.03	0.08
1987-88	15	938	72	2 478	0.82	0.57	1.08	0.07
1988-89	14	615	92	1 261	0.65	0.71	1.00	0.03
1989-90	11	311	76	586	0.70	1.00	0.58	0.04
1990-91	10	110	68	279	1.00	1.15	0.72	0.05
1991-92	5	67	78	57	0.00	0.00	0.65	0.00
1992-93	6	116	72	306	0.48	1.04	0.42	0.08
1993-94	9	133	97	223	0.50	0.81	0.58	0.02
1994-95	7	105	90	101	0.04	0.01	0.57	0.01
1995-96	9	132	79	84	0.00	0.00	0.62	0.01
1996-97	6	89	84	175	0.30	0.60	0.50	0.04
1997-98	8	94	55	85	0.19	0.22	0.75	0.01
1998-99	8	107	16	144	0.15	0.12	0.75	0.02
1999-2000	9	77	13	146	0.15	0.27	0.72	0.05
2000-01	7	69	30	159	0.40	1.09	0.48	0.06
2001-02	7	36	50	56	0.17	0.22	0.72	0.03
2002-03	8	72	58	224	1.00	2.87	0.28	0.07
2003-04	10	87	55	137	0.33	0.59	0.33	0.02
2004-05	7	56	41	132	0.31	0.63	0.43	0.09
2005-06	10	96	55	144	0.48	1.01	0.34	0.01
2006-07	7	86	44	219	0.50	1.06	0.29	0.05
2007-08	5	139	77	301	0.50	1.43	0.27	0.06
2008-09	3	228	80	526	0.50	1.71	0.27	0.07

Recent unstandardised catch rates continued to decline on the Northwest Chatham Rise Flat, Smith's City & Neighbours, Andes, and Big Chief & Neighbours, and in 2008–09 were at, or close to, historical lows (Table 16).

Unstandardised catch rates in Hegerville & Surrounds increased after 2004–05, although they remained lower than in the closest fisheries at Big Chief & Neighbours and Andes, until 2008–09 (Table 16). A substantial proportion of the tows at Hegerville & Surrounds caught orange roughy whilst targeting other species (predominantly oreos), but the proportion caught in targeted tows increased substantially in 2007–08 and 2008–09, indicating a substantial increase in targeted orange roughy fishing at Hegerville.

Large catches (greater than 10 t/tow) continued to be most frequent in the Spawning Box, and increased in recent years in the 180 Hills, and Northwest Chatham Rise Flat (Table 16). The incidence of large catches was at an historical low in 2008–09 in Andes, and Big Chief & Neighbours. In the Andes fishery, the incidence of large catches was about one in four at the start of the fishery, declined to about 1 in 20 by the early 2000s, and was 1 in 100 in 2008–09.

The seasonal uptake of catches during the last three fishing years was similar to historical patterns for most areas (Figure 24). Almost all of the catch on the 180 Hills in recent years was taken during the spawning season (June). Catches in Priceless and North Pukaki shifted away from the start of the fishing year, and whilst the focus of fishing in Priceless remained between October and May, in 2008–09 almost all catches in North Pukaki were in August.

In the Sub-Antarctic, relatively high orange roughy catches in each subarea have generally persisted for only a few years (Table 17). The majority of orange roughy were caught in targeted tows at the start of the fishery, but catches and catch rates have declined substantially in most areas. In 2008–09, the orange roughy catches were almost all by-catch (in oreo fisheries) in Snares, Bounty Platform, and Antipodes, with catches at a low level, such that the orange roughy fisheries had effectively ceased in these areas.

Voluntary closure of the Puysegur fishery by the Orange Roughy Management Company since 1997–98 resulted in zero catches of orange roughy during 1997–98 and 1998–99. In subsequent years a small bycatch of orange roughy was taken during oreo target fishing, and in 2004–05 and 2005–06 the catches include those taken during an orange roughy acoustic biomass survey (Table 17). No catches of orange roughy were reported for Puysegur since 2006–07.

Most subareas of the Sub-Antarctic were only fished by one or two boats in 2008–09 (Table 17). Median unstandardised catch rates for the Sub-Antarctic were generally lower than on Chatham Rise, although the overall catch rate (total catch divided by total number of tows) has often been comparable (Tables 16 and 17). The reason for this difference is that catches of orange roughy in the Sub-Antarctic are generally more “hit or miss”.

In 2008–09, the highest unstandardised catch rates were in Fiordland and Macquarie Ridge, and the lowest catch rates on Bounty Platform (Table 17). During 2007–08 and 2008–09, fishing effort was relatively high, albeit fewer than 50 tows in each area, in Auckland Islands, Antipodes, Macquarie Ridge, and Fiordland, resulting in a few catches exceeding 10 t in Auckland Islands, but poor catches in Antipodes.

Priceless and North Pukaki have dominated the Sub-Antarctic fishery since 2001–02 (Table 17). In recent years there has been a substantial decline in unstandardised catch rates in Priceless and North Pukaki (Figure 25), although the proportion of large catches (greater than 10 t/tow) remained relatively high in both areas (Table 17). Estimated catches in Priceless in 2008–09 were 208 t, well below the 500 t feature catch limit, with effort and catches focusing on the surrounding North Pukaki subarea. Catches from the Priceless and North Pukaki subareas were 87% of the non-Chatham catches

in 2007–08, and 70% in 2008–09. Estimated catches from Priceless and North Pukaki declined by 36% between 2007–08 and 2008–09.

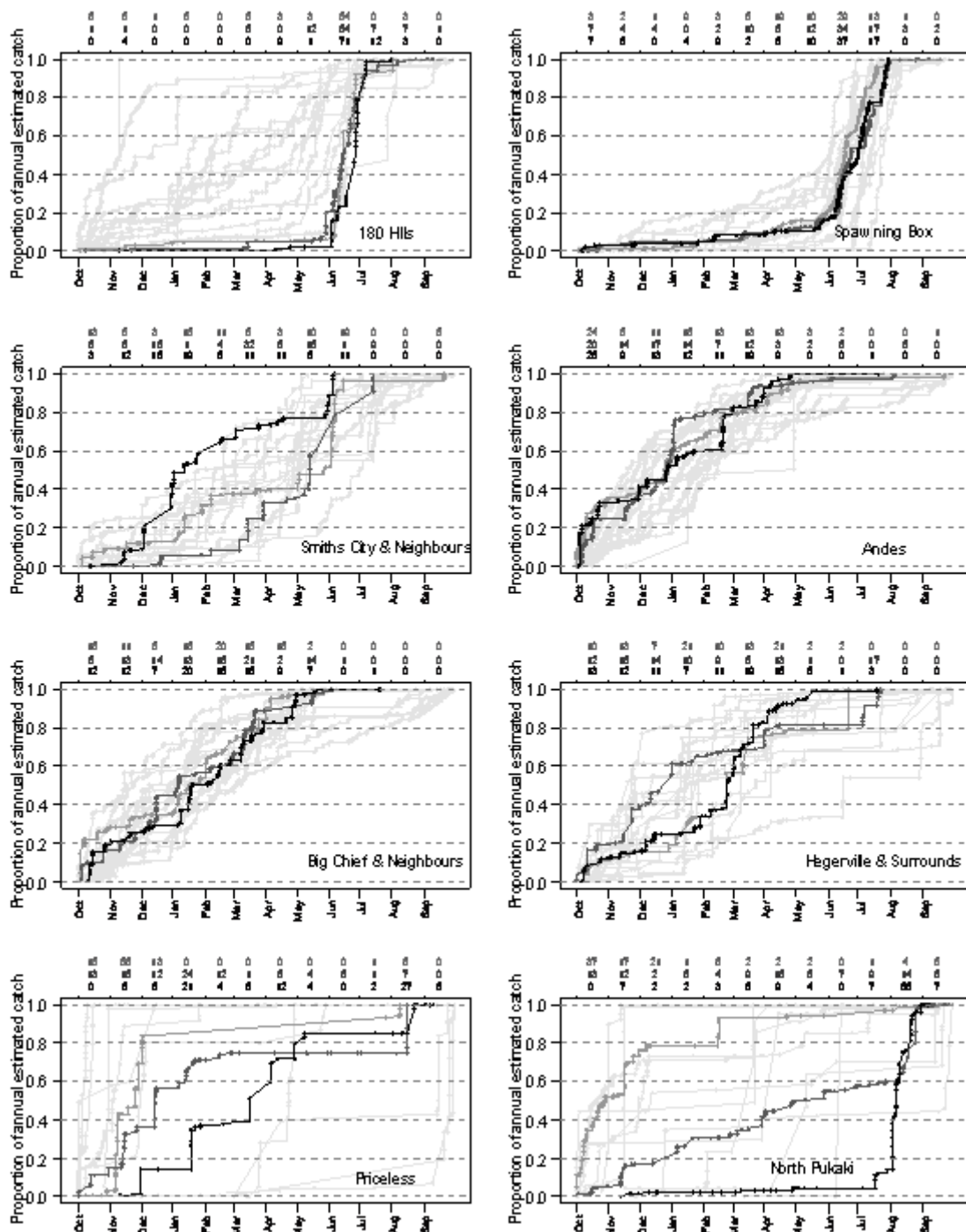


Figure 24: Cumulative catches and effort in selected subareas of ORH 3B. Catches are summed in chronological order through the fishing year, and scaled to the total estimated catch for the year. Each point represents the relative accumulated catch after the addition of the catch from each new trawl. The 2006–07, 2007–08, and 2008–09 fishing years are shown individually in grey (2006–07), dark grey (2007–08), and black (2008–09). The percentage of trawls by month is shown above each panel, using the same shading to represent years. Cumulative catches for all previous years are shown in light grey.

Table 17: ORH 3B subareas (non-Chatham Rise). Summary of effort, catch (t), catch rates, tow duration, and frequency of large catches for the fishing years 1979–80 to 2008–09, using tow-by-tow data. Catch rates and tow duration are calculated only for years in which there were ten or more tows. * tows were within the defined areas and therefore close to, but not on, the hills; tows on the hills have shorter tow duration. # subarea catch limit was 0 t in 2006–07, and closed in 2007 as a Benthic Protected Area.

Fishing year	Number of vessels	Total number of tows	% ORH target	Total estimated catch	Median catch rate (t/tow)	Median catch rate (t/h)	Median tow duration	Proportion of tows > 10 t
Auckland Islands								
1992–93	3	45	44	212	2.00	6.00	0.35	0.13
1993–94	4	163	98	190	0.00	0.00	0.38	0.02
1994–95	5	277	65	1 234	0.50	2.00	0.20	0.10
1995–96	6	251	96	380	0.15	0.50	0.27	0.03
1996–97	6	116	94	125	0.10	0.18	0.33	0.03
1997–98	6	194	97	371	0.01	0.03	0.26	0.06
1998–99	7	249	88	523	0.10	0.41	0.28	0.04
1999–2000	3	174	76	227	0.02	0.07	0.28	0.03
2000–01	4	81	84	82	0.02	0.06	0.28	0.01
2001–02	4	71	82	158	0.05	0.14	0.35	0.04
2002–03	4	68	44	76	0.05	0.17	0.35	0.01
2003–04	3	39	64	9	0.02	0.09	0.35	0.00
2004–05	1	7	86	2	–	–	–	0.00
2005–06	1	3	0	7	–	–	–	0.00
2006–07	0	–	–	–	–	–	–	–
2007–08	1	40	72	174	0.12	0.51	0.32	0.10
2008–09	1	41	41	194	0.04	0.13	0.27	0.12
Arrow Plateau[#]								
1985–86	3	12	75	134	5.24	8.40	1.42	0.42
1986–87	1	10	100	108	10.62	2.76	4.08	0.60
1987–88	2	3	100	5	–	–	–	0.00
1988–89	2	3	100	7	–	–	–	0.00
1989–90	0	–	–	–	–	–	–	–
1990–91	1	16	100	148	4.50	28.64	0.13	0.25
1991–92	1	8	100	96	–	–	–	0.38
1992–93	2	2	100	13	–	–	–	0.50
1993–94	2	57	100	472	1.00	12.00	0.12	0.25
1994–95	6	253	100	746	0.25	1.50	0.18	0.07
1995–96	4	50	100	169	0.10	0.90	0.13	0.12
1996–97	8	153	100	279	0.05	0.41	0.15	0.06
1997–98	6	185	100	327	0.05	0.50	0.15	0.03
1998–99	6	279	100	726	0.30	1.50	0.17	0.06
1999–2000	5	157	100	285	0.10	0.60	0.15	0.05
2000–01	4	83	100	187	0.10	0.53	0.17	0.06
2001–02	3	48	100	73	0.17	1.34	0.16	0.04
2002–03	5	80	100	216	0.20	1.39	0.17	0.09
2003–04	6	79	100	138	0.05	0.30	0.15	0.06
2004–05	5	87	100	62	0.05	0.31	0.17	0.01
2005–06	3	73	100	97	0.09	0.72	0.15	0.03

Table 17 (cont.)

Fishing year	Number of vessels	Total number of tows	% ORH target	Total estimated catch	Median catch rate (t/tow)	Median catch rate (t/h)	Median tow duration	Proportion of tows > 10 t
Antipodes								
1995–96	2	320	95	3 180	5.00	60.00	0.08	0.30
1996–97	7	607	99	672	0.00	0.03	0.15	0.02
1997–98	6	212	80	373	0.00	0.00	0.16	0.06
1998–99	7	74	80	119	0.00	0.00	0.19	0.03
1999–2000	5	41	71	2	0.00	0.00	0.17	0.00
2000–01	4	13	62	1	0.00	0.00	0.18	0.00
2001–02	0	–	–	–	–	–	–	–
2002–03	3	14	0	2	0.02	0.07	0.34	0.00
2003–04	3	12	58	2	0.02	0.06	0.23	0.00
2004–05	5	16	12	1	0.02	0.03	0.28	0.00
2005–06	1	3	0	0	–	–	–	0.00
2006–07	3	18	6	1	0.01	0.06	0.21	0.00
2007–08	1	30	0	6	0.01	0.04	0.25	0.00
2008–09	2	26	0	8	0.02	0.04	0.37	0.00
Priceless								
1996–97	1	6	50	8	–	–	–	0.00
1997–98	3	17	71	21	0.50	0.52	0.30	0.00
1998–99	2	14	14	15	0.35	1.40	0.21	0.00
1999–2000	2	10	10	3	0.07	0.29	0.28	0.00
2000–01	3	18	6	5	0.05	0.24	0.31	0.00
2001–02	4	28	64	615	9.75	47.62	0.24	0.43
2002–03	4	52	71	489	2.00	6.84	0.30	0.31
2003–04	5	110	89	454	0.25	0.38	0.68	0.08
2004–05	7	184	95	557	0.28	0.41	0.49	0.06
2005–06	5	65	97	575	1.00	2.67	0.38	0.23
2006–07	3	101	91	468	0.30	0.64	0.47	0.13
2007–08	1	108	93	570	0.60	1.96	0.27	0.16
2008–09	2	48	88	208	0.08	0.10	0.32	0.17
North Pukaki								
1981–82	1	1	0	0	–	–	–	0.00
1982–83	0	–	–	–	–	–	–	–
1983–84	1	5	60	3	–	–	–	0.00
1984–85	0	–	–	–	–	–	–	–
1985–86	0	–	–	–	–	–	–	–
1986–87	0	–	–	–	–	–	–	–
1987–88	0	–	–	–	–	–	–	–
1988–89	2	2	100	6	–	–	–	0.00
1989–90	1	3	0	0	–	–	–	0.00
1990–91	0	–	–	–	–	–	–	–
1991–92	0	–	–	–	–	–	–	–
1992–93	1	1	100	0	–	–	–	0.00
1993–94	0	–	–	–	–	–	–	–
1994–95	3	4	100	0	–	–	–	0.00
1995–96	1	2	100	0	–	–	–	0.00
1996–97	2	15	80	2	0.00	0.00	0.48	0.00
1997–98	5	30	73	24	0.00	0.00	0.84	0.00
1998–99	4	18	72	62	0.19	0.93	0.25	0.06
1999–2000	4	22	64	0	0.00	0.00	0.13	0.00

Table 17 (cont.)

Fishing year	Number of vessels	Total number of tows	% ORH target	Total estimated catch	Median catch rate (t/tow)	Median catch rate (t/h)	Median tow duration	Proportion of tows > 10 t
2000–01	5	25	68	41	0.10	0.60	0.17	0.08
2001–02	3	14	7	8	0.12	0.68	0.16	0.00
2002–03	5	10	10	1	0.07	0.16	0.31	0.00
2003–04	5	19	11	3	0.05	0.12	0.33	0.00
2004–05	9	92	47	893	2.81	5.33	0.33	0.34
2005–06	5	148	61	931	1.40	4.19	0.34	0.18
2006–07	3	170	69	814	0.50	1.36	0.37	0.15
2007–08	1	198	82	727	0.30	1.05	0.33	0.11
2008–09	2	149	85	619	0.20	0.41	0.37	0.13
Bounty Platform								
1985–86	1	1	1	0	–	–	–	0.00
1986–87	0	–	–	–	–	–	–	–
1987–88	0	–	–	–	–	–	–	–
1988–89	0	–	–	–	–	–	–	–
1989–90	0	–	–	–	–	–	–	–
1990–91	0	–	–	–	–	–	–	–
1991–92	0	–	–	–	–	–	–	–
1992–93	0	–	–	–	–	–	–	–
1993–94	1	10	0	4	0.22	0.33	1.03	0.00
1994–95	4	19	26	50	0.20	0.26	0.57	0.05
1995–96	3	73	47	208	0.18	0.22	0.68	0.10
1996–97	4	52	25	134	1.00	1.00	0.67	0.06
1997–98	7	132	84	277	0.04	0.05	0.65	0.05
1998–99	11	213	79	152	0.10	0.13	0.50	0.00
1999–2000	8	90	79	184	0.05	0.08	0.69	0.04
2000–01	5	74	74	150	0.13	0.13	0.92	0.04
2001–02	5	46	57	38	0.08	0.06	0.91	0.00
2002–03	4	92	58	301	0.24	0.43	0.73	0.09
2003–04	4	86	62	117	0.09	0.10	0.62	0.03
2004–05	6	57	67	112	0.10	0.09	0.72	0.05
2005–06	2	56	61	57	0.15	0.18	0.83	0.02
2006–07	5	26	54	2	0.03	0.06	0.69	0.00
2007–08	2	14	14	2	0.01	0.01	0.58	0.00
2008–09	2	39	3	2	0.02	0.05	0.47	0.00
Maquarie Ridge								
1990–91	2	8	88	1	–	–	–	0.00
1991–92	0	–	–	–	–	–	–	–
1992–93	3	27	96	0	0.00	0.00	0.23	0.00
1993–94	3	11	100	0	0.00	0.00	0.20	0.00
1994–95	1	1	0	0	–	–	–	0.00
1995–96	3	72	92	11	0.00	0.00	0.27	0.00
1996–97	3	73	93	8	0.00	0.00	0.15	0.00
1997–98	6	49	88	4	0.00	0.00	0.17	0.00
1998–99	5	73	42	38	0.10	0.47	0.25	0.00
1999–2000	4	69	35	15	0.03	0.09	0.22	0.00
2000–01	4	231	61	510	0.20	2.00	0.15	0.06
2001–02	3	81	26	107	0.10	0.60	0.17	0.04
2002–03	3	105	24	188	0.10	0.69	0.17	0.05
2003–04	2	68	40	119	0.05	0.38	0.18	0.06

Table 17 (cont.)

Fishing year	Number of vessels	Total number of tows	% ORH target	Total estimated catch	Median catch rate (t/tow)	Median catch rate (t/h)	Median tow duration	Proportion of tows > 10 t
2004-05	3	44	43	112	0.29	1.04	0.27	0.05
2005-06	2	17	35	29	0.05	0.20	0.17	0.06
2006-07	2	7	0	1	–	–	–	0.00
2007-08	1	20	25	5	0.05	0.40	0.12	0.00
2008-09	1	17	53	122	0.15	1.20	0.12	0.12
Puysegur								
1983-84	1	3	0	0	–	–	–	0.00
1984-85	0	–	–	–	–	–	–	–
1985-86	0	–	–	–	–	–	–	–
1986-87	0	–	–	–	–	–	–	–
1987-88	0	–	–	–	–	–	–	–
1988-89	0	–	–	–	–	–	–	–
1989-90	1	77	96	107	0.5	1.36	0.33	0.01
1990-91	4	204	64	798	0.40	1.22	0.23	0.12
1991-92	19	642	93	6 645	5.97	15.69	0.33	0.35
1992-93	14	714	89	4 746	3.00	4.97	0.48	0.21
1993-94	13	1 272	100	2 408	0.15	0.25	0.53	0.04
1994-95	4	186	86	1 459	2.00	7.79	0.25	0.25
1995-96	6	321	95	758	0.40	0.77	0.42	0.05
1996-97	5	202	95	510	0.61	1.71	0.35	0.04
1997-98	0	–	–	–	–	–	–	–
1998-99	0	–	–	–	–	–	–	–
1999-2000	1	17	0	7	0.10	1.20	0.17	0.00
2000-01	2	10	0	34	1.00	2.75	0.29	0.10
2001-02	1	2	0	0	–	–	–	0.00
2002-03	1	1	0	12	–	–	–	1.00
2003-04	1	23	0	5	0.20	0.30	0.33	0.00
2004-05	2	38	45	117	1.19	5.30	0.23	0.05
2005-06	1	72	100	187	0.10	0.33	0.33	0.08
2006-07	1	7	0	10	–	–	–	0.00
Fiordland								
1993-94	1	35	100	40	0.55	0.75	0.83	0.00
1994-95	2	11	100	10	0.50	0.86	0.55	0.00
1995-96	1	1	0	0	–	–	–	0.00
1996-97	1	1	0	2	–	–	–	0.00
1997-98	0	–	–	–	–	–	–	–
1998-99	0	–	–	–	–	–	–	–
1999-2000	1	7	0	2	–	–	–	0.00
2000-01	1	319	99	490	0.61	0.70	0.88	0.02
2001-02	2	123	100	231	0.78	0.91	0.83	0.04
2002-03	2	56	86	53	0.37	0.49	0.52	0.00
2003-04	2	35	100	49	0.41	0.48	0.90	0.03
2004-05	1	6	100	2	–	–	–	0.00
2005-06	1	3	100	0	–	–	–	0.00
2006-07	0	–	–	–	–	–	–	–
2007-08	1	7	100	2	–	–	–	0.00
2008-09	1	26	100	29	0.50	0.32	1.38	0.00

Table 17 (cont.)

Fishing year	Number of vessels	Total number of tows	% ORH target	Total estimated catch	Median catch rate (t/tow)	Median catch rate (t/h)	Median tow duration	Proportion of tows > 10 t
Snares								
1990–91	2	18	78	28	0.12	1.50	0.15	0.00
1991–92	2	18	72	8	0.10	0.40	0.16	0.00
1992–93	7	230	66	490	0.50	2.86	0.17	0.02
1993–94	9	351	95	38	0.00	0.00	0.23	0.00
1994–95	5	29	86	19	0.00	0.00	0.20	0.00
1995–96	5	78	99	8	0.00	0.00	0.22	0.00
1996–97	3	86	94	55	0.00	0.00	0.15	0.00
1997–98	6	81	79	159	0.50	2.73	0.20	0.04
1998–99	7	91	32	68	0.10	0.75	0.23	0.01
1999–2000	5	41	34	14	0.10	0.40	0.30	0.00
2000–01	2	46	30	24	0.05	0.15	0.25	0.02
2001–02	4	35	17	16	0.05	0.32	0.27	0.00
2002–03	4	35	0	17	0.10	0.40	0.32	0.00
2003–04	1	4	0	3	–	–	–	0.00
2004–05	3	8	50	1	–	–	–	0.00
2005–06	2	20	0	1	0.05	0.18	0.25	0.00
2006–07	2	3	0	1	–	–	–	0.00
2007–08	2	7	29	2	–	–	–	0.00
2008–09	1	3	0	1	–	–	–	0.00

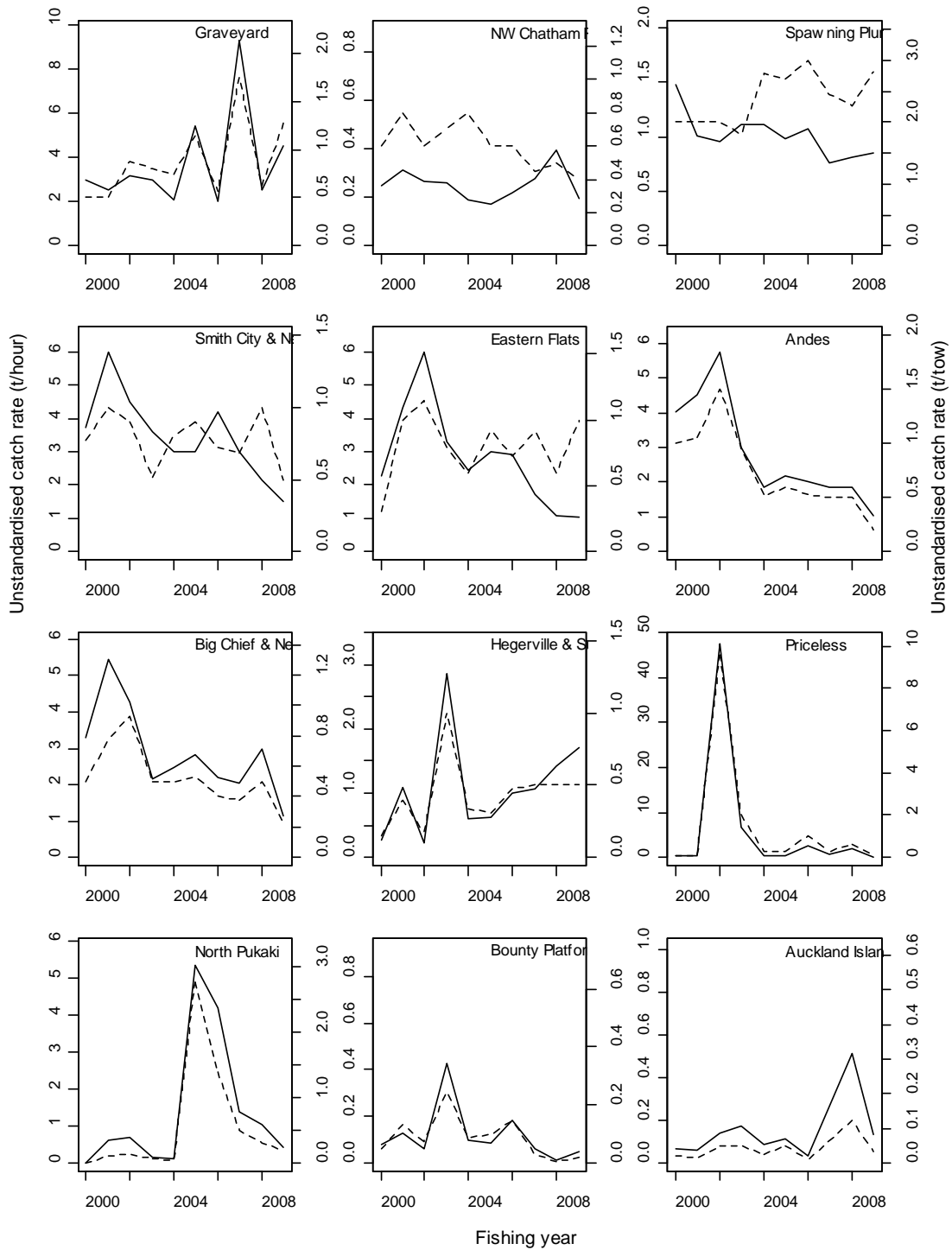


Figure 25: Unstandardised median catch rates for subareas of ORH 3B. Solid lines and left y-axis, t/hr; broken line and right y-axis, t/tow.

7. CHALLENGER PLATEAU (ORH 7A)

7.1 Summary for 2007–08 and 2008–09

- The fishery remained effectively closed, with a TACC of 1 t.

7.2 Total catch

Between 1981–82 and 1988–89 the Challenger Plateau was the second largest New Zealand orange roughy fishery, with annual landings of 4000–12 000 t (Table 18). The TACC was reduced from 12 000 t in 1988–89 to 2500 t the following year and, after a stock assessment in 2000, reduced again to 1 t, effectively closing the fishery. The only recent catches in ORH 7A have been taken by industry-led research surveys, with estimated catches of 158 t in 1995, 200 t in 2006, and 240 t in 2009, although landings from these surveys were not officially reported. The survey results are reported elsewhere (see Ministry of Fisheries 2009).

7.3 Distribution of catch and effort, and catch rates

The ORH 7A fishery was centred in the southwest of the Challenger Plateau, about 200 n.miles west-north-west of Cape Farewell (Figure 26). The fishery developed in late 1981, rapidly expanding as spawning concentrations of fish were located. In 1987, the fishery expanded to an area known as Westpac Bank, about 25 n.miles outside of the EEZ and about 40 n.miles from the centre of fishing inside the zone. Catches from Westpac Bank have counted against the TACC inside the EEZ for New Zealand vessels, but foreign (mainly Australian) vessels have fished freely in this area. A stock assessment was carried out in 2000 (Field & Francis 2001), which indicated that the stock was about one tenth of virgin biomass levels (B_{MSY}), and the fishery was subsequently effectively closed with a 1 t TACC to promote the rebuilding of the stock.

In 1982–83 to 1986–87, a significant portion of the catch came from early in the fishing year, with sometimes more than half the annual catch being taken before the spawning season (usually between the end of June and the middle of July (Anderson 2006)). However, in most subsequent years the catch was taken almost entirely during June and July, with fishing occasionally continuing through August (Figure 27). The three recent research surveys, in the winters of 2005, 2006, and 2009, were focussed on the spawning period (and show as almost vertical lines in Figure 27).

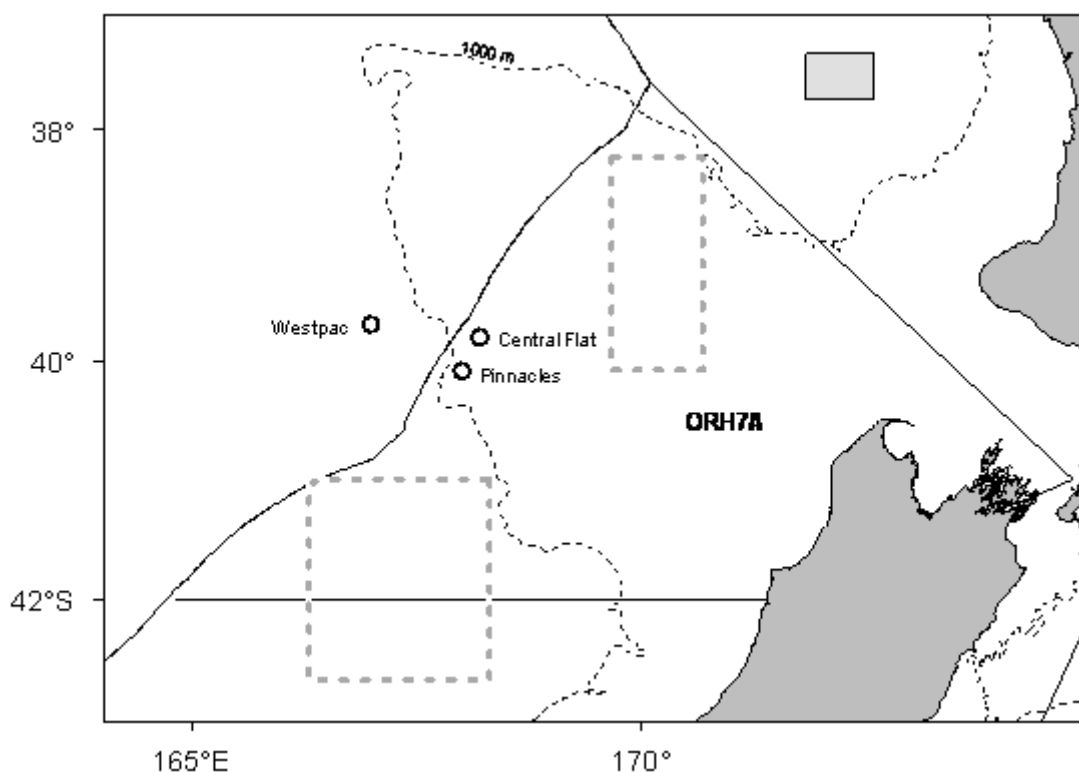


Figure 26: The ORH 7A fishery area. Positions of the main grounds are marked as open circles, perimeters of Benthic Protection Areas (BPAs) closed to bottom trawling are marked with dashed grey lines, and seamounts closed to trawling are marked as shaded rectangles

Table 18: ORH 7A. Reported landings (t), TACC (t), and percentage of landings recorded on TCEPR forms, for 1980–81 to 2008–09.

Fishing year	Landings	TACC	Estimated TCEPR as % of landings
1980–81	33	–	0
1981–82	4 248	–	87
1982–83	11 839	–	38
1983–84	9 527	4 950	67
1984–85	5 117	4 950	98
1985–86	7 753	6 190	98
1986–87	11 492	10 000	88
1987–88	12 181	12 000	82
1988–89	10 241	12 000	53
1989–90	#4 309	2 500	68
1990–91	1 357	1 900	92
1991–92	1 911	1 900	89
1992–93	2 087	1 900	65
1993–94	1 732	1 900	69
1994–95	1 636	1 900	85
1995–96	1 669	1 900	74
1996–97	1 308	1 900	75
1997–98	1 502	1 900	77
1998–99	1 249	1 425	64
1999–00	629	1 425	66
2000–01	< 1	1	0
2001–02	< 1	1	0
2002–03	4	1	0

Table 18 (cont.):

Fishing year	Landings	TACC	Estimated TCEPR as % of landings
2003–04	< 1	1	0
2004–05	* < 1	1	>100
2005–06	* < 1	1	>100
2006–07	< 1	1	0
2007–08	< 1	1	0
2008–09	* < 1	1	>100

This is a minimum value, due to unreported fishing by foreign vessels fishing outside the EEZ.

* Reported landings for these years do not include fish caught during research surveys (a total of about 600 t) but TCEPR records do.

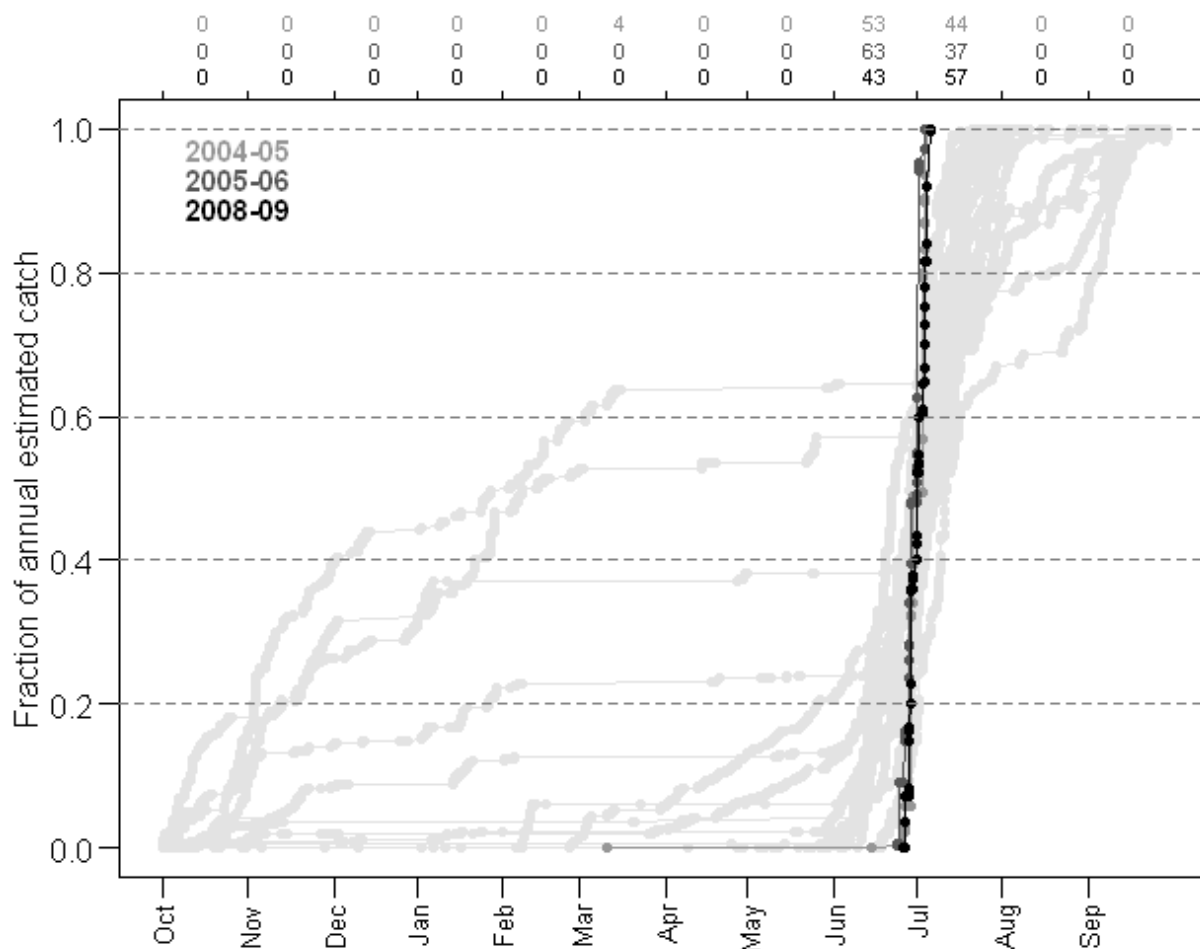


Figure 27: Cumulative catches and effort in ORH 7A. Catches are summed in chronological order through the fishing year, and scaled to the total estimated catch for the year. Each point represents the relative accumulated catch after the addition of the catch from each new trawl. The 2006–07, 2007–08, and 2008–09 fishing years are shown individually in grey (2006–07), dark grey (2007–08), and black (2008–09). The percentage of trawls by month is shown above each panel, using the same shading to represent years. Cumulative catches for all previous years are shown in light grey.

A number of discrete fishing locations were developed early in the fishery, but by 1983–84 the geographical distribution became stable with few, if any, substantial areas being developed during the peak of the fishery during the late-1980s and into the 1990s (Figure 28). The fishery developed some new areas in the late 1990s, when fishing shifted from short tows on features to include longer tows on flat ground, and this spread the catch over an increasingly wide area, but this development was insufficient to prevent the closure of the fishery in 2000–01. The recent survey fishing was focussed on and around the historical spawning grounds.

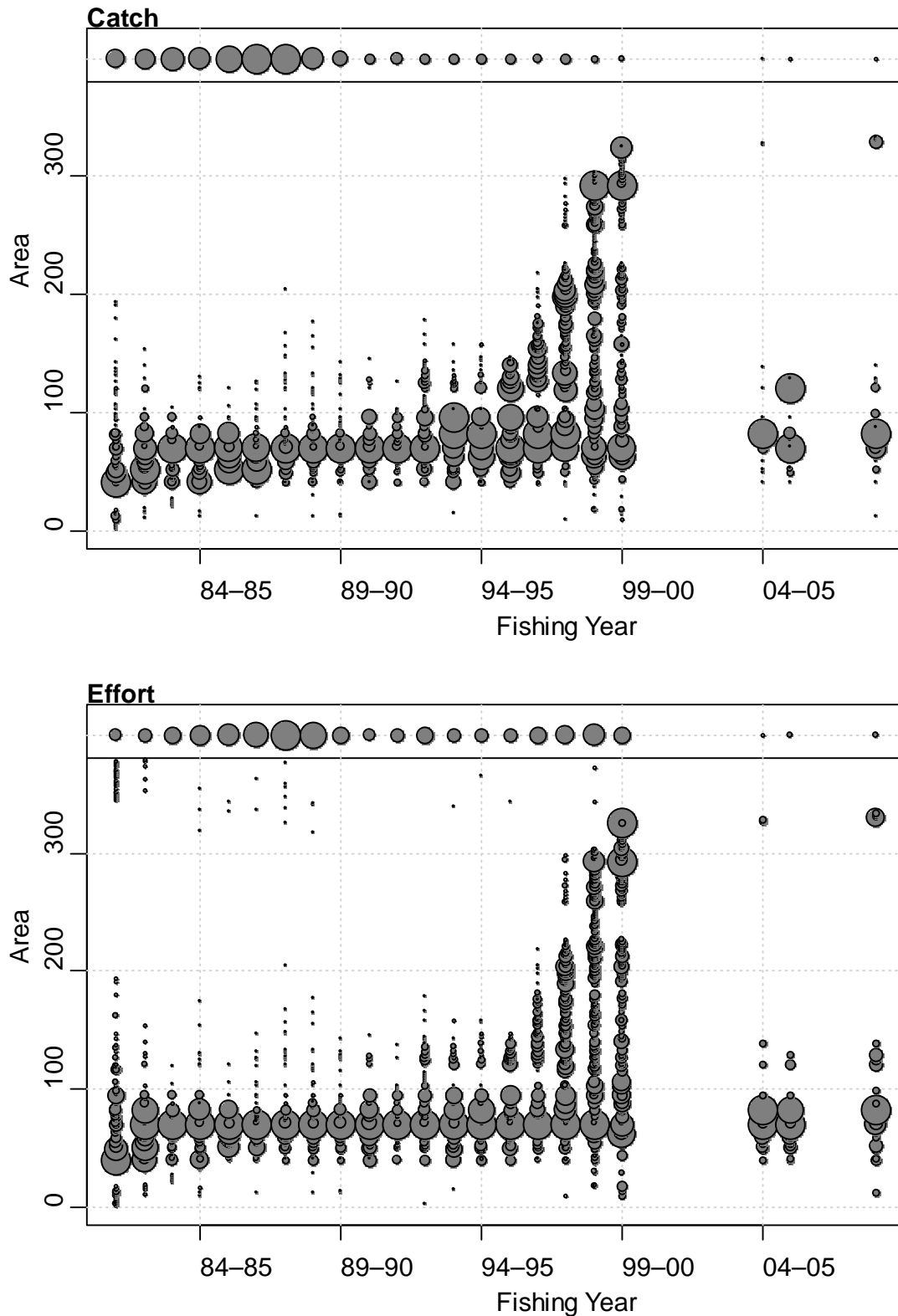


Figure 28: The distribution of orange roughy estimated catch (top panel) and effort (number of tows, bottom panel) by fishing year and area (where area is a square of 1/10th of a degree latitude and longitude) for the ORH 7A fishery. Catch and effort are proportional to circle size. The maximum circle size in each year is set to be equal. Areas were ordered, in both plots, by the mean year in which the catch was taken. The top panel in each plot shows the (relative) total catch (upper) and total effort (lower) by year.

8. WEST COAST SOUTH ISLAND (ORH 7B)

8.1 Summary for 2007–08 and 2008–09

The fishery remained effectively closed, with a TACC of 1 t.

8.2 Total catch

Quota Management Area ORH 7B covers an area off the west coast of the South Island from near Westport to south of Jackson Head. The west coast South Island fishery has been defined as the area between 42° S and 44.25° S, and 166° E and 171.5° E. Orange roughy occur throughout the QMA, which includes domestic fishing return areas 033, 034, 705, 706, and the northern part of 032 (Figure 29). The fishery has mainly been centred on an area near the Cook Canyon, which is a trench running out from the coast in roughly an east-west direction. Fishing has also occurred to the south, around the Moeraki Canyon.

The fishery developed from May 1985, and catches increased substantially in the 1985–86 fishing year when aggregations of spawning orange roughy were targeted in winter. Catches from 1992–93 to 1994–95 increasingly fell below the TACC of 1708 t (Table 19). The TACC was reduced to 430 t for the 1995–96 fishing year, but was reached only in the 1995–96 and 1996–97 fishing years. Annual catches then continued to decline through to 2000–01, and the TACC was further reduced in 2001–02 to 110 t. Annual landings subsequently averaged about 100 t, with catches in 2005–06 reaching a low of 77 t. The reported catch of 125 t for 2006–07 was the largest annual catch since 2000–01. This increase in catch was, in part, a consequence of directed fishing effort in response to a proposed effective closure of the stock by MFish. The stock was nevertheless effectively closed with the introduction of a 1 t TACC in October 2007.

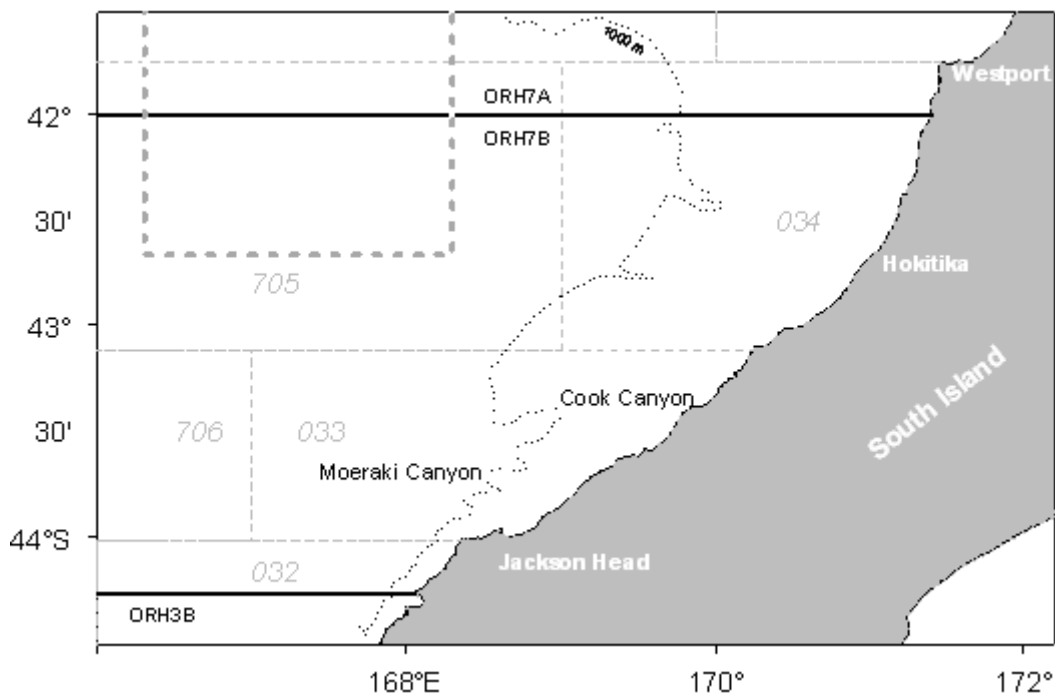


Figure 29: Location of the west coast South Island orange roughy fishery showing domestic fishing return statistical areas. The thick dashed grey line marks the perimeter of Benthic Protection Area “Challenger South” closed to bottom trawling.

Table 19: Reported landings (t), TACC (t), estimated catch from TCEPR and CELR forms (t), total estimated catch (t), and percentage of landings recorded on TCEPR/CELR forms for ORH 7B, for 1983–84 to 2008–09. –, no data.

Fishing year	Landings	TACC	TCEPR catch	CELR catch	Total estimated catch	Total estimated catch as % of landings
1983–84†	2	–	–	–	–	–
1984–85†	282	–	–	–	–	–
1985–86†	1 763	1 558	1 071	473	1 544	88
1986–87†	1 446	1 558	827	423	1 250	86
1987–88‡	1 413	1 558	911	339	1 250	88
1988–89‡	1 750	1 708	827	–	827	47
1989–90‡	1 711	1 708	871	411	1 282	75
1990–91‡	1 683	1 708	904	753	1 657	98
1991–92‡	1 604	1 708	905	696	1 601	100
1992–93‡	1 139	1 708	589	539	1 128	99
1993–94‡	701	1 708	481	179	660	94
1994–95‡	290	1 708	185	135	320	110
1995–96‡	446	430	150	125	275	62
1996–97‡	425	430	197	47	244	57
1997–98‡	330	430	39	131	170	52
1998–99‡	405	430	40	320	359	89
1999–00‡	284	430	85	142	227	80
2000–01‡	161	430	47	105	152	94
2001–02‡	95	110	23	60	82	86
2002–03‡	90	110	13	75	88	87
2003–04‡	119	110	3	115	118	100
2004–05‡	106	110	1	100	102	95
2005–06‡	77	110	0	73	73	100
2006–07‡	125	110	22	97	119	95
2007–08‡	6	1	2	0	2	33
2008–09‡	1	1	0	0	0	0

† FSU data; ‡ QMS data

8.3 Distribution of catch and effort, and catch rates

There was a substantial drop in the number of vessel days and tows associated with the reduction of the TACC in 1995–96 and 2001–02 (Table 20). For this summary, tow-by-tow TCEPR data were condensed into a daily format to enable combination with CELR data.

The mean tow distance from TCEPR records increased abruptly in 1999–2000, to more than three times the tow length at the start of the fishery, and remained at an average tow length of 10–15 n.miles for the following six years. In 2005–06, the mean tow distance abruptly fell, to a level close to that of the pre-1999–2000 period. However, since 1997–98 reporting in this fishery has been mainly via CELR forms (Figure 30), so the TCEPR form statistics (tow speed, duration, and length) may be misleading for this period, and not reflect the overall fishery well. Average tow duration estimated from CELR forms was 2.1–2.7 h between 2002–03 and 2006–07, slightly less than the TCEPR-based estimates. In 2005–06, only 3 of 257 tows (1%) were recorded on TCEPR forms, although in 2006–07 this fraction increased to about 20%.

The unstandardized catch rate (calculated from data from both form types) was relatively low in the years just before the closure of the fishery, for both catch per tow and catch per hour, with the mean of the daily values between 1999–2000 and 2005–06 about 10% or less of the values at the beginning of the fishery (Table 20). In 2006–07 the catch rates more than doubled, but remained less than 1 t per tow and only 0.5 t per hour.

Table 20: Summary of groomed data from TCEPR and CELR forms. “*” denotes TCEPR data only; –, not estimated.

Fishing year	Number of vessel days	Number of tows	Total estimated catch (t)	Mean daily catch rate (t/tow)	Mean daily catch rate (t/hour)	Mean tow speed* (knots)	Mean tow duration* (hours)	Mean tow length* (n.mile)
1985–86	138	357	1 544	4.5	2.9	2.5	1.7	4.4
1986–87	132	405	1 250	4.0	2.7	2.6	1.8	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	5.0
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	4.8
1991–92	238	810	1 601	2.0	1.4	2.9	1.9	5.1
1992–93	258	784	1 128	1.5	2.3	3.0	1.7	5.0
1993–94	298	708	660	1.1	0.9	2.8	2.3	6.5
1994–95	162	361	320	0.9	1.6	3.0	2.0	5.4
1995–96	66	150	275	2.2	1.7	2.9	2.1	6.4
1996–97	90	182	244	1.3	7.5	2.9	3.0	8.6
1997–98	96	228	170	0.7	0.3	2.8	2.6	7.0
1998–99	188	566	359	0.6	0.2	2.6	2.6	6.5
1999–00	213	647	259	0.4	0.1	3.6	4.3	13.5
2000–01	177	431	152	0.3	0.1	3.5	3.2	10.4
2001–02	120	276	82	0.3	0.1	3.8	3.5	12.3
2002–03	89	231	88	0.4	0.2	3.8	3.6	12.2
2003–04	90	252	118	0.4	0.2	3.6	3.8	14.0
2004–05	121	393	102	0.3	0.1	4.2	4.6	14.2
2005–06	87	257	73	0.3	0.2	4.4	3.7	15.3
2006–07	57	167	119	0.8	0.5	3.1	2.8	8.3
2007–08	3	3	2	–	–	–	–	–
2008–09	1	1	0	–	–	–	–	–

Historically, most effort and catch (Figure 31) in the west coast South Island fishery was in the winter spawning period (June and July) with a further, less intense, period of catch and effort in September and October. This appears to also have been the case in the most recent years before closure, shown individually in Figure 31.

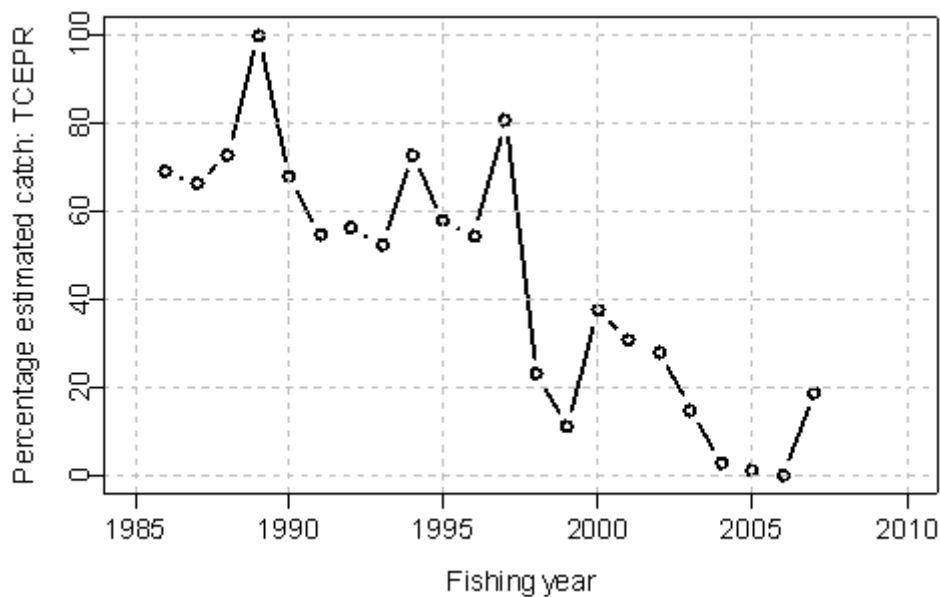


Figure 30: Percentage of the estimated catch recorded on TCEPR forms between 1985–86 and 2006–07 (prior to the closure of the fishery).

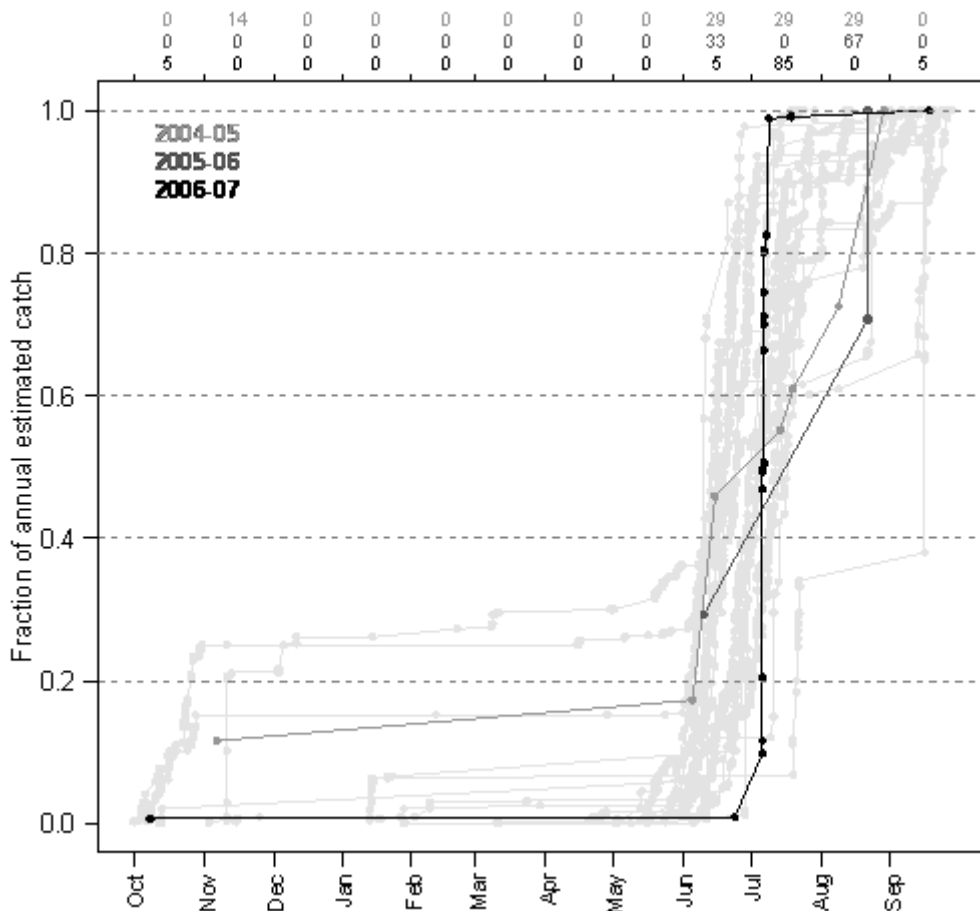


Figure 31: Cumulative catches and effort in ORH 7B. Catches are summed in chronological order through the fishing year, and scaled to the total estimated catch for the year. Each point represents the relative accumulated catch after the addition of the catch from each new trawl. Recent fishing years are shown individually in grey (2004–05), dark grey (2005–06), and black (2006–07). The percentage of trawls by month is shown above each panel, using the same shading to represent years. Cumulative catches for all previous years are shown in light grey.

After the expansion into unfished areas in 1992–93, the ORH 7B fishery does not show a strong pattern of sequential fishing, with fishing rather erratic, and either continuing in or returning to areas fished early in its history (Figure 32). The fishery has operated over about 180 1/10th degree squares over the 24 years since it was developed, similar to that of fishing in the North West Chatham Rise and South Chatham Rise Fisheries (see Figures 20 and 22), but less than most other orange roughly fisheries.

TCEPR returns showed high catch rates in the Cook Canyon in the early years of the fishery (Figure 33). Catch rates began to decrease in the early 1990s as the fishery dispersed further into Statistical Areas 033 and 034, but relatively high catches were taken in the Moeraki Canyon to the south in 1992–93 and 1993–94. TCEPR catch rates were low throughout ORH 7B between 1996–97 and 2006–07, with very few catches over 5 t/tow. Overall catch rates (CELR + TCEPR records) decreased substantially in 1997–98, at the same time as the fishery became dominated by CELR records, and then remained relatively low.

The geographical distribution of effort and catch from TCEPR forms has changed over the course of the fishery. Initially, effort was concentrated in a very small area in the Cook Canyon, at the intersection of Statistical Areas 033, 034, and 705, with catch rates frequently over 20 t per tow (Figure 33). From 1992–93, effort dispersed further into Statistical Areas 033 and 034 as fishers

ranged more widely in an attempt to catch the available quota, and relatively high catches were taken in the Moeraki Canyon to the south in 1992–93 and 1993–94. TCEPR catch rates were low throughout ORH 7B between 1996–97 and 2006–07, with very few catches over 5 t/tow. Overall catch rates (CELR + TCEPR records) decreased substantially in 1997–98, at the same time as the fishery became dominated by CELR records, and then remained relatively low.

The exact distribution of effort in recent years before the closure was unknown, as catches were mostly reported on CELR forms, but these showed that the majority of the catch since 2002–03 came from statistical area 033, with a lesser amount from area 032, and only a very small amount from area 705. The 20 TCEPR-recorded tows in 2006–07 were located at the intersection of statistical areas 034, 033, and 705, the Cook Canyon area which was the historical focus of the fishery.

Between 7 and 12 vessels operated each year in this fishery since 2003, split roughly evenly by CELR and TCEPR forms (although this split was not even in terms of effort). Some fishing by the four vessels operating in ORH 7B in 2006–07 yielded some relatively large catches (up to about 6 t/tow) demonstrating that moderate catch rates were still achievable in the fishery at times.

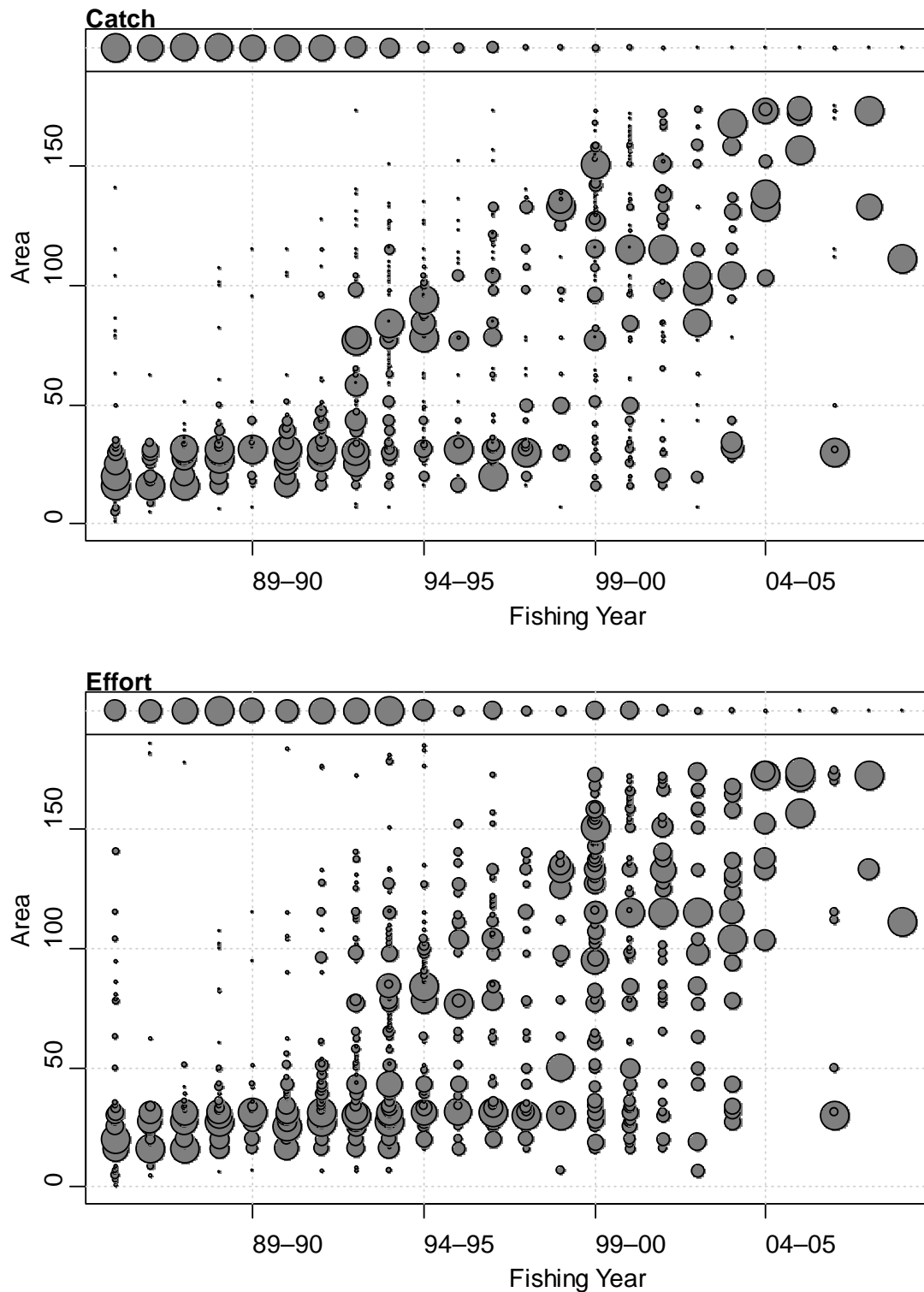


Figure 32: The distribution of orange roughy estimated catch (top panel) and effort (number of tows, bottom panel) by fishing year and area (where area is a square of 1/10th of a degree latitude and longitude) for the ORH 7B fishery. Catch and effort are proportional to circle size. The maximum circle size in each year is set to be equal. Areas were ordered, in both plots, by the mean year in which the catch was taken. The top panel in each plot shows the (relative) total catch (upper) and total effort (lower) by year.

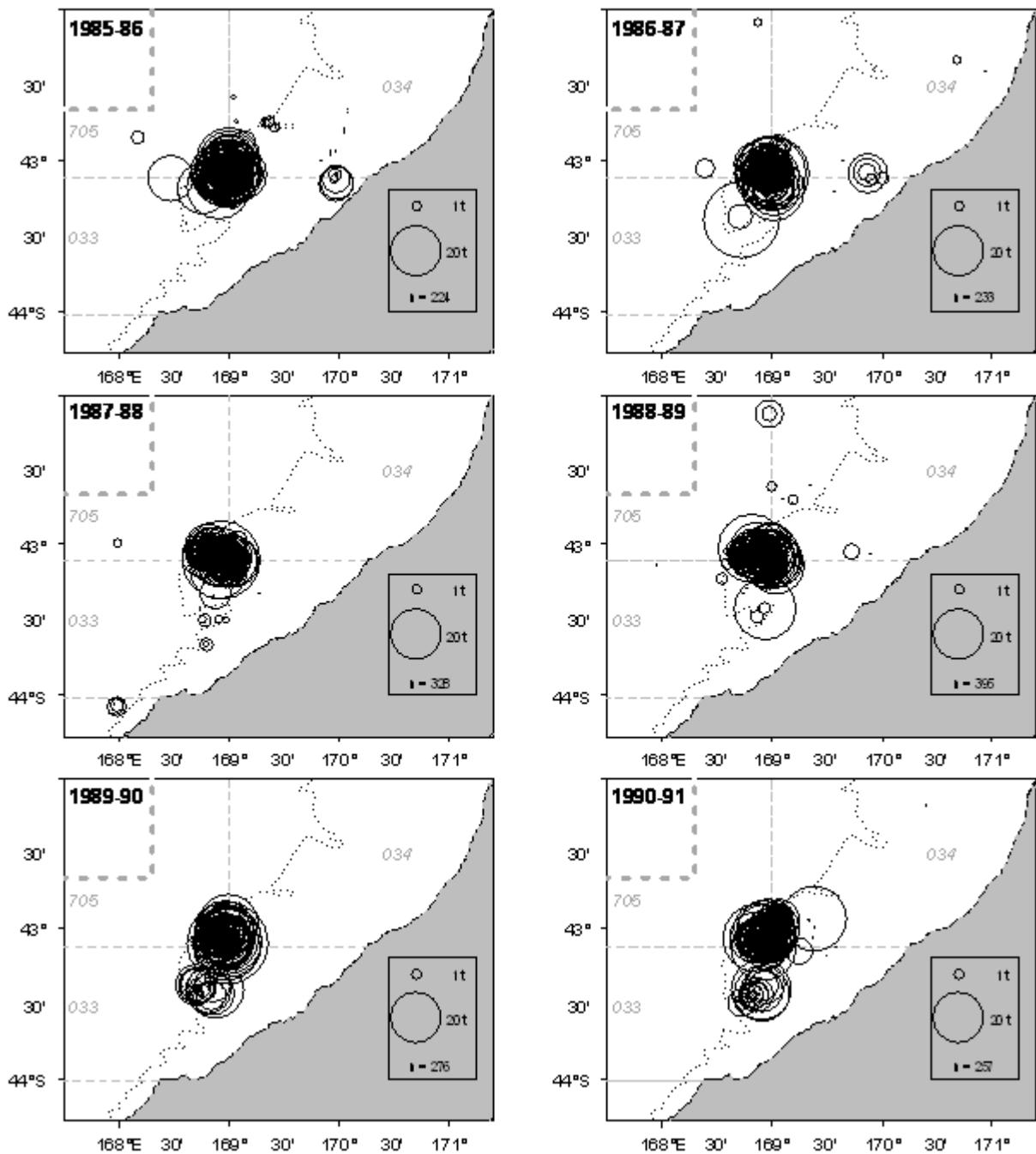


Figure 33: Unstandardised catch rates (t/tow) of tows which targeted or caught orange roughy in the west coast South Island fishery, 1985–86 to 1990–91, TCEPR data only. Circle area is proportional to catch rate; dotted line is the 1000 m isobath; thin dashed lines indicate statistical area boundaries; thick dashed lines indicate Benthic Protection Area closed to bottom trawling; n, number of tows.

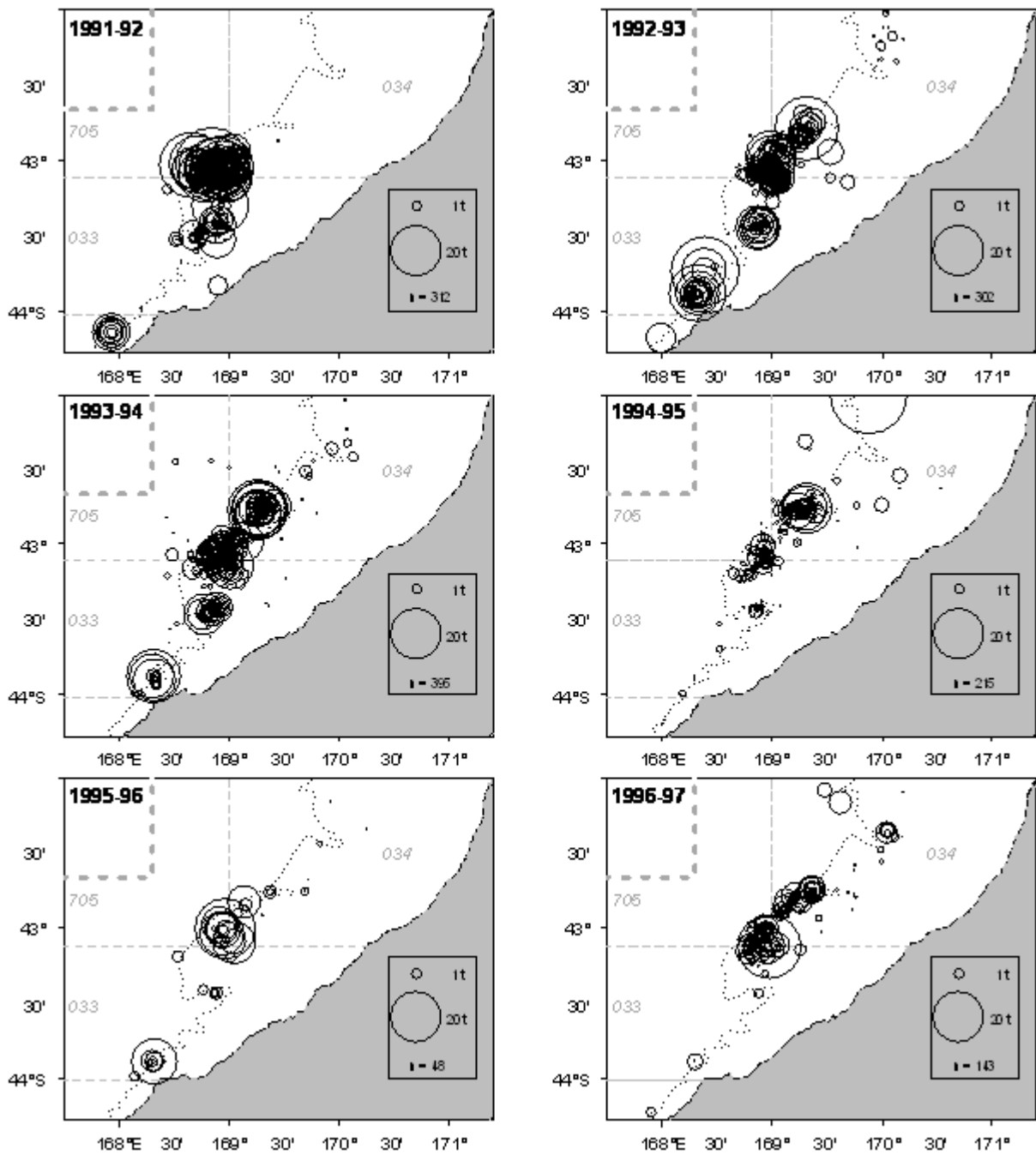


Figure 33 (cont.): Unstandardised catch rates (t/tow) of tows which targeted or caught orange roughy in the west coast South Island fishery, 1991–92 to 1996–97, TCEPR data only. Circle area is proportional to catch rate; dotted line is the 1000 m isobath; thin dashed lines indicate statistical area boundaries; thick dashed lines indicate Benthic Protection Area closed to bottom trawling; n, number of tows.

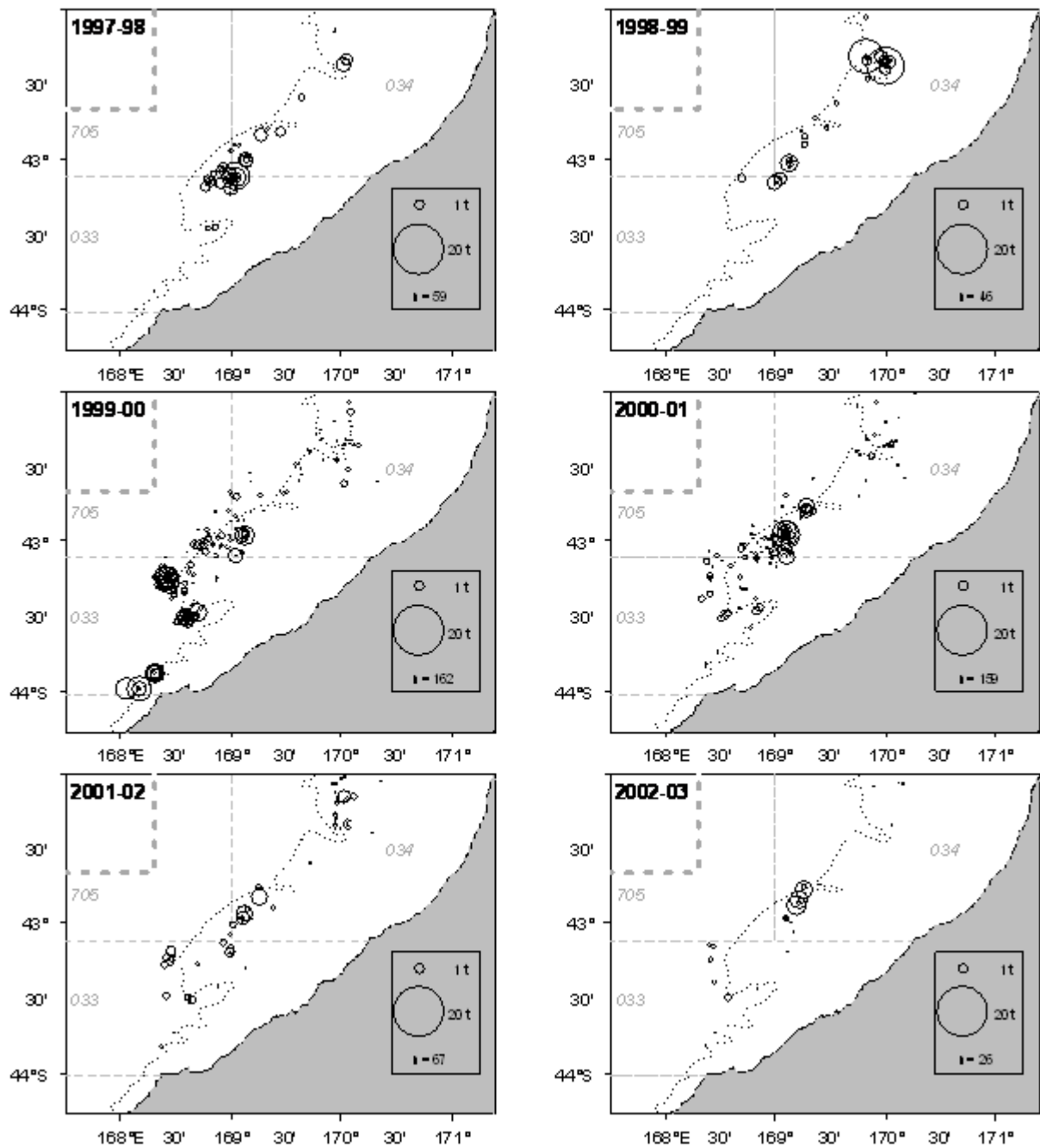


Figure 33 (cont.): Unstandardised catch rates (t/tow) of tows which targeted or caught orange roughy in the west coast South Island fishery, 1997–98 to 2002–03, TCEPR data only. Circle area is proportional to catch rate; dotted line is the 1000 m isobath; thin dashed lines indicate statistical area boundaries; thick dashed lines indicate Benthic Protection Area closed to bottom trawling; n, number of tows.

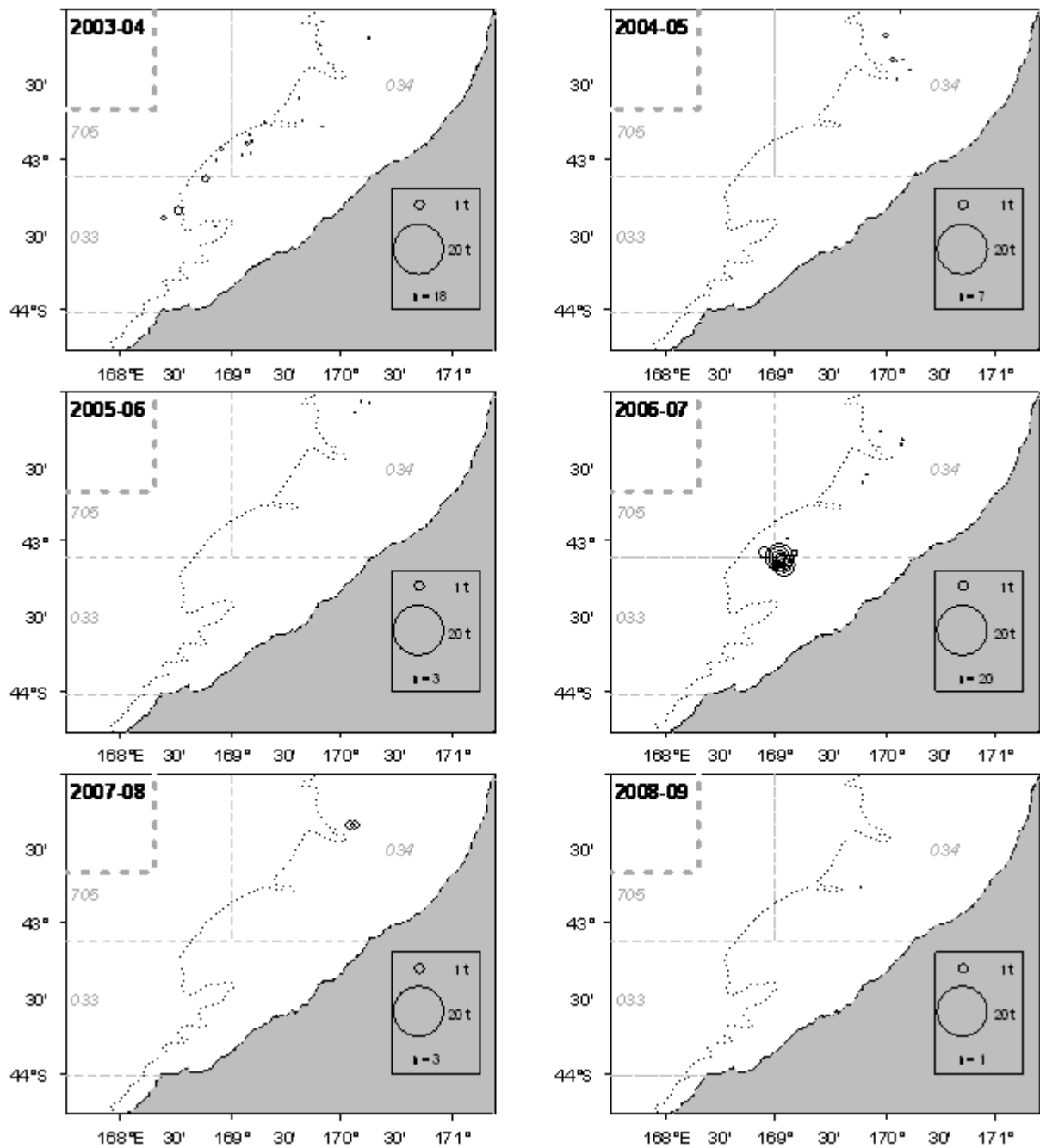


Figure 33 (cont.): Unstandardised catch rates (t/tow) of tows which targeted or caught orange roughy in the west coast South Island fishery, 2003–04 to 2008–09, TCEPR data only. Circle area is proportional to catch rate; dotted line is the 1000 m isobath; thin dashed lines indicate statistical area boundaries; thick dashed lines indicate Benthic Protection Area closed to bottom trawling; n, number of tows.

9. ACKNOWLEDGMENTS

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