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Matthew Dunn
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New Zealand Fisheries Assessment Report 2005/19
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## EXECUTIVE SUMMARY

**Dunn, M.R.; Anderson, O.F.; McKenzie, A. (2005). Descriptive analysis of catch and effort data from New Zealand orange roughy fisheries in ORH 1, 2A, 2B, 3A, 3B, and 7B to the end of the 2002–03 fishing year.**

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This report updates descriptive analyses of commercial catch and effort data for all the main orange roughy fisheries in the New Zealand EEZ, with data to the end of the 2002–03 fishing year. Data are summarised back to the start of most of the fisheries, and are analysed in detail for the last 2 years, 2001–02 and 2002–03. The Challenger Plateau fishery (ORH 7A) is not included, as this fishery has effectively been closed.

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

Overall, there were few changes in the distribution of fishing effort, with the established fishing areas remaining the focus of effort. Effort changed in some areas in response to increases or decreases in catch quota levels. Overall, about 96% of the quota was caught. The quota was over-caught in ORH 2A, ORH 2B and ORH 3A following reductions in the TACC in 2002–03, but the over-run was less than 10% in all areas. The TACCs remained unchanged in all other areas, and were not exceeded. The seasonal distribution of catch and effort was generally similar to that of previous years in most areas.

## 1. INTRODUCTION

Orange roughy are widespread in New Zealand waters. They occur in all areas of the upper continental slope at depths between 700 and 1500 m. They are the focus of an important deepwater fishery in New Zealand, and have been fished for over 20 years (Annala et al. 2004). The orange roughy fishery first developed on the Chatham Rise in 1979, followed by new grounds being located on the Challenger Plateau, off the east coast (Wairarapa, Kaikoura, Ritchie Banks), and Cook Canyon in the mid 1980s, and Puysegur Bank, East Cape, and Bay of Plenty in the early 1990s (Clark 1995). There have been, or are currently, over 15 major fishing grounds (Figure 1). These are distributed between eight Quota Management Areas (labelled *ORH 1–10* in Figure 1).

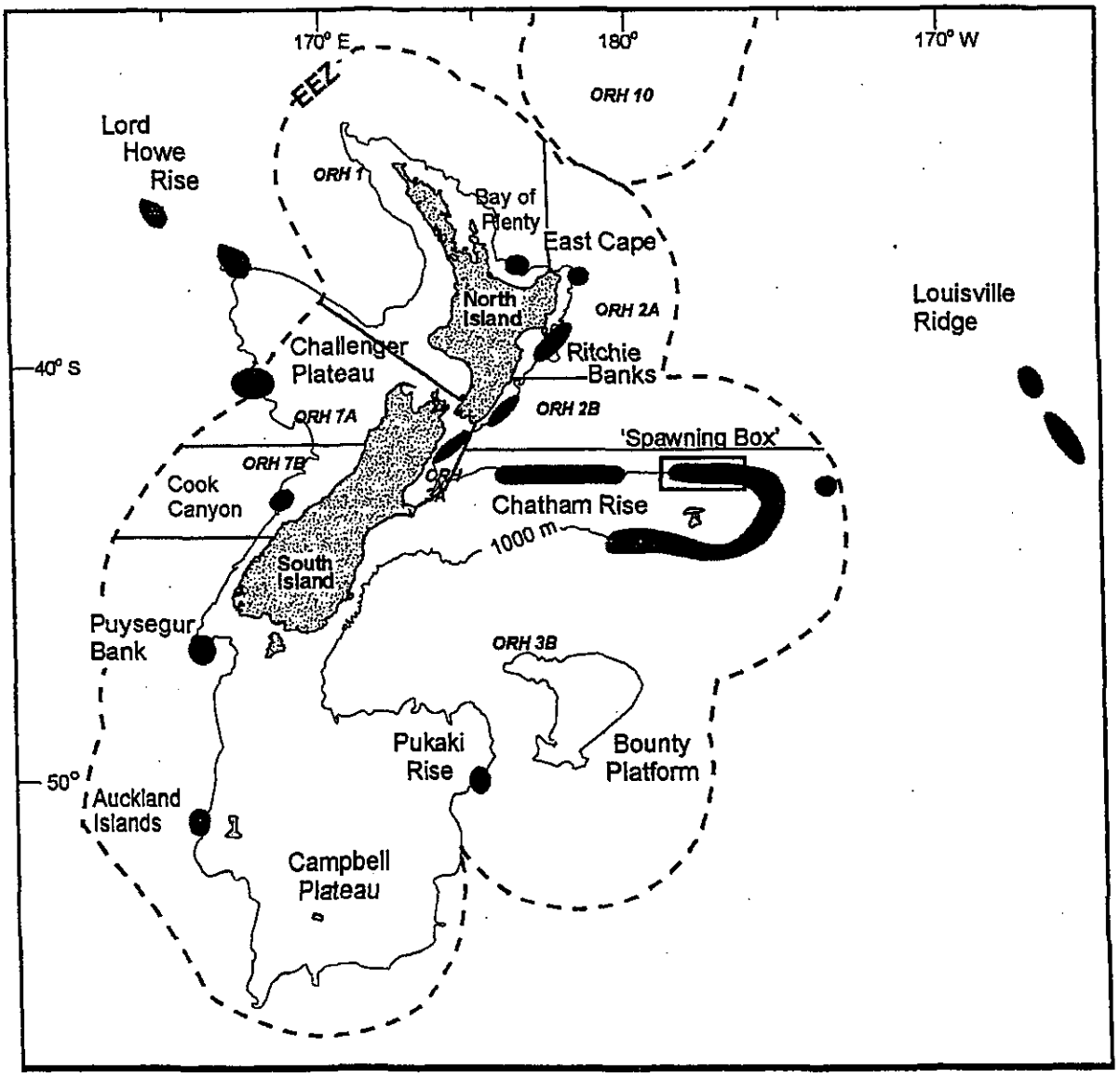


**Figure 1: The New Zealand region, showing a summary of the distribution of the main orange roughy fishing grounds (grey areas), the main fishery names as mentioned in the text, and Quota Management Areas (italicised) for orange roughy.**

The size of the total fishery was relatively steady at about 40000–50000 t during the 1980s, but started to decrease in the 1990s with reductions in Total Allowable Commercial Catches (TACCs) as some of the main stocks became fully or over-exploited (Clark et al. 2000, Clark 2001a). 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 fisheries. There is a need to carry out regular monitoring

programmes and stock assessments to determine stock status and estimate sustainable yields for all orange roughy fisheries, and, in order to update the stock assessment for each fishery, commercial catch and effort data should be monitored and the descriptive analysis of the commercial catch and effort data updated annually (Ministry of Fisheries 2003).

The work described in this report was carried out under Objective 1 of Ministry of Fisheries project ORH2002/03: "To update the descriptive analysis of the commercial catch and effort data from selected orange roughy fisheries with the inclusion of data up to the end of the 2002/03 fishing year. These fisheries include ORH 1, ORH 2A (North and South), ORH 2B, ORH 3A, ORH 3B (Chatham Rise and other areas), and ORH 7B." The Challenger Plateau fishery (ORH 7A) was not included in this project as the fishery has had a TACC of only 1 t since 2000–01.

This report updates Clark et al. (2003). Although the orange roughy fishery description is regularly updated, the level of detail may vary between reports. This is in response to research efforts focusing on specific areas for stock assessment. Stock assessments were conducted in 2004 for the Mid-East Coast (Dunn 2005), North-west Chatham Rise (McKenzie in press), South Chatham Rise (Anderson 2005), and West Coast South Island stocks (McKenzie in press).

## 2. REVIEW OF THE FISHERY

### 2.1 Data sources and methods

Estimated catch and effort data for the orange roughy fishery are recorded on either trawl catch effort processing return (TCEPR) or catch, effort and landing return (CELR) forms. The TCEPR forms give tow-by-tow information, with location and estimated catch for each trawl. The CELR forms provide daily estimated catch records with effort as the number and total duration of tows in the day. CELR forms tend to be used by smaller inshore vessels. Larger deepwater vessels (over 28 m in length) are required to complete TCEPR forms. Up-to-date data were requested from the Ministry of Fisheries catch-effort database in December 2003. TCEPR data were loaded into a relational (Empress) database at NIWA, and CELR data were stored as an Excel spreadsheet. This report focuses on data from the more detailed TCEPR forms. Although CELR forms were widely used in earlier years, their use has declined over time, representing less than 10% of the total estimated catch since 1993–94. Where CELR data are included in any table or figure, this is indicated in the text.

Data were selected where orange roughy were either the declared target species, or were caught. Data were error-checked. Obvious mistakes in position (e.g., large differences in start and finish coordinates), depth, and tow duration were corrected where possible, as were positions well outside any other fished area where typing or recording mistakes could be resolved (e.g., by examining that vessel's tows in sequence). Otherwise, records were excluded from analysis. Data for the 2002–03 fishing year may be incomplete because forms not yet supplied by fishing vessels will not have been entered into the Ministry database. Records containing errors that could not be resolved or corrected were excluded from further analyses.

The total dataset of trawls (where orange roughy was either the declared target species or was caught) totalled 8424 for 2001–02, and 8476 for 2002–03.

## 3. THE TOTAL ORANGE ROUGHY FISHERY

In 2002–03, over 95% of the total orange roughy landings reported to the Quota Management System (QMS) was recorded on the TCEPR or CELR forms, of which over 98% was recorded on the more detailed TCEPR forms (representing about 94% of overall reported catch; Table 1). The total catch of orange roughy increased from 14 379 t in 2001–02 to 14 585 t in 2002–03, with about 96% of the TACC taken in 2002–03, roughly 6% higher than the percentage taken in 2001–02.

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

| | 2001–02 | 2002–03 |
|---|---|---|
| Reported landings (QMS) | 14 379 | 14 585 |
| TACC | 15 911 | 15 231 |
| TCEPR catch | 13 436 | 13 670 |
| CELR catch | 442 | 210 |
| Total reported catch | 13 878 | 13 880 |
| Reported catch/landings (%) | 96.5 | 95.2 |

Following reductions in TACCs in ORH 2A, ORH 2B, and ORH 3A between 2001–02 and 2002–03, the TACCs were exceeded in these areas in 2002–03, although in all cases by less than 10% (Table 2). No TACCs had been exceeded in the previous fishing year. The TACCs remained unchanged in all other areas, and were not exceeded.

**Table 2: Annual reported catches and TACCs of orange roughy from the EEZ.**

| | 2001–02 | | 2002–03 | |
|---|---|---|---|---|
| Quota Management Area | TACC | Catch | TACC | Catch |
| ORH 1 | 1 400 | 1 294 | 1 400 | 1 123 |
| ORH 2A | 1 100 | 1 087 | 680 | 719 |
| ORH 2B | 185 | 180 | 99 | 105 |
| ORH 3A | 415 | 400 | 221 | 235 |
| ORH 3B | 12 700 | 11 324 | 12 700 | 12 333 |
| ORH 7A | 1 | 0.1 | 1 | 0.1 |
| ORH 7B | 110 | 95 | 110 | 90 |

The percentage of orange roughy caught in different target fisheries was generally similar in 2002–03 and 2001–02, with over 85% of the effort in the orange roughy target fisheries (Table 3). Changes in the number of tows where orange roughy were caught when targeting other species were small (under 1%). New Zealand domestic vessels remain dominant in the orange roughy fishery, although their share of fishing effort reduced slightly from 99.4% in 2001–02 to 97.1% in 2002–03, mostly due to an increase in Australian vessels (Table 4). Although present in previous years, there was no activity in the last two fishing years by vessels registered in Belize, and this nationality has been removed from Table 4.

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

| | 2001–02 | | 2002–03 | |
|---|---|---|---|---|
| | No. tows | % tows | No. tows | % tows |
| Orange roughy | 4 093 | 86.8 | 4486 | 85.9 |
| Oreos | 124 | 2.6 | 139 | 2.7 |
| Smooth oreos | 122 | 2.6 | 105 | 2.0 |
| Black oreo | 5 | 0.1 | 4 | 0.1 |
| Cardinalfish | 164 | 3.5 | 206 | 3.9 |
| Alfonsino and long–finned beryx | 11 | 0.2 | 34 | 0.7 |
| Hake | 4 | <0.1 | 1 | <0.1 |
| Hoki | 178 | 3.8 | 241 | 4.6 |

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

| | 2001–02 | | 2002–03 | |
|---|---|---|---|---|
| | No. tows | % tows | No. tows | % tows |
| Domestic | 4 676 | 99.4 | 4757 | 97.1 |
| Australia | 2 | 0.1 | 110 | 2.2 |
| Cyprus | 3 | 0.1 | 3 | <0.1 |
| Panama | 11 | 0.2 | 31 | 0.6 |
| Korea | 14 | 0.3 | 0 | – |

## 4. NORTHERN NORTH ISLAND FISHERIES (ORH 1)

The coastline of ORH 1 extends from north of Wellington on the west coast, northwards around to the eastern Bay of Plenty on the east coast. There was exploratory fishing in this area during the early to mid 1980s, with the commercial fishery first developing in the western Bay of Plenty after 1994. Further detailed analyses for this area were presented by Clark (2001b), and stock assessments for some of the ORH 1 by sub-area were described by Annala et al. (2004). The ORH 1 stock was re-introduced into the Adaptive Management Programme (AMP) in 2002, under which decision rules based upon catch per unit effort (CPUE) were put in place to restrict or maintain catches, including the use of specific feature catch limits (Annala et al. 2004). The only stock assessment for this fishery was conducted in 2001, and only for the Mercury-Colville box (Annala et al. 2004).

### 4.1 Total catch

The TACC was reduced in 2000–01 following the conclusion of the Adaptive Management Programme (AMP) initiated for the Mercury-Colville box in 1995 (Table 5). In 2001–02, ORH 1 was reintroduced into the AMP for the coming 5 years, the TACC increased to 1400 t, and the total catch increased to the highest recorded under TACC in ORH 1. In 2002–03, the TACC remained the same, but catches dropped by about 13%. The amount of catch reported on TCEPRs was 1160 t in 2001–02 and 1013 t in 2002–03 (89.6% and 90% of the TACC respectively).

**Table 5: Reported catches (t) and TACCs (t) for ORH 1 from 1995–96 to 2001–02. The catches in parentheses indicate combined exploratory (under special permit) and TACC catches.**

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

### 4.2 Distribution of catch and effort

Following previous analyses, eight sub-areas have been defined:

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

The patterns of catch and effort in 2001–02 and 2002–03 were generally similar, but relatively large catches were realised in 2002–03 between Tauroa and Manukau on the west coast, at the western edge of the Northland box, northwest of the Mercury-Colville Box, and on the Colville Ridge close to the EEZ boundary (Figure 2). Conversely, catches were less extensive in the North Colville box, and similar to the pattern in 2000–01 (Clark et al. 2003).

Following periods of exploratory fishing in the late 1990s, large catches were taken on Tauroa Knoll, the West Norfolk Ridge, the north Colville Ridge, and in the central Bay of Plenty (Table 6).

Historically, catch and effort have been concentrated in the Bay of Plenty. The Mercury-Colville Box was effectively closed to orange roughy fishing in 2000–01, and although catches and effort increased from 2000–01 to 2001–02 beyond the allowed 50 t bycatch, they dropped to 15 t in 2002–03 (Table 6). Catches have continued to decline in White Island, reaching a low in 2002–03 despite an increase in effort. Catches and effort remain low in the Aldermen Islands area.

After peaking in 2001–02, catch and effort have decreased on the West Norfolk Ridge, although the largest catches were still taken from this area in 2002–03 (Table 6). Catches and effort increased on Tauroa Knoll in 2001–02, and this has continued into 2002–03. Catches and effort have also increased in Manukau, with new catches taken in the area between Manukau and Tauroa. Effort has continued to increase on the north Colville Ridge, although catches have dropped, and both catches and effort have increased in Northland. The Aotea region remains closed to fishing.

The timing of effort has typically been variable from year to year, but since 1997–98 has generally been at the highest level in March and June or July (Clark et al. 2003). However, in 2002–03 the highest effort was earlier in the year, peaking in December and March (as in some previous years), but relatively low in June and July (Figure 3). The total effort in the main fishing areas increased slightly between 2001–02 and 2002–03, from 534 tows to 596 tows, although effort in 2002–03 remained substantially lower than in the previous fishing years (Table 6). Although the seasonality of catches has also been variable, the largest catches have been taken during June in all years between 1997–98 and 2001–02 (Figure 3). In 2002–03, the highest catches were in December and March, with smaller catches in October, November, April and July.

### 4.3 Catch rates

In 2001–02 the highest mean catch rate (t/tow) was taken in Tauroa, followed by North Colville, and the lowest was from Northland (Table 6). In 2002–03, the highest catch rates were in Manukau, followed by Tauroa, and the lowest were in Aldermen. There was a large drop in the catch rates between 2001–02 and 2002–03 for all areas within the Bay of Plenty, and for North Colville. The only areas where catch rates increased were Manukau and Northland.

In 2002–03, occasional high catch rates were taken in most sub-areas, except for the Bay of Plenty (Figure 4). In White Island and Aldermen, the effort was concentrated in the same months in 2001–02 and 2002–03. In Mercury-Colville, the effort in 2001–02 was concentrated between April and September, whereas in 2002–03 more effort was recorded during December. In North Colville, the timing of the fishery has been variable, and was between November and February in 2000–01 (Clark et al. 2003), was concentrated in June in 2001–02, and in March and June in 2002–03.

In Tauroa, the timing of the fishery has also been variable, and high catch rates and effort were concentrated in October in 2000–01, in January in 2001–02, and in January and February in 2002–03 (Figure 4). In 2001–02, effort on the West Norfolk Ridge started in January, with relatively large catches in January, May, and September, but in 2002–03, effort started earlier in November, with most effort and high catch rates in January, February, and April.

**Table 6: Summary of orange roughy catch and effort data for sub-areas within ORH 1 during fishing years 1997–98 to 2002–03 (subareas are marked on Figure 2). –, insufficient data. Catch rate (ORH t/tow) is calculated as total catch/number of target ORH tows, where there were 3 or more vessels, and 10 or more tows, per year.**

| | 1997–98 | 1998–99 | 1999–2000 | 2000–01 | 2001–02 | 2002–03 |
|---|---|---|---|---|---|---|
| **West Norfolk** | | | | | | |
| No. tows | 2 | 4 | 35 | 81 | 169 | 112 |
| No. ORH target | 2 | 4 | 29 | 57 | 157 | 73 |
| Catch ORH (t) | 0 | 0.1 | 111.7 | 167.3 | 337.1 | 218 |
| ORH t/tow | – | – | 3.8 | 2.9 | 2.1 | 1.9 |
| **Tauroa** | | | | | | |
| No. tows | 26 | 73 | 144 | 18 | 35 | 78 |
| No. ORH target | 26 | 72 | 144 | 5 | 34 | 77 |
| Catch ORH (t) | 5.7 | 583.1 | 516.5 | 143.5 | 151.8 | 209 |
| ORH t/tow | 0.2 | 8.1 | 3.6 | – | 4.5 | 2.7 |
| **Manukau** | | | | | | |
| No. tows | 0 | 0 | 0 | 0 | 45 | 52 |
| No. ORH target | 0 | 0 | 0 | 0 | 45 | 52 |
| Catch ORH (t) | 0 | 0 | 0 | 0 | 115 | 185 |
| ORH t/tow | 0 | 0 | 0 | 0 | 2.5 | 3.6 |
| **Northland** | | | | | | |
| No. tows | 1 | 24 | 21 | 3 | 51 | 95 |
| No. ORH target | 1 | 24 | 21 | 3 | 51 | 93 |
| Catch ORH (t) | 0 | 37 | 46.7 | 31.5 | 46.8 | 104 |
| ORH t/tow | – | 1.5 | 2.2 | – | 0.9 | 1.1 |
| **N. Colville** | | | | | | |
| No. tows | 3 | 10 | 66 | 13 | 69 | 77 |
| No. ORH target | 3 | 9 | 42 | 8 | 58 | 54 |
| Catch ORH (t) | 0 | 127.2 | 120 | 81.1 | 212.4 | 109 |
| ORH t/tow | – | 14.1 | 2.9 | – | 3.7 | 1.4 |
| **Mercury–Colville** | | | | | | |
| No. tows | 683 | 261 | 178 | 36 | 79 | 65 |
| No. ORH target | 658 | 243 | 125 | 2 | 43 | 31 |
| Catch ORH (t) | 289.2 | 142.9 | 297.3 | 29.9 | 115.7 | 15 |
| ORH t/tow | 0.4 | 0.6 | 2.4 | – | 2.7 | 0.2 |
| **White I.** | | | | | | |
| No. tows | 257 | 482 | 293 | 55 | 71 | 98 |
| No. ORH target | 230 | 410 | 253 | 30 | 50 | 74 |
| Catch ORH (t) | 67.7 | 617.9 | 294.7 | 175.7 | 131.8 | 18 |
| ORH t/tow | 0.3 | 1.5 | 1.2 | 5.8 | 2.6 | 0.2 |
| **Aldermen** | | | | | | |
| No. tows | 129 | 40 | 42 | 3 | 15 | 19 |
| No. ORH target | 127 | 39 | 42 | 1 | 15 | 19 |
| Catch ORH (t) | 138.7 | 24 | 34 | 75 | 44.2 | 2 |
| ORH t/tow | 1.1 | 0.6 | 0.8 | – | 2.9 | 0.1 |

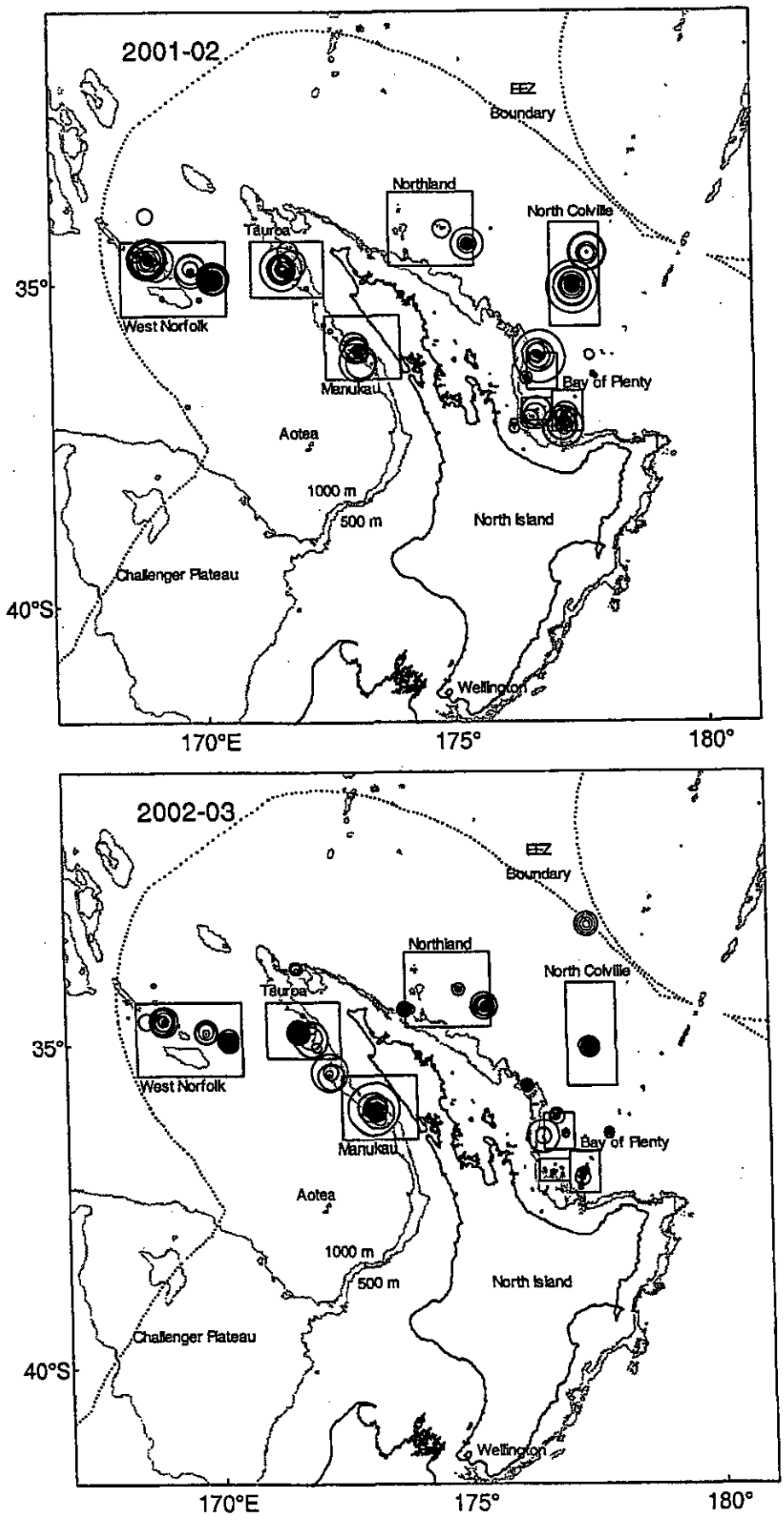


**Figure 2: Distribution of trawls and orange roughy catch rate (t/tow) in ORH 1 for 2001–02 and 2002–03 (max. = 55 t). Bay of Plenty boxes are: Mercury-Colville (northwest), Aldermen (southwest), and White Island (southeast).**

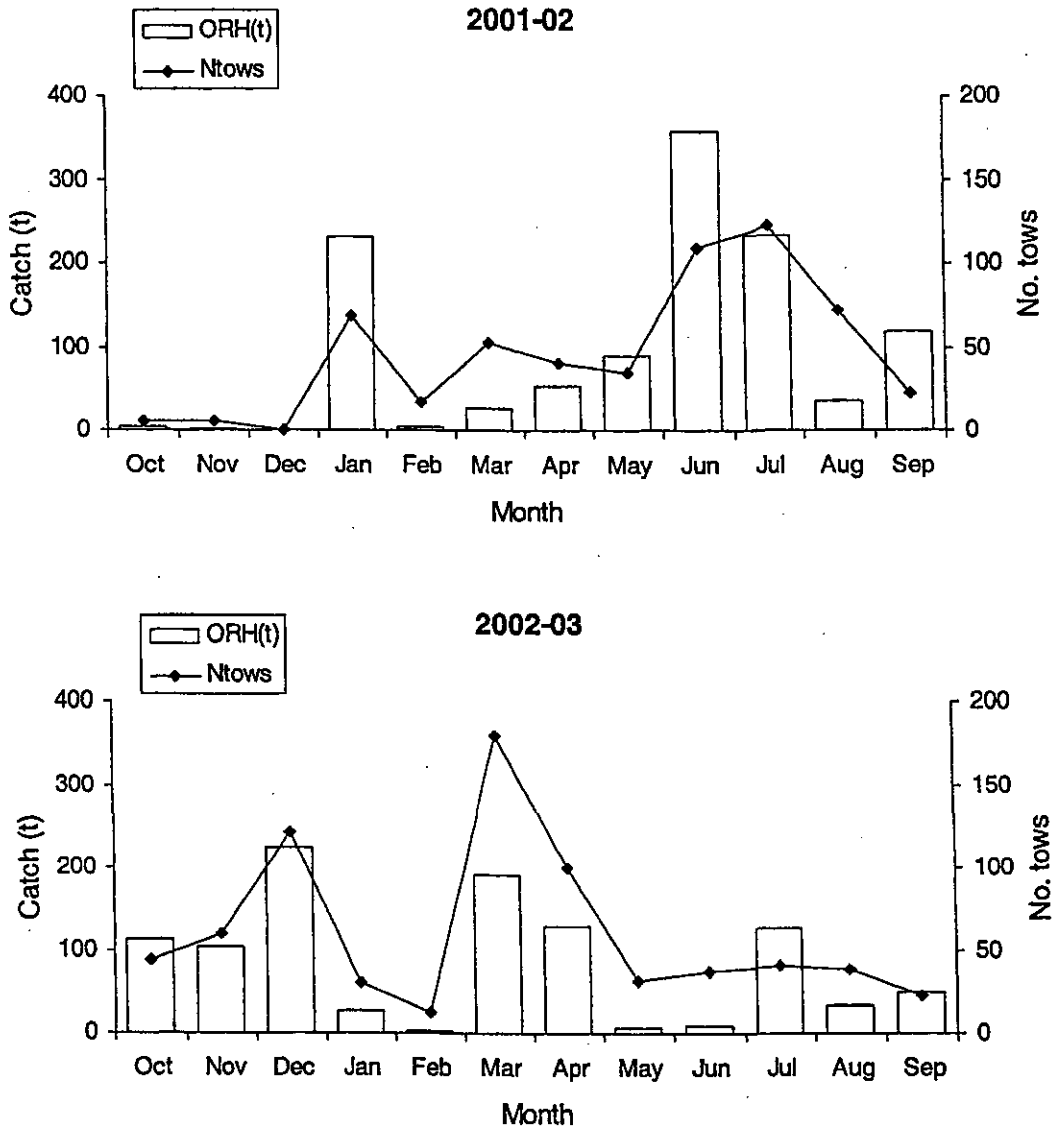


**Figure 3: Monthly distribution of total catch and effort in ORH 1 for 2001–02 and 2002–03.**

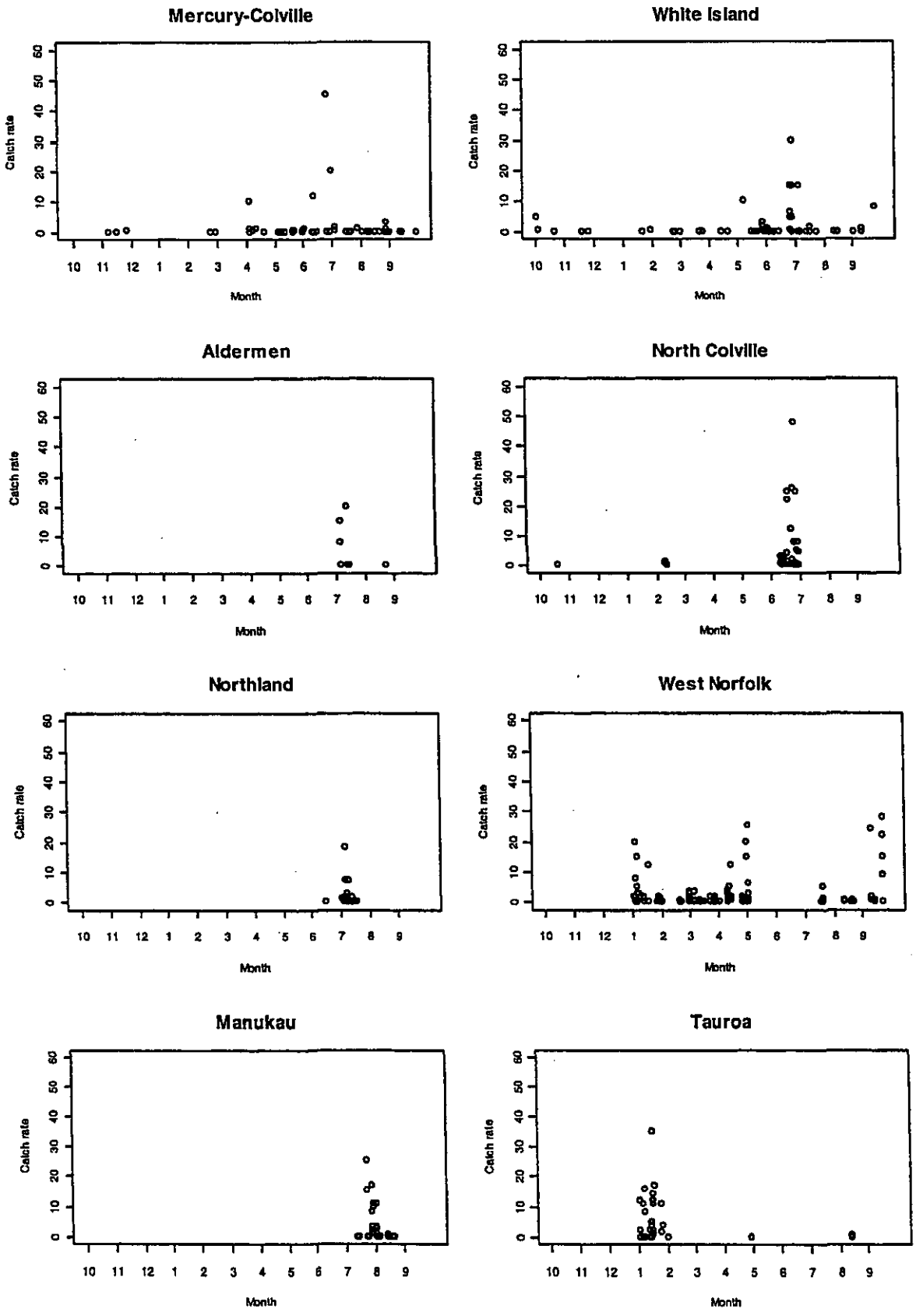


Figure 4: Daily unstandardised catch rate profiles (t/tow) of orange roughy in ORH 1 by subarea, 2001–02.

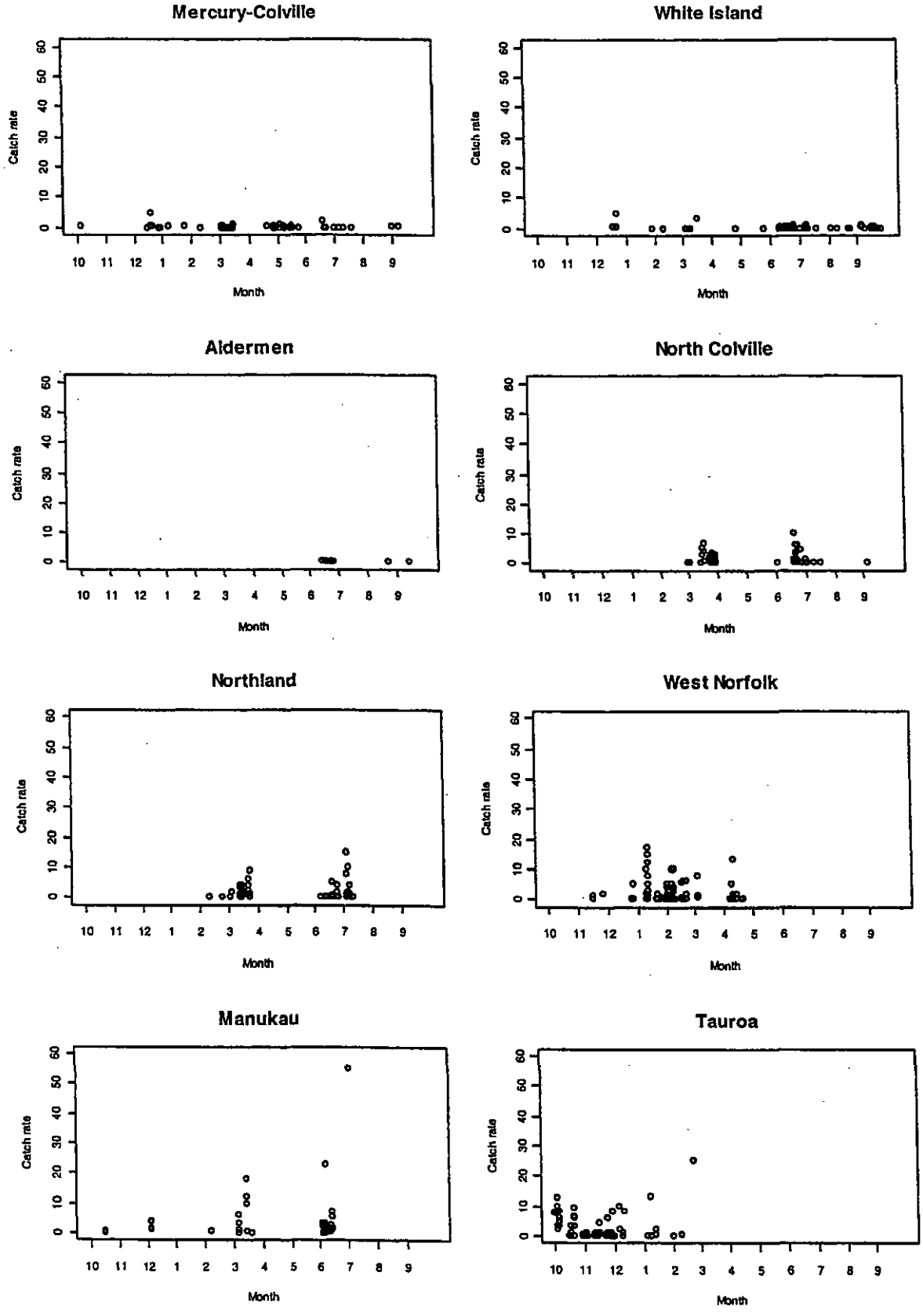


Figure 4 (cont): Daily unstandardised catch rate profiles (t/tow) of orange roughy in ORH 1 by subarea, 2002–03.

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

The fisheries for orange roughy in ORH 2A South (the portion of ORH 2A south of 38° 23′ S), ORH 2B (Wairarapa), and ORH 3A (Kaikoura) form what has been known since 1995 as the Mid-East Coast (MEC) stock. The northern part of ORH 2A (ORH 2A North) is referred to as the East Cape (EC) stock. The stock boundaries are based upon knowledge of spawning locations, and from allozyme studies (Annala et al. 2004).

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

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

### 5.1 Total catch

Annual landings in the MEC fishery have been in decline since 1994–95, following a series of reductions in the TACC, to a level of 1500 t in 2000–01, and 800 t in 2002–03 (Table 7).

**Table 7: Reported landings (t) and TACCs (t) by QMA for the MEC fishstock for the fishing years 1981–82 to 2002–2003.**

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

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

Up until 1999–2000, annual landings in the EC fishery ranged from 1500 to 3400 t, with very little of the catch coming from outside the East Cape hills area. A sharp decrease in the catch limit in 2000–01, from 2500 t to 200 t, has restricted landings from this fishery to low levels in the past three years (Table 8).

**Table 8: Total landings for the East Cape hills and exploratory areas of the EC stock. Total landings data from Annala et al. (2000) (1993–94 to 1998–99) and from data supplied by the Orange Roughy Management Company Limited, pro-rated to QMS data for ORH 2A, for 1999–2000 to 2002–03. Catch limits in parentheses. NA, no area split.**

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

## 5.2 Distribution of catch and effort

Since 1993–94, TCEPR records for both EC and MEC have provided data covering between 75% and 97% of the total landings (Tables 9 & 10). In the MEC stock, effort (number of vessel days) has shown considerable variation (Table 9).

**Table 9: Vessel-days and estimated catch (t) by data type for the MEC stock for the fishing years 1982–83 to 2002–2003.**

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

The highest effort levels were during the early 1990s, when landings were at their peak, followed by a general reduction in subsequent years, with effort dropping since 1998–99. Effort in 2002–03 was the lowest reported since 1988–89. In the EC stock, effort dropped considerably in 2000–01, in line with the TACC reduction. Catch has subsequently decreased, to 129 t in 2002–03, the lowest level reported for the fishery (Table 10).

**Table 10: Vessel-days and estimated catch (t) by data type for the EC stock for the fishing years 1993–94 to 2002–2003.**

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

* Estimated

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

In the Mid-East Coast fishery, the distribution of effort has remained fairly constant from year to year, with tow positions tracking the 1000 m contour along almost the entire extent of the three QMAs (Figure 5). There is, however, a section of mostly unfished grounds centred near the boundary of ORH 2A and ORH 2B which has provided a natural separation between the two QMAs. The last five fishing years have seen an increase in fishing effort in the northern half of this previously unfished section (south part of 2A South), reducing its extent. In 2002–03, there was also a decline in the catches from the fishery at Tuaheni High (the focus of catches in the northern part of 2A South). The Ritchie Bank and Rockgarden areas in 2A South continue to form the focus of the MEC fishery. The distribution of fishing effort has been more continuous around the boundary between the ORH 2B and ORH 3A fisheries, although fishing effort has been typically very light in this area, in particular in the southern parts of ORH 2B. In the EC stock, the effort has occurred in all months in most years, but was generally inconsistent for the first six months of the year, followed by an increase around April to June, and a subsequent decline (Table 11). In 2001–02, there was more fishing earlier in the year, especially in January, February, and April, and there was no fishing at all after June. In 2002–03, the pattern was similar, with peak effort in February, followed by April.

**Table 11: Percent of tows by month for the EC stock for the fishing years 1993–94 to 2002–2003.**

| Fishing year | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Total tows |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1993–94 | 4 | 0 | 10 | 3 | 9 | 13 | 13 | 12 | 15 | 15 | 2 | 4 | 527 |
| 1994–95 | 6 | 4 | 8 | 12 | 14 | 9 | 15 | 29 | 2 | 0 | 1 | 0 | 1 212 |
| 1995–96 | 11 | 8 | 9 | 11 | 8 | 11 | 12 | 18 | 7 | 2 | 1 | 2 | 1 023 |
| 1996–97 | 12 | 17 | 11 | 3 | 5 | 8 | 7 | 15 | 10 | 7 | 2 | 3 | 829 |
| 1997–98 | 9 | 3 | 5 | 2 | 8 | 12 | 10 | 15 | 30 | 5 | 0 | 0 | 1 439 |
| 1998–99 | 3 | 3 | 2 | 5 | 3 | 6 | 7 | 18 | 35 | 9 | 4 | 6 | 1 110 |
| 1999–00 | 9 | 5 | 1 | 3 | 6 | 1 | 3 | 14 | 30 | 14 | 8 | 9 | 749 |
| 2000–01 | 3 | 12 | 0 | 0 | 4 | 7 | 5 | 35 | 33 | 2 | 0 | 0 | 188 |
| 2001–02 | 7 | 6 | 0 | 12 | 20 | 2 | 19 | 22 | 11 | 0 | 0 | 0 | 163 |
| 2002–03 | 1 | 0 | 5 | 2 | 35 | 0 | 24 | 17 | 14 | 1 | 0 | 0 | 136 |

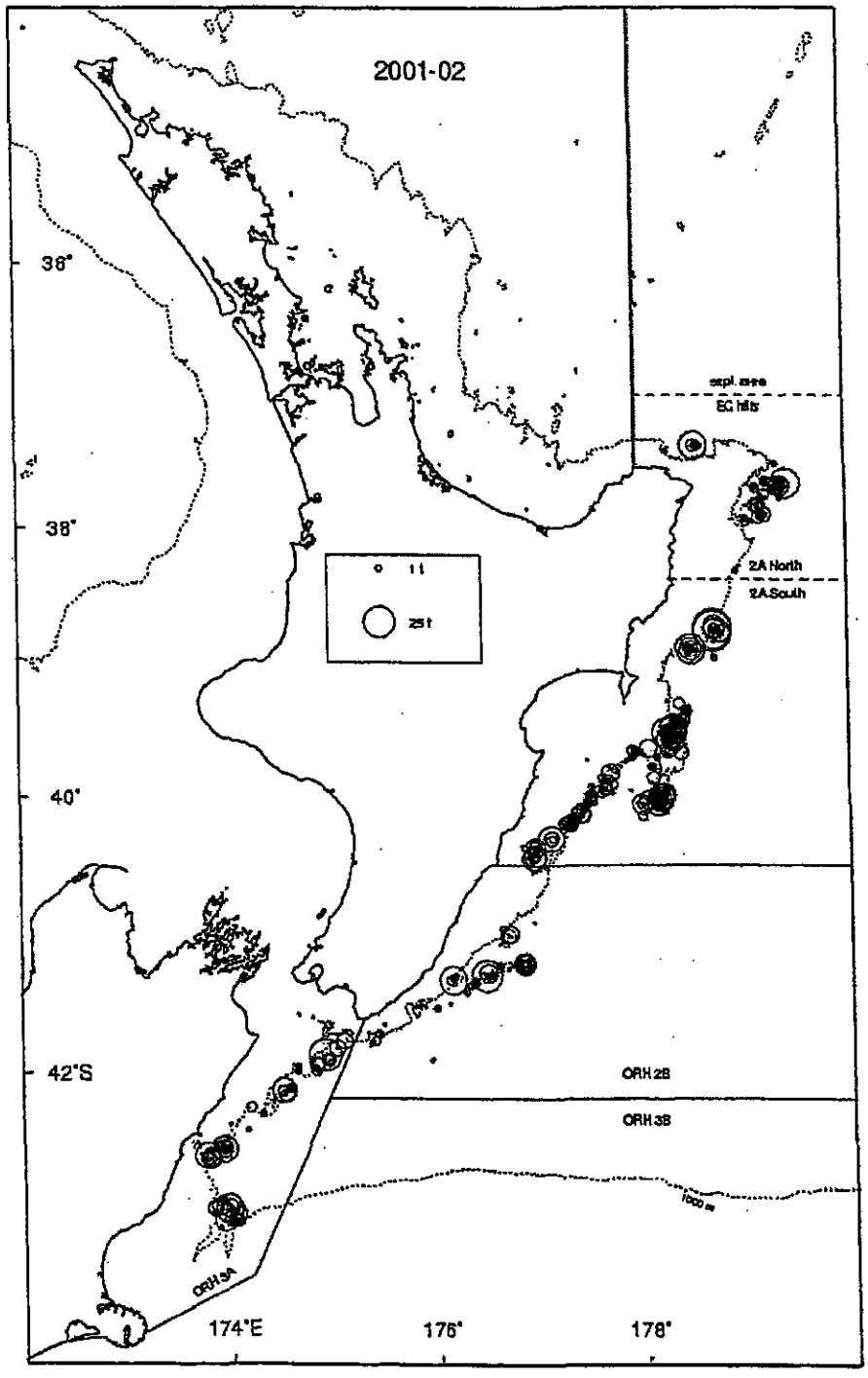


**Figure 5: Unstandardised catch (t) per tow of orange roughy in the EC and MEC fish stocks for the 2001–02 fishing year.**

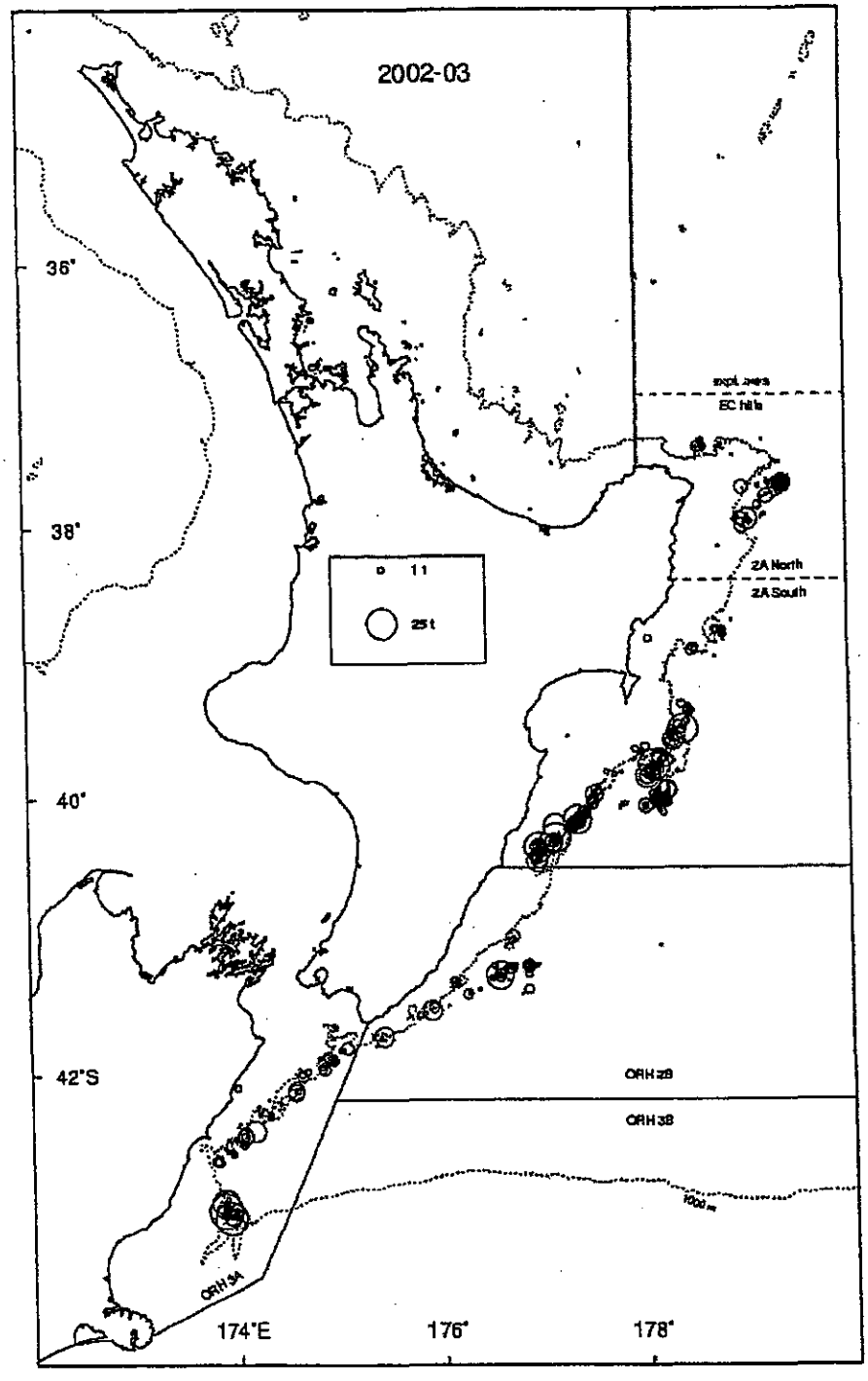


**Figure 5 (cont.): Unstandardised catch (t) per tow of orange roughy in the EC and MEC fish stocks for the 2002–03 fishing year.**

Within the MEC stock, effort in ORH 2A South has declined sharply over the last two years, after a reduction in the catch limit, and has continued to decline to 2002–03 (Table 12). Fishing has taken place in most months of most years, and although effort has generally been greatest around May and June, and low after June, seasonal fishing patterns have been variable from year to year (Table 12).

**Table 12: Percent of tows by month for ORH 2A South for the fishing years 1993–94 to 2002–2003.**

| Fishing year | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Total tows |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1993–94 | 3 | 6 | 7 | 13 | 7 | 9 | 15 | 11 | 23 | 3 | 1 | 1 | 1 593 |
| 1994–95 | 3 | 8 | 0 | 2 | 0 | 3 | 4 | 8 | 39 | 15 | 6 | 12 | 1 687 |
| 1995–96 | 2 | 6 | 5 | 4 | 4 | 9 | 15 | 18 | 18 | 12 | 6 | 2 | 481 |
| 1996–97 | 6 | 6 | 2 | 7 | 4 | 3 | 6 | 30 | 18 | 8 | 1 | 8 | 556 |
| 1997–98 | 21 | 13 | 2 | 3 | 18 | 15 | 9 | 8 | 5 | 0 | 0 | 6 | 1 124 |
| 1998–99 | 7 | 5 | 3 | 21 | 12 | 5 | 12 | 12 | 10 | 4 | 3 | 5 | 1 625 |
| 1999–00 | 16 | 7 | 3 | 8 | 7 | 5 | 7 | 12 | 12 | 12 | 4 | 5 | 1 404 |
| 2000–01 | 6 | 8 | 2 | 8 | 4 | 12 | 12 | 20 | 24 | 2 | 0 | 1 | 702 |
| 2001–02 | 21 | 8 | 0 | 13 | 4 | 2 | 12 | 12 | 22 | 1 | 1 | 4 | 405 |
| 2002–03 | 6 | 4 | 7 | 6 | 11 | 3 | 12 | 28 | 15 | 3 | 2 | 2 | 358 |

In the central area of the MEC (ORH 2B), most of the fishing has taken place between September and May, with vessels generally absent from this fishery during June-July, the main spawning period of the larger fisheries (Table 13). In 2001–02, more effort was expended in the last four months of the fishing year than in any year since at least 1993–94, but effort declined in 2002–03. In 2002–03, effort was relatively high in April and May.

**Table 13: Percent of tows by month for ORH 2B for the fishing years 1993–94 to 2002–2003.**

| Fishing year | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Total tows |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1993–94 | 8 | 9 | 7 | 16 | 20 | 11 | 14 | 5 | 4 | 1 | 2 | 3 | 804 |
| 1994–95 | 15 | 9 | 8 | 15 | 5 | 10 | 7 | 12 | 3 | 1 | 4 | 11 | 767 |
| 1995–96 | 16 | 7 | 4 | 14 | 7 | 12 | 18 | 8 | 4 | 3 | 3 | 3 | 304 |
| 1996–97 | 18 | 11 | 10 | 11 | 10 | 6 | 9 | 15 | 0 | 0 | 0 | 10 | 204 |
| 1997–98 | 20 | 10 | 4 | 23 | 18 | 12 | 11 | 3 | 0 | 0 | 0 | 0 | 260 |
| 1998–99 | 13 | 11 | 8 | 24 | 19 | 10 | 11 | 3 | 0 | 0 | 0 | 1 | 238 |
| 1999–00 | 14 | 12 | 5 | 6 | 19 | 15 | 7 | 6 | 3 | 0 | 6 | 7 | 236 |
| 2000–01 | 17 | 21 | 4 | 15 | 10 | 0 | 5 | 9 | 3 | 0 | 0 | 15 | 191 |
| 2001–02 | 12 | 22 | 7 | 10 | 7 | 3 | 9 | 2 | 7 | 10 | 1 | 9 | 89 |
| 2002–03 | 17 | 17 | 9 | 10 | 3 | 7 | 14 | 12 | 3 | 3 | 2 | 2 | 116 |

**Table 14: Percent of tows by month for ORH 3A for the fishing years 1993–94 to 2002–2003.**

| Fishing year | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Total tows |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1993–94 | 8 | 5 | 2 | 9 | 10 | 9 | 10 | 14 | 6 | 2 | 7 | 16 | 1 282 |
| 1994–95 | 15 | 12 | 11 | 8 | 9 | 14 | 9 | 6 | 2 | 1 | 5 | 10 | 851 |
| 1995–96 | 12 | 7 | 14 | 22 | 7 | 15 | 11 | 5 | 2 | 0 | 4 | 0 | 448 |
| 1996–97 | 21 | 18 | 5 | 4 | 3 | 15 | 19 | 4 | 5 | 0 | 0 | 4 | 493 |
| 1997–98 | 18 | 14 | 19 | 22 | 8 | 4 | 6 | 6 | 0 | 1 | 0 | 1 | 453 |
| 1998–99 | 36 | 8 | 19 | 12 | 7 | 3 | 9 | 4 | 1 | 0 | 0 | 1 | 384 |
| 1999–00 | 32 | 15 | 12 | 11 | 14 | 5 | 3 | 4 | 2 | 1 | 0 | 3 | 387 |
| 2000–01 | 19 | 13 | 24 | 20 | 5 | 5 | 3 | 2 | 6 | 0 | 0 | 3 | 221 |
| 2001–02 | 24 | 6 | 9 | 14 | 6 | 4 | 8 | 4 | 14 | 0 | 7 | 5 | 138 |
| 2002–03 | 15 | 20 | 16 | 8 | 4 | 8 | 9 | 16 | 2 | 0 | 0 | 0 | 142 |

In the southern area of the MEC (ORH 3A), the fishing pattern has been similar to that in ORH 2B, with most fishing before June in each year (Table 14). Before 2001–02, the effort in this fishery had been

contracting steadily into the early part of the fishing year (about 60% of effort between October and December), but in 2001–02 the effort was spread more evenly through the year. In 2002–03, the effort was again focused early in the fishing year (around 51% between October and December).

### 5.2.1 Catch profiles by latitude

Catch profiles of orange roughy by latitude have been plotted to help describe changes in the geographical distribution of the total catch by year (Figure 6).

In the East Cape stock (ORH 2A North), the fishery in 2001–02 was spread north and south of the main spawning hill, as in previous years (Clark et al. 2003). However, in 2002–03 the fishery was again focused on the spawning hill at approximately 37.7° S (Figure 6).

In the MEC stock, catches were distributed throughout the entire latitudinal range in early years, but with a focus on the Ritchie Banks, between latitudes 39.5 and 40° S (Clark et al. 2003). In 2002–03, the fishery in the Ritchie Banks area was reduced, and the focus was on the southern area including the Rockgarden, at about 40° S (Figure 6). In addition, the fishery at Tolaga Hill (38.8° S) was much reduced in 2002–03.

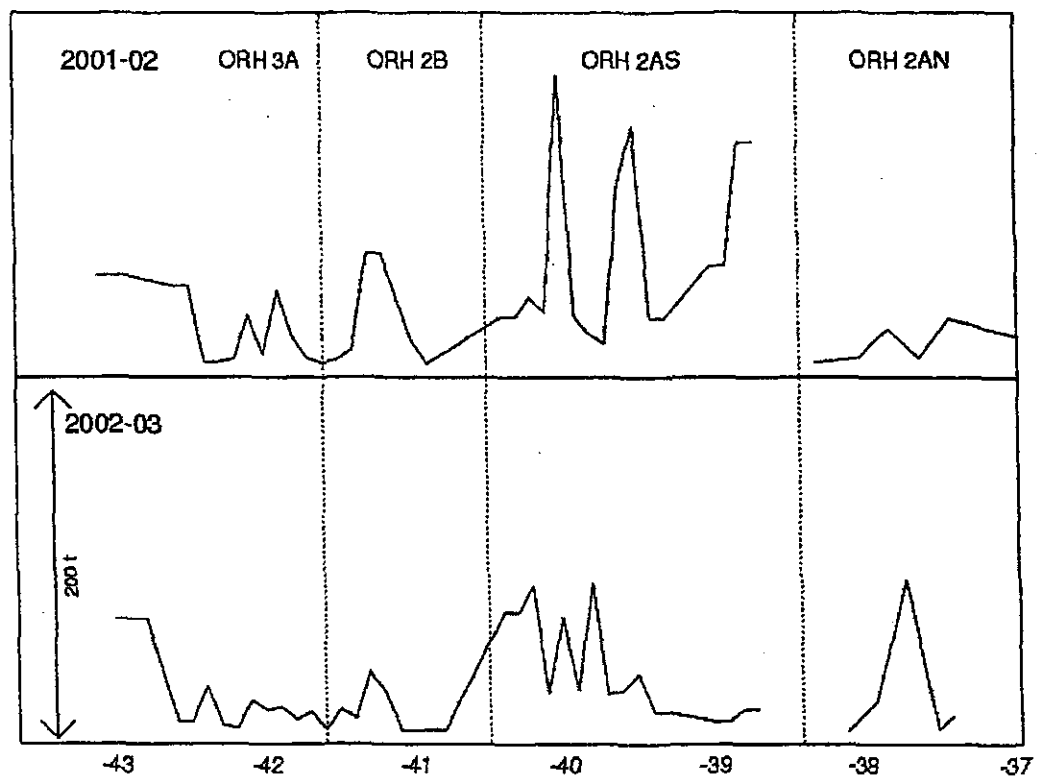


**Figure 6: Catch profiles for orange roughy by latitude for the EC and MEC fisheries for the 2001–02 and 2002–03 fishing years. Catches were summed over each 0.1 degree of latitude and a smoothed line fitted.**

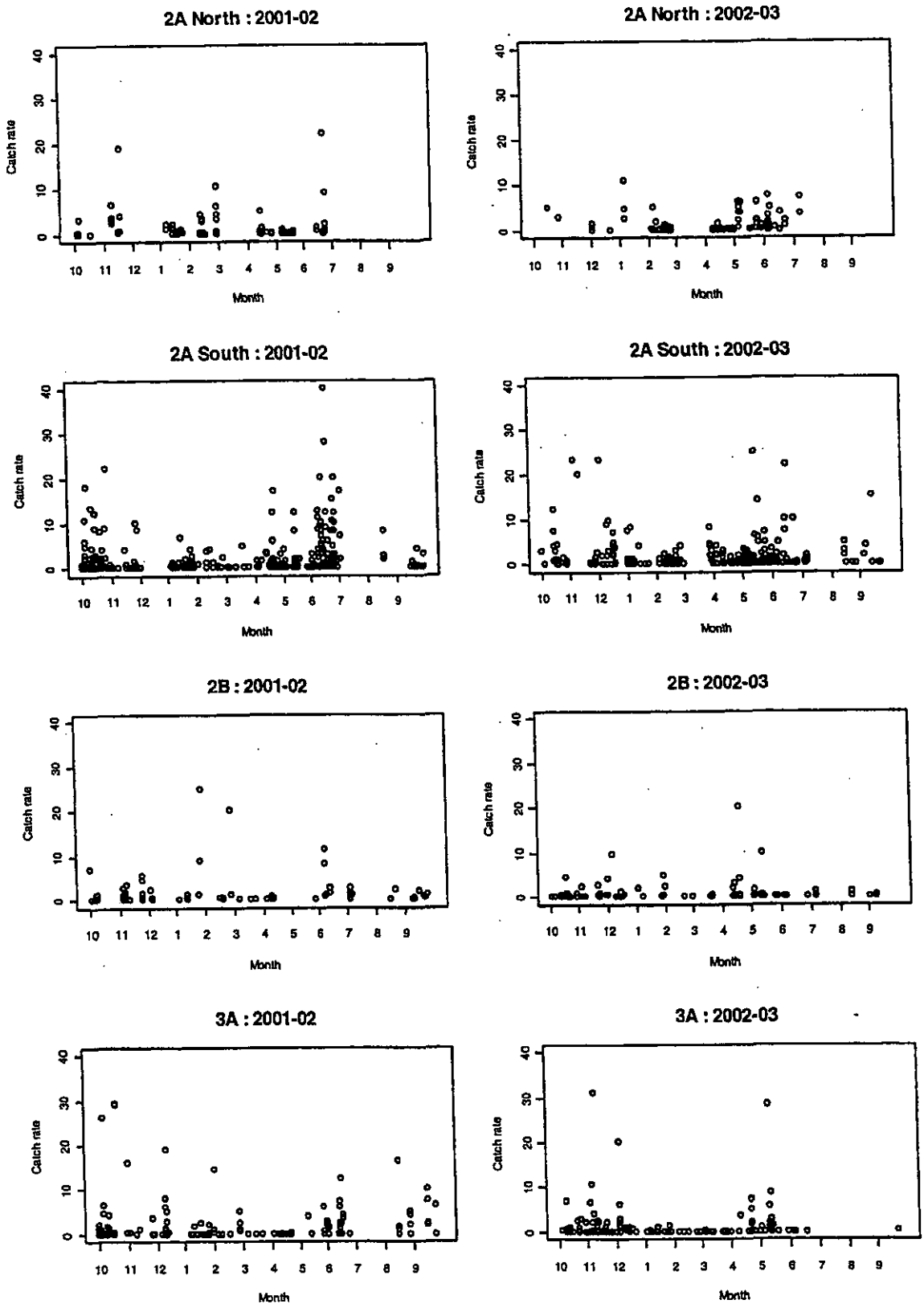


**Figure 7: Unstandardised daily catch rate profiles (t/tow) of orange roughy in the MEC and EC stocks for 2001–02 and 2002–03.**

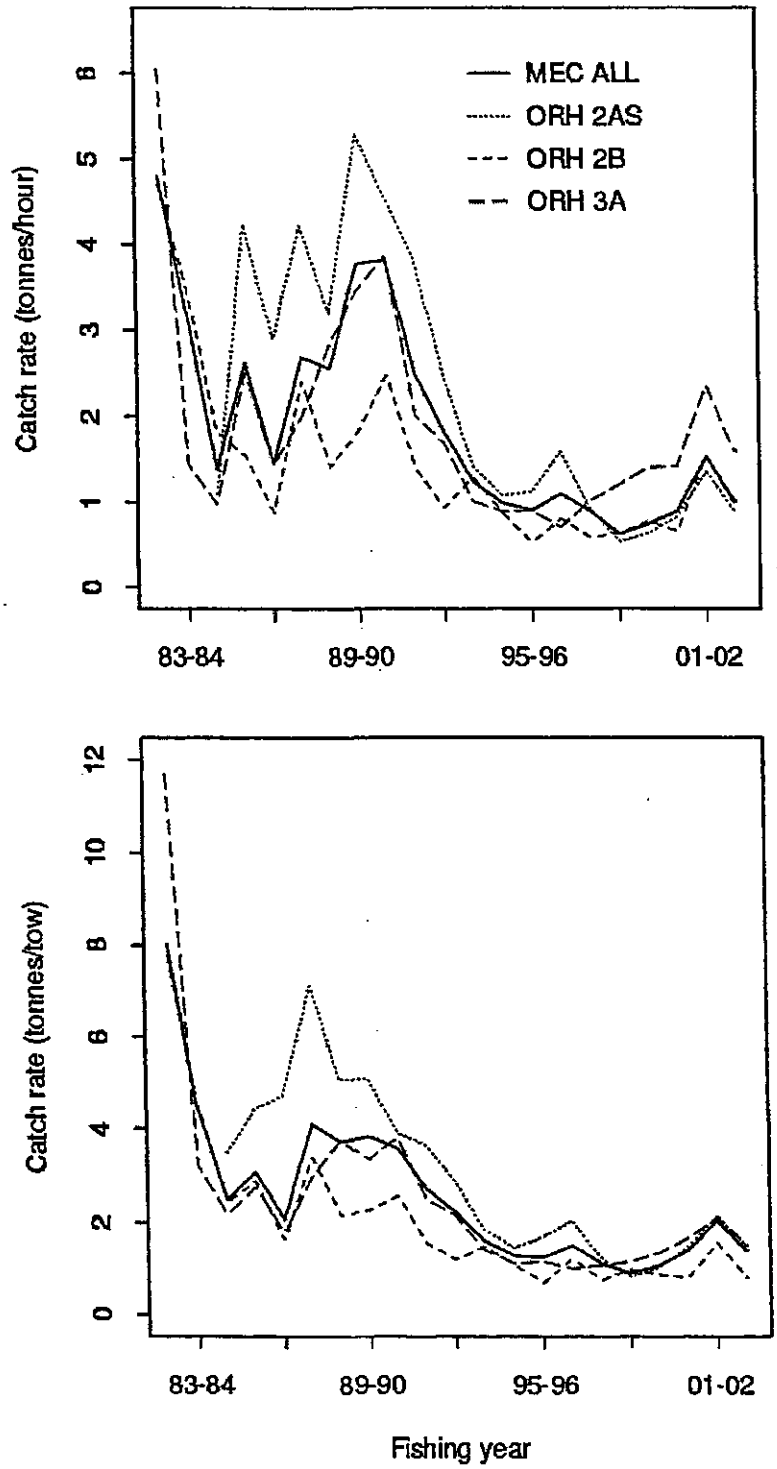


**Figure 8: Unstandardised catch rates of orange roughy in the MEC stock and sub-areas for 1982–83 to 2002–2003.**

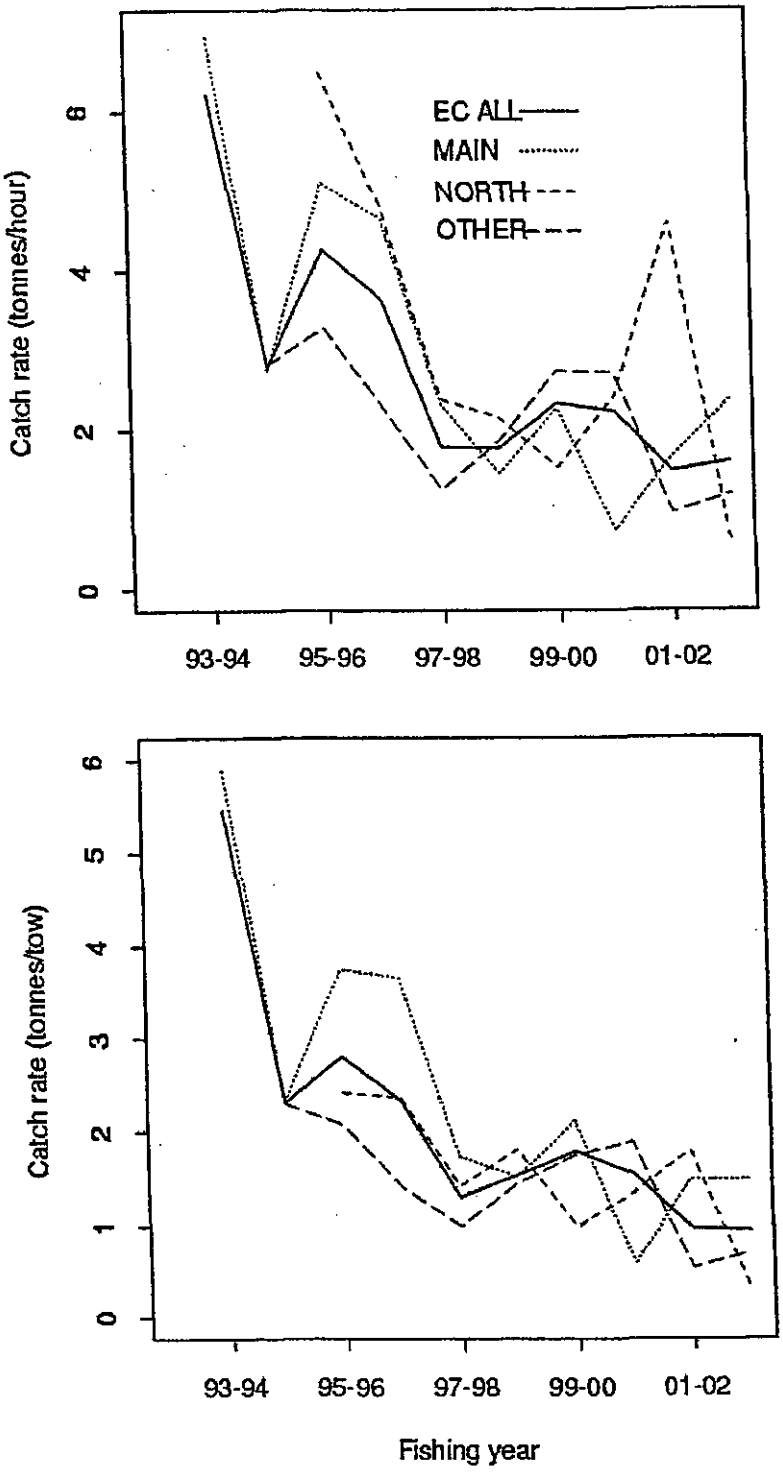


**Figure 9: Unstandardised catch rates of orange roughy in the EC stock and sub-areas for 1993–94 to 2002–2003.**

### 5.3 Catch rates

#### 5.3.1 Daily catch rate profiles

The highest levels of effort, and daily unstandardised catch rates for the MEC fishery have typically been during the spawning season, in June and July (Clark et al. 2003), and this pattern was repeated in 2001–02 and 2002–03, but in 2002–03 catch rates were also relatively high in November in ORH 2A South and ORH 3A (Figure 7). Effort took place all year around in the MEC, except in July and August in ORH 3A in 2002–03.

The effort and catch rates in 2001–02 and 2002–03 were also greatest in November and around the spawning season, from April to June (Figure 7). The reduction of clear seasonal spikes, and homogenisation of catch rates over recent years in the EC fishery (Clark et al. 2003) has continued into 2002–03, with occasional relatively high catch rates taken between October and February, and between May and July.

#### 5.3.2 Annual catch rates

Within the MEC stock, unstandardised annual catch rates peaked in the early 1990s, and then declined (Figure 8). The catch rate in 2001–02 (both t/tow and t/h) was higher than that of the previous year, and higher or at the maximum level recorded in any of the previous eight years. In 2002–03, the catch rate dropped back again.

In the MEC stock, catch rates have been higher in ORH 2A South than in the other two QMAs for all years until the last four years (Figure 8). Catch rates in ORH 3A increased steadily from 1996–97 such that since 2000–01 catch rates in this area were greater than in the other two areas. The catch rates in ORH 2A South have shown the greatest decline, and catch rates in ORH 2B have shown the least decline.

The catch rates for the EC stock have been described using the three basic sub-areas defined by Anderson (2000). The overall EC catch rates have shown a decline since the start of the fishery, and little change in the last two fishing years (Figure 9). Catch rates were initially highest in MAIN, followed by NORTH, and then by OTHER, but since the late 1990s other all areas have shown broadly similar catch rates. Following a decline in catch rates in all areas between 1995–96 and 1997–98, catch rates increased in OTHER to 2000–01, but with a sharp decline in 2001–02. Catch rates in MAIN have fluctuated, but increased in the last 2 fishing years. Catch rates in area NORTH hincreased to a peak in 2001–02, but have subsequently shown a large drop in 2002–03.

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

Quota Management Area ORH 3B extends from the north of the Chatham Rise on the east coast of the South Island, south and west to encompass most of the southern region of the EEZ. The area has been subdivided at 46° S for some years now, which separates the Chatham Rise from areas to the south. Although further subdivisions have taken place, the QMA is generally treated as two large areas. In this section, we first present combined total ORH 3B information, then analyse the Chatham Rise and Southern data as discrete fisheries, and then provide detailed descriptions of the fisheries on the north-west and southern Chatham Rise.

### 6.1 Overall total catch

Total catch in ORH 3B during 2002–03 was 12 333 t (Table 15), which represented 97% of the quota. This represents an increase in catch compared to the previous six years.

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 2002–03, the overall TACC remained the same, with 10 400 t allocated to the Chatham Rise (Table 16). In 2001–02 the area quotas were exceeded for the northwest Rise and Puysegur, and in 2002–03 quotas were exceeded for the Spawning Box and East Rise, and South Rise and Waitaki. However, in all cases (except Puysegur), the quotas were exceeded by less than 10%. The quota for the Sub-Antarctic and Arrow plateau continued to be under-caught.

**Table 15: Annual reported catches and TACs of orange roughy from ORH 3B. Catches from 1978–79 to 1985–86 are from Robertson & Mace (1988) and from 1986–87 to 2001–02 from the Fisheries Statistics Unit and Quota Monitoring System data.**

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

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

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

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

**Table 16: Changes in catch (rounded to the nearest 50 t) and quota for MFish–ORMC subareas on the Chatham Rise.**

| | | Catch | |
|---|---|---|---|
| Area | Quota | 2001–02 | 2002–03 |
| Northwest Rise | 2 000 | 2 100 | 2 200 |
| Spawning Box, East Rise | 7 000 | 6 500 | 7 100 |
| South Rise, Waitaki | 1 400 | 1 100 | 1 500 |
| Puysegur | 0 | 50 | 0 |
| Subantarctic | 1 300 | 1 200 | 1 100 |
| Arrow Plateau | 1 000 | 100 | 200 |

## 7. CHATHAM RISE FISHERIES

New Zealand commercial fisheries started on the Chatham Rise in the late 1970s, and the area continues to support the largest orange roughy fisheries in New Zealand waters. Initial catches were

largely taken from the northern slopes of the Chatham Rise, in particular the area where large spawning plumes of orange roughy occurred between June and August. The importance of other fisheries on both spawning and non-spawning aggregations of orange roughy increased as this fishery declined in the 1990s. The northwest stock and southern stocks were last assessed in 2004 (McKenzie in press, Anderson 2005), and the northeast stock, including the Spawning Box, was last assessed in 2001 (Francis 2001a).

### 7.1 Total catch

The most important fishery in ORH 3B was initially the Spawning Box (the north Rise between 177° 30' W and 175° W), but the percentage of the total catch taken in this area has decreased from over 50% before 1990–91 to 10–30% after the fishery closure in 1992–93 and 1993–94, although catches were relatively large in 2001–02 and 2002–03 (Table 17). In general, the largest fishery since the early 1990s has been the East Rise, followed by the Northwest Rise. In the last two years, the largest fisheries have been the East Rise and the Spawning Box, together contributing about 60% of the catch in 2002–03. Catches from the South Rise continue to be about 10–20% of the total, with the remainder contributed by non-Chatham fisheries.

The Arrow Plateau fishery is geographically part of the Chatham Rise, although it is not generally included when referring to the Chatham Rise fisheries. The fishing grounds and hill features are relatively deep, and catches have generally been small. The catch has decreased in recent years, and in 2001–02 was about 70 t from 45 tows, and in 2002–03 about 215 t from 77 tows.

**Table 17: ORH 3B catches by area (Figure 10) to the nearest 100 t, and by percentage (to the nearest percent) of the total ORH 3B catch. All years are from 1 October–30 September (2002–03 data are provisional, and catch totals may be incomplete).**

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

## 7.2 Distribution of catch and effort

The main areas of the Chatham Rise can be divided and examined as individual features or groups of spatially related features. Of these, the 180 Hills, Smiths City and neighbours (north east Hills), Andes, Big Chief, and the Spawning Box have contributed the largest proportion of the total catch of the Chatham Rise (Table 18). Of the four main seamount complexes outside the Spawning Box, catches from Andes have generally been highest, although they have tended to decline over time. This pattern was repeated in 2001–02 and 2002–03 (Figure 10).

The main fishing areas of the Chatham Rise, with trawl positions and catch rates, are shown in Figure 10. The distribution of catches and effort was similar in 2001–02 and 2002–03, although some minor differences occurred, such as a reduction in the eastwards extension of fishing from the Spawning Box towards the East Rise, and a reduction in the number of features fished in the central South Rise. Effort targeted at orange roughy was highest in Andes, followed by the Spawning Box and Big Chief. In these three areas, effort increased between 2001–02 and 2002–03 (Table 18). Conversely, effort decreased in 180 Hills and Smiths City and neighbours between 2001–02 and 2002–03 (Table 18).

## 7.3 Catch rates

The pattern of unstandardised catch rates at the different fishing locations was similar to that in previous years, with the highest catch rates in the Spawning Box (Table 18). Catch rates in 2002–03 increased from the previous year in the 180 Hills (the "Graveyard" hills), Andes, Big Chief, and the Spawning Box, and only decreased in Smiths City and neighbours.

Catch rates in all areas have been variable over time. However, the highest catch rates have consistently been taken when fishing on the orange roughy aggregations in the Spawning Box (Table 18), where the catch rates were similar in 2001–02 and 2002–03. The next highest catch rate in 2002–03 was taken in Andes, where the catch rate had increased compared to 2001–02. The catch rates in the other areas remained much the same as reported in previous years, with the lowest catch rate in 2002–03 taken in Big Chief.

## 7.4 Bycatch fraction

The bycatch fraction of oreos relative to orange roughy in 2002–03 decreased from previous years in the 180 Hills, Smiths City and neighbours, increased in Andes, and remained much the same in Big Chief and the Spawning Box (Table 18). As in previous years, the highest bycatch fraction was taken in Big Chief and the lowest in the Spawning Box.

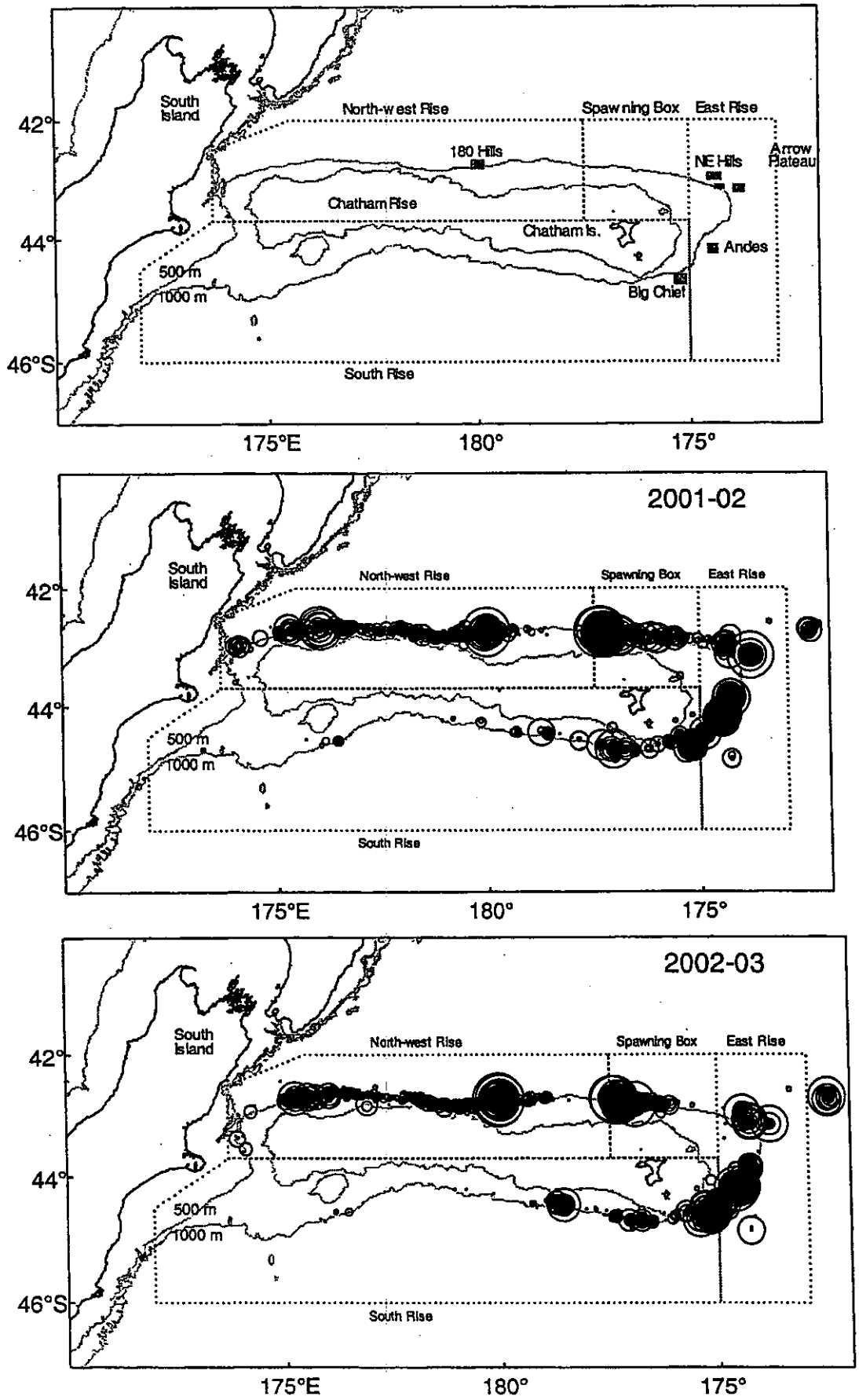


**Figure 10: Map of locations, with shaded areas indicating the hill areas described in Table 18, and distribution of unstandardised catch rates (t per tow) for orange roughy targeted or caught in the Chatham Rise area during 2001–02 and 2002–03 (circle area proportional to catch rate, maximum at 90 t).**

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

| Area & fishing year | Number of tows targeting ORH | Number of tows targeting OEO | Catch of ORH (ORH target) | Catch of OEO (ORH target) | ORH catch per tow (t) | *Bycatch fraction |
|---|---|---|---|---|---|---|
| **180 Hills** | | | | | | |
| 1992–93 | 296 | 0 | 3 266.1 | 377.5 | 11 | 0.12 |
| 1993–94 | 355 | 6 | 2 155.3 | 268.0 | 4.2 | 0.09 |
| 1994–95 | 356 | 6 | 1 499.7 | 139.9 | 4.2 | 0.09 |
| 1995–96 | 351 | 1 | 1 776.3 | 137.9 | 5.1 | 0.08 |
| 1996–97 | 242 | 3 | 872.0 | 94.1 | 3.6 | 0.11 |
| 1997–98 | 304 | 0 | 828.6 | 66.5 | 2.7 | 0.08 |
| 1998–99 | 186 | 2 | 933.4 | 88.0 | 5 | 0.09 |
| 1999–00 | 238 | 17 | 620.3 | 99.0 | 2.6 | 0.16 |
| 2000–01 | 387 | 0 | 1 227.2 | 174.7 | 3.2 | 0.14 |
| 2001–02 | 319 | 0 | 827.3 | 84.6 | 2.6 | 0.10 |
| 2002–03 | 271 | 0 | 1 094.9 | 55.2 | 4.0 | 0.05 |
| **Smiths City and neighbours (North-east Hills)** | | | | | | |
| 1990–91 | 624 | 10 | 4 863.7 | 746.7 | 7.8 | 0.15 |
| 1991–92 | 219 | 0 | 1 271.7 | 95.6 | 5.8 | 0.07 |
| 1992–93 | 79 | 0 | 592.1 | 45.8 | 7.5 | 0.07 |
| 1993–94 | 109 | 1 | 556.5 | 108.9 | 5.1 | 0.19 |
| 1994–95 | 346 | 0 | 1 178.3 | 220.0 | 3.4 | 0.19 |
| 1995–96 | 141 | 0 | 387.7 | 99.7 | 2.7 | 0.26 |
| 1996–97 | 163 | 2 | 704.3 | 175.9 | 4.3 | 0.25 |
| 1997–98 | 142 | 0 | 370.2 | 73.4 | 2.6 | 0.2 |
| 1998–99 | 269 | 0 | 770.1 | 116.4 | 2.9 | 0.15 |
| 1999–00 | 211 | 0 | 674.8 | 103.3 | 3.2 | 0.15 |
| 2000–01 | 192 | 0 | 648.7 | 140.9 | 3.4 | 0.22 |
| 2001–02 | 164 | 0 | 489.6 | 56.7 | 3.0 | 0.11 |
| 2002–03 | 124 | 0 | 403.8 | 30.9 | 3.2 | 0.07 |
| **Andes** | | | | | | |
| 1991–92 | 719 | 15 | 7 032.7 | 2411.7 | 9.8 | 0.34 |
| 1992–93 | 333 | 13 | 2 881.2 | 723.2 | 8.6 | 0.25 |
| 1993–94 | 590 | 9 | 3 295.4 | 1001.4 | 5.6 | 0.3 |
| 1994–95 | 565 | 0 | 1 648.4 | 525.1 | 2.9 | 0.32 |
| 1995–96 | 415 | 2 | 1 104.3 | 359.3 | 2.6 | 0.33 |
| 1996–97 | 253 | 4 | 725.6 | 501.5 | 2.9 | 0.69 |
| 1997–98 | 471 | 0 | 1 107.2 | 451.0 | 2.4 | 0.41 |
| 1998–99 | 445 | 10 | 1 253.4 | 432.3 | 2.8 | 0.34 |
| 1999–00 | 526 | 2 | 1 960.9 | 652.7 | 3.7 | 0.33 |
| 2000–01 | 357 | 0 | 979.5 | 296.5 | 2.7 | 0.36 |
| 2001–02 | 546 | 0 | 2 023.9 | 561.7 | 3.7 | 0.28 |
| 2002–03 | 872 | 0 | 2 226.3 | 872.1 | 2.6 | 0.39 |

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

**Table 18 —*Continued***

| Area & fishing year | Number of tows targeting ORH | Number of tows targeting OEO | Catch of ORH (ORH target) | Catch of OEO (ORH target) | ORH catch per tow (t) | *Bycatch fraction |
|---|---|---|---|---|---|---|
| **Big Chief** | | | | | | |
| 1988–89 | 196 | 0 | 1 009.1 | 119.1 | 5.1 | 0.11 |
| 1989–90 | 525 | 15 | 2 813.4 | 464.3 | 5.3 | 0.16 |
| 1990–91 | 452 | 17 | 3 131.2 | 630.3 | 6.9 | 0.2 |
| 1991–92 | 136 | 2 | 818.1 | 351.4 | 6 | 0.42 |
| 1992–93 | 694 | 0 | 3 282.4 | 2 058.3 | 4.7 | 0.62 |
| 1993–94 | 694 | 6 | 2 324.5 | 1 633.0 | 3.3 | 0.7 |
| 1994–95 | 241 | 0 | 507.9 | 400.6 | 2.1 | 0.79 |
| 1995–96 | 147 | 2 | 575.0 | 200.0 | 3.9 | 0.35 |
| 1996–97 | 191 | 1 | 555.8 | 389.9 | 2.9 | 0.7 |
| 1997–98 | 282 | 3 | 937.5 | 652.2 | 3.3 | 0.67 |
| 1998–99 | 214 | 3 | 562.0 | 459.9 | 2.6 | 0.82 |
| 1999–00 | 123 | 1 | 379.2 | 531.4 | 3.1 | 1.42 |
| 2000–01 | 214 | 1 | 1 016.8 | 753.5 | 4.7 | 0.74 |
| 2001–02 | 236 | 3 | 659.3 | 559.3 | 2.8 | 0.85 |
| 2002–03 | 277 | 4 | 688.2 | 631.8 | 2.5 | 0.89 |
| **Spawning Box** | | | | | | |
| 1986–87 | 1 646 | 4 | 20 173 | 88 | 12.2 | 0 |
| 1987–88 | 1 329 | 2 | 13 702 | 14 | 10.3 | 0 |
| 1988–89 | 1424 | 0 | 13 806 | 18 | 9.7 | 0 |
| 1989–90 | 1 010 | 0 | 11 872 | 54 | 11.7 | 0 |
| 1990–91 | 453 | 0 | 5714 | 132 | 12.6 | 0.02 |
| 1991–92 | 140 | 0 | 947 | 8 | 6.7 | 0.01 |
| 1992–93 | 4 | 0 | 59 | 2 | – | – |
| 1993–94 | 10 | 0 | 38 | 49 | – | – |
| 1994–95 | 121 | 0 | 512 | 5 | 4.2 | 0.01 |
| 1995–96 | 156 | 1 | 1 511 | 33 | 9.7 | 0.02 |
| 1996–97 | 234 | 1 | 1 604 | 20 | 6.9 | 0.01 |
| 1997–98 | 267 | 0 | 2 188 | 36 | 8.2 | 0.02 |
| 1998–99 | 219 | 1 | 1 051 | 56 | 4.8 | 0.05 |
| 1999–00 | 146 | 2 | 1 432 | 35 | 9.8 | 0.02 |
| 2000–01 | 175 | 0 | 1 203 | 89 | 6.9 | 0.07 |
| 2001–02 | 367 | 0 | 3 014 | 43 | 8.2 | 0.01 |
| 2002–03 | 377 | 0 | 3 144 | 16 | 8.3 | 0.01 |

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

## 7.5 Northwest Rise

The northwest Chatham Rise has been assessed as a separate stock since 1997 (Figure 11). Before 1997 it was assessed as part of a single Chatham Rise stock. The most recent stock assessment was carried out in 2004, using data to the end of the 2002–03 fishing year (McKenzie, in press).

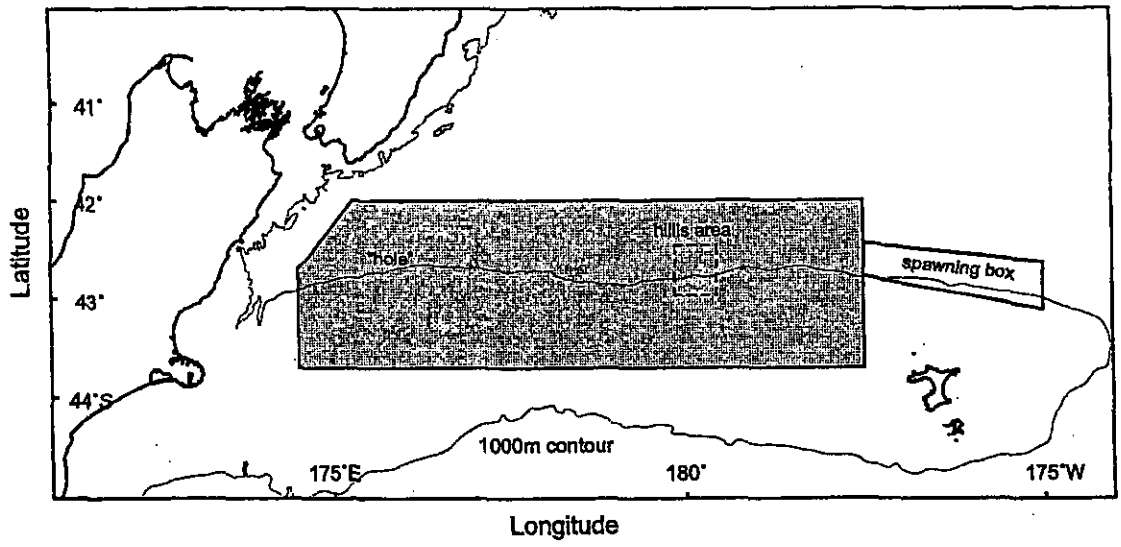


**Figure 11: The northwest Chatham Rise sub-area (grey shading). The 180 Hills ("Graveyard") complex is indicated as the "hills area".**

### 7.5.1 Total catch

Since the 1992–93 fishing year, the total catch in this sub-area has been limited by a series of catch limit agreements between industry and the Minister of Fisheries. In the 1992–93 year, the catch-limit was 3500 t, dropping to 2500 t in the 1994–95 year, then to 2250 t the following year, where it remained until 2001–2002 when it dropped to 2000 t (Annala et al. 2004).

Reported catch of orange roughy in the northwest Chatham Rise started in the 1979–80 fishing year, increased to 8400 t in 1980–81, then dropped and fluctuated for the following years. Since the introduction of catch limits in 1992–93, reported catches have been within 10% of the catch limits in all years except for 1998–99 and 2000–01 (Table 19).

**Table 19: Estimated catches (tonnes, to the nearest 100) for the northwest Chatham Rise ("1980" means the fishing year 1979–80). The catches for the years 2001–2003 are provisional values (Annala et al. 2004).**

| Year | Catch | Year | Catch | Year | Catch |
|---|---|---|---|---|---|
| 1980 | 1 200 | 1988 | 1 600 | 1996 | 2 400 |
| 1981 | 8 400 | 1989 | 3 800 | 1997 | 2 200 |
| 1982 | 7 000 | 1990 | 3 300 | 1998 | 2 300 |
| 1983 | 5 400 | 1991 | 1 500 | 1999 | 2 700 |
| 1984 | 3 300 | 1992 | 300 | 2000 | 2 100 |
| 1985 | 1 800 | 1993 | 3 800 | 2001 | 2 600 |
| 1986 | 3 700 | 1994 | 3 500 | 2002 | 2 200 |
| 1987 | 3 200 | 1995 | 2 400 | 2003 | 2 100 |

### 7.5.2 Distribution of catch and effort

From 1979 until 1991, a significant proportion of the fishery took place at an area known as the "Hole", located at about 176° longitude (Figures 11 & 12). Orange roughy are believed to form

feeding aggregations in this area, and it is possible that some localised spawning may also take place in the area (M. Clark, NIWA, pers. comm.).

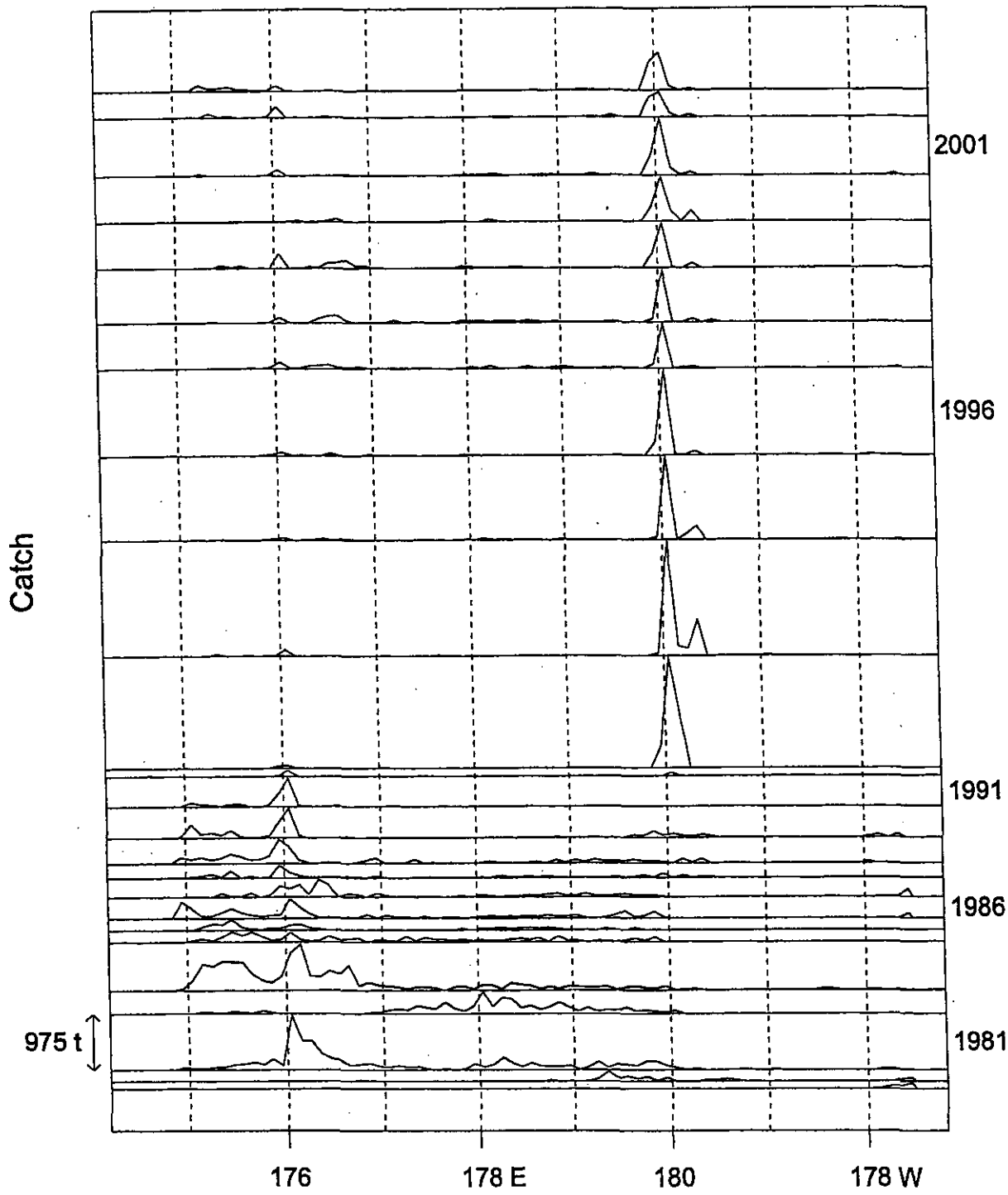


**Figure 12: Catch plotted against longitude for each fishing year ("1981" means the fishing year 1980–81). Catches are summed for each 0.1° of longitude, with the same vertical scale used for each year.**

In 1992–93, the seamount area known as the 180 Hills ("Graveyard") was discovered, and since then most of the catch by weight has come from this area (Figure 12). Associated with this change has been a shift from long duration tows on relatively flat deep sea bottom, to short duration and precisely targeted "scoops" near the tops of seamounts (Figure 13).

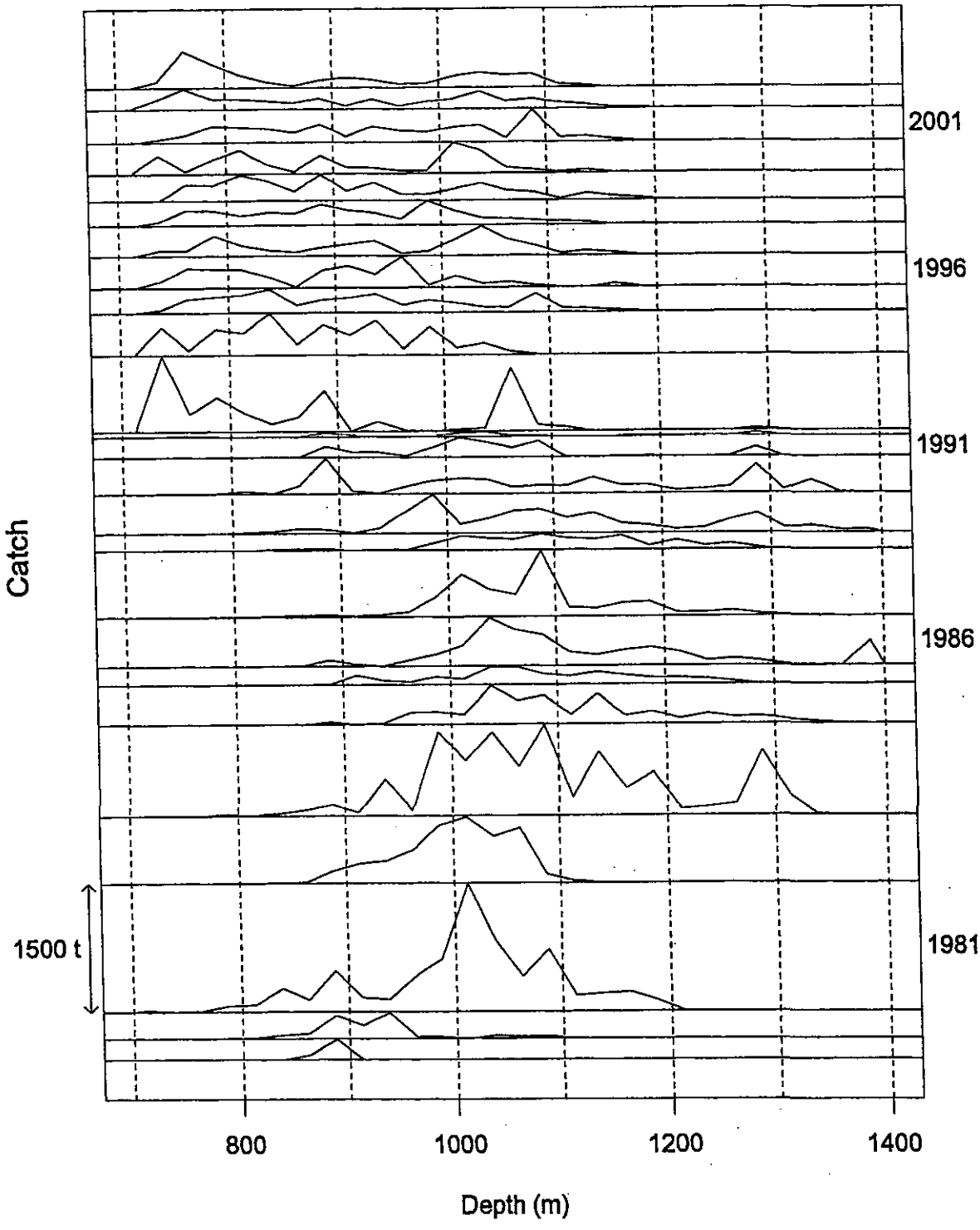


**Figure 13: Catch plotted against depth for each fishing year ("1981" means the fishing year 1980–81). Catches are summed for each 25m of depth, with the same vertical scale used for each year.**

The spread of catch throughout the year has remained much the same since the mid-1990s (Figure 14). Since the mid-1990s, the catches have been spread throughout most of the year, but with a decrease from June through to September. The even catch spread is a reflection of the market-driven need for a constant supply of orange roughy throughout the year (I. Doonan, NIWA, pers. comm.), but with catch occurring elsewhere (for instance the adjacent Spawning Box) during the spawning season.

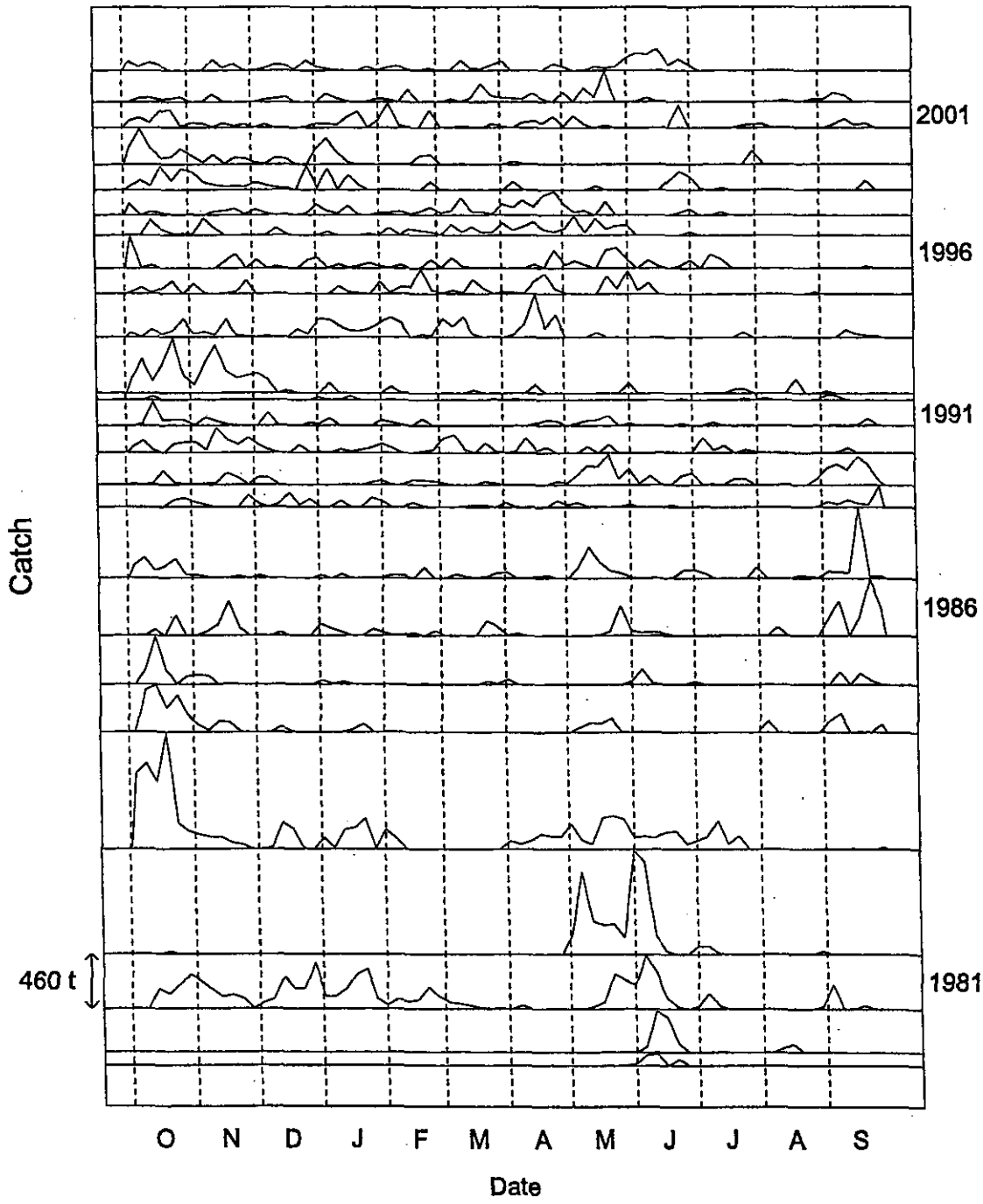


**Figure 14: Catch plotted against date for each fishing year ("1981" refers to the fishing year 1980–81). Catches are summed for each five days, with the same vertical scale used for each year.**

### 7.5.3 Catch rates

There are no exact criteria for the distinction between flat tows and hill tows, but for the purposes of comparability, the present analysis follows the definition used by Taylor (2003) and McKenzie (2003). This defines hill tows as being those in the rectangular area defined by longitudes 179.87° E to 179.55° W and latitudes 42.46° S to 42.97° S, with a tow duration of less than 30 minutes. Any tow that is not a hill tow is deemed to be a flat tow. Since the fishing techniques used are quite different on the flats and on the hills, the appropriate units to use for catch rate is tonnes/hour for tows on the flats, and tonnes/tow for tows on hills.

From the plots of the unstandardised catch rates for hill and flat tows (Figure 15a), it is clear that the catch rates have declined for both types, and most steeply for hill tows. The rapid increase in the number of hill tows with the discovery of the 180 Hills fishery is shown in Figure 15b.

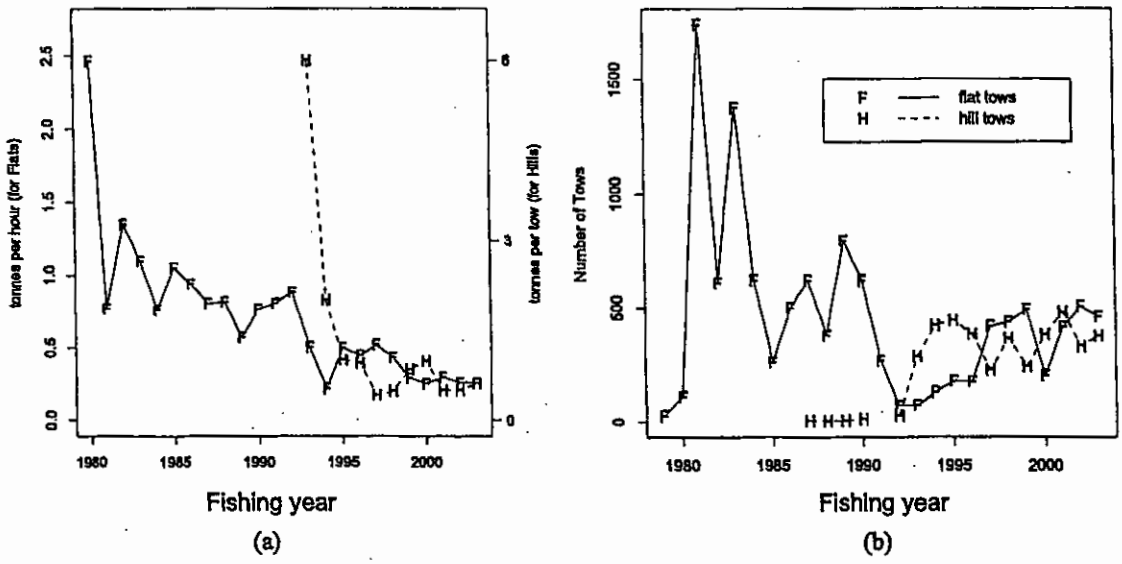


**Figure 15: Plots of (a) unstandardised catch rates (medians), and (b) number of tows by fishing year ("1980" refers to the fishing year 1979–80). Hill tows are those of less than 30 minutes duration, and located in the hills area. Flat tows are all other tows. Catch rates are not shown if there are less than 50 tows for a year; the number of tows is not shown if there are no tows for a year.**

**Table 20: South Rise orange roughy catches, to the nearest 100 t, and by percentage (to the nearest percent) of the total ORH 3B catch.**

| Fishing year | Catch (t) | % | Catch limit (t) |
|---|---|---|---|
| 1978–79 | 0 | 0 | – |
| 1979–80 | 800 | 3 | – |
| 1980–81 | 3 700 | 13 | – |
| 1981–82 | 500 | 2 | – |
| 1982–83 | 4 800 | 31 | – |
| 1983–84 | 5 100 | 21 | – |
| 1984–85 | 7 900 | 27 | – |
| 1985–86 | 5 300 | 18 | – |
| 1986–87 | 4 900 | 16 | – |
| 1987–88 | 6 800 | 28 | – |
| 1988–89 | 9 200 | 28 | – |
| 1989–90 | 11 000 | 35 | – |
| 1990–91 | 6 900 | 32 | – |
| 1991–92 | 2 200 | 9 | – |
| 1992–93 | 5 400 | 27 | 6 300 |
| 1993–94 | 5 100 | 30 | 6 300 |
| 1994–95 | 1 600 | 13 | 2 000 |
| 1995–96 | 1 300 | 10 | – |
| 1996–97 | 1 400 | 15 | – |
| 1997–98 | 1 700 | 17 | – |
| 1998–99 | 1 200 | 13 | – |
| 1999–00 | 1 100 | 13 | – |
| 2000–01 | 1 700 | 18 | – |
| 2001–02 | 1 100 | 10 | 1 400 |
| 2002–03 | 1 500 | 12 | 1 400 |

## 7.6 South Rise

The area boundaries for the South Chatham Rise analysis are the same as those given by Annala et al. (2004), and as defined by Francis (2001b), but differ slightly from the boundaries originally set by the Minister of Fisheries in 1992. The most recent stock assessment was conducted in 2004 (Anderson 2005).

### 7.6.1 Total catch

The South Rise fishery developed in the early 1980s, with annual catches rapidly increasing to between 6000 and 8000 t and remaining at this level until the early 1990s (Table 20, Figure 16). Annual catches fell, in line with declining TACCs, and since 1995 have stabilised at about 1000–1500 t per year. Effort in long tows (over 30 minutes), associated with fishing on flat ground, rose rapidly from the early 1980s, peaking at about 1800 tows in 1989, then dropped sharply in the early 1990s, as the practice of short tows, associated with fishing on hills, became more predominant (Francis 2001b). Since 1995 there has been a decline in both hill and flat fishing effort. There has been a significant but variable level of non-target fishing, higher in the 1980s than in the 1990s, and at a level of about 100–200 tows per year over the last 10 years (Figure 16).

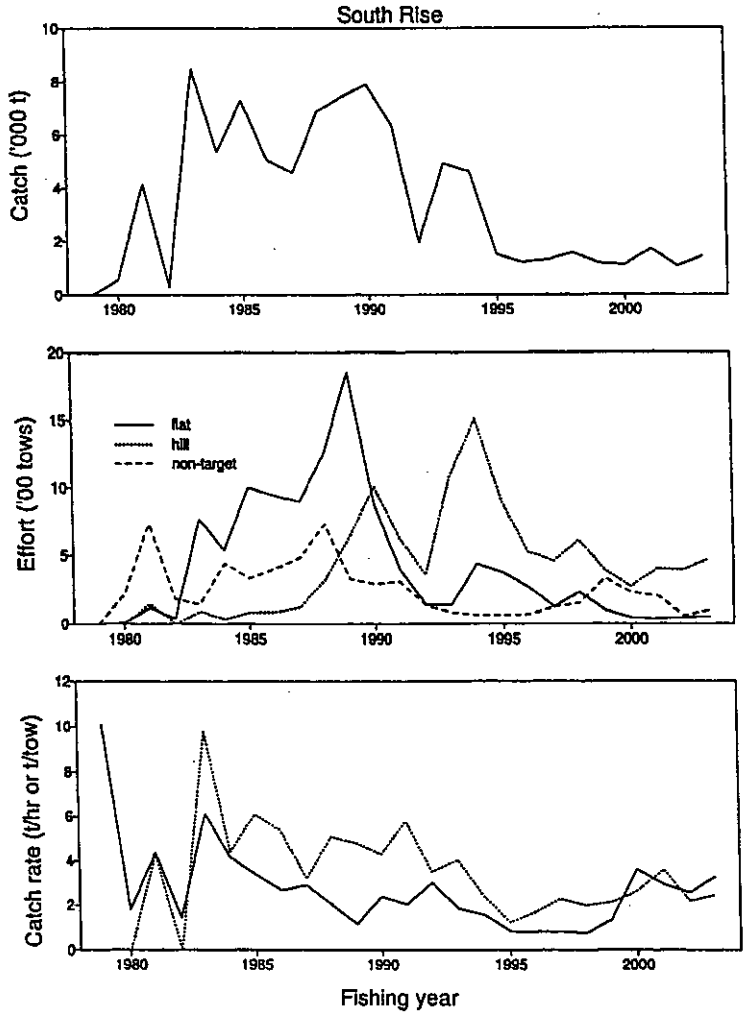


**Figure 16: Catch, effort (number of tows), and unstandardised catch rate (targeted tows only) by fishing year ("1980" refers to the fishing year 1979–80) for the South Rise. "Hill" tows are tows of less than 30 minutes duration and catch rates are calculated as t/tow; "flat" tows are longer tows and catch rates are calculated as t/h.**

### 7.6.2 Distribution of catch and effort

Most of catch and effort have been concentrated at the eastern end of the QMA, and in particular in the Big Chief area (Figure 17).

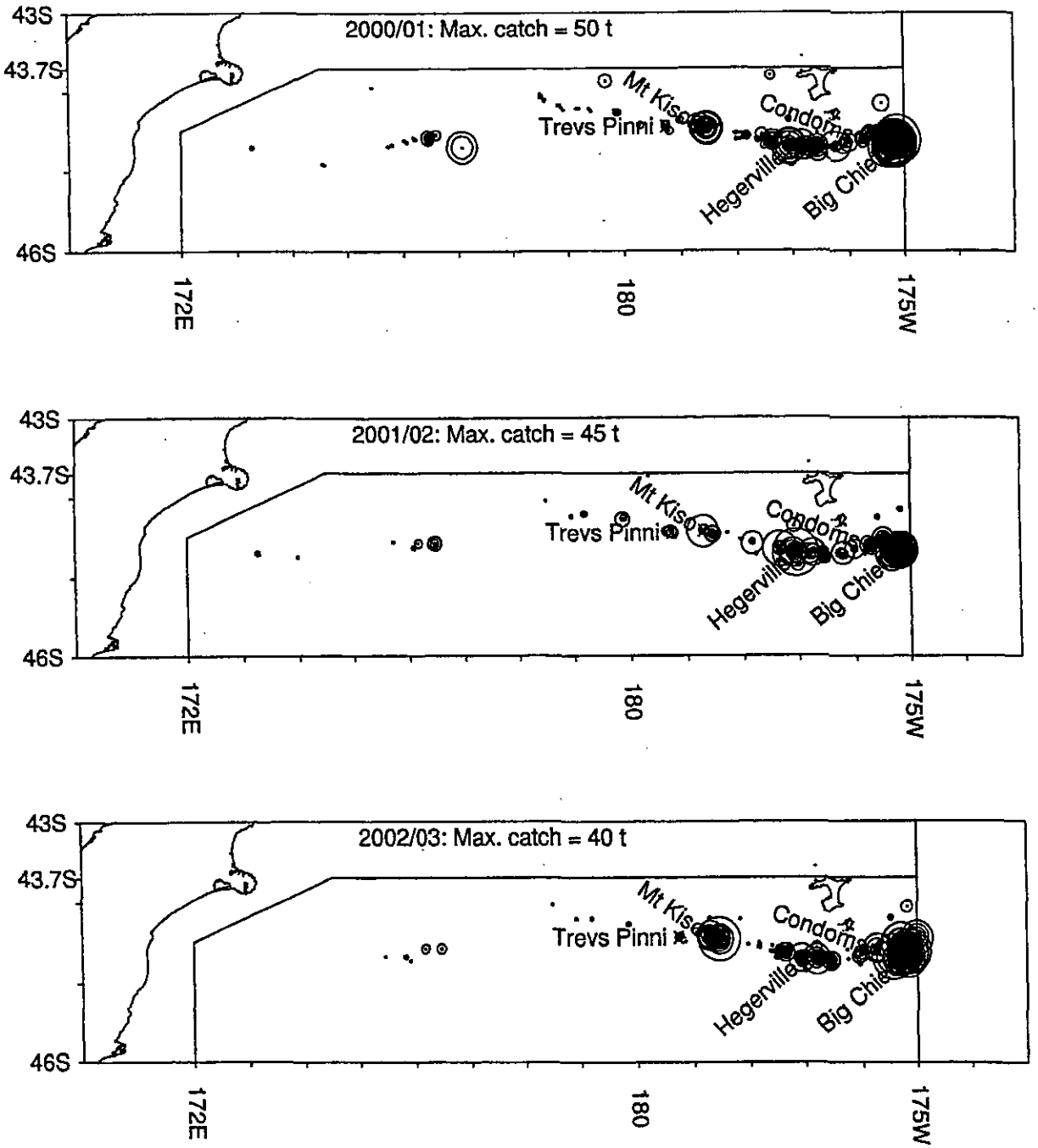


**Figure 17: Unstandardised catch (t) per tow of orange roughy on the South Rise for the 2000–01, 2001–02, and 2002–03 fishing years. Circle area is proportional to catch. The main hill features and a line representing the boundaries of the South Rise are also shown.**

There was a significant change in the fishery in the early 1990s, due mostly to the more accurate navigation possible with GPS, from longer tows over flat terrain to shorter tows on hills, particularly for tows targeting orange roughy (Figure 18).

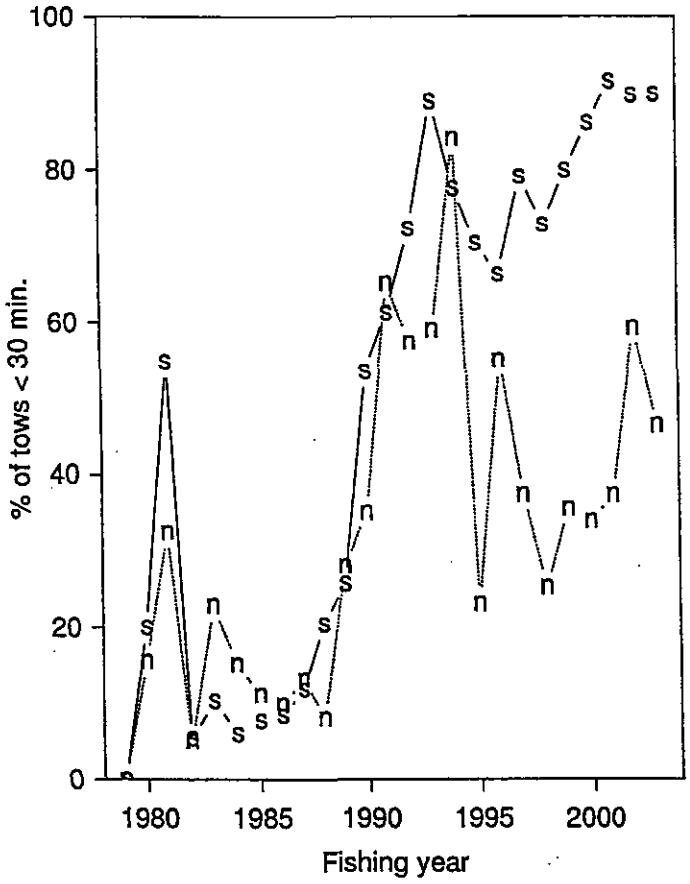


**Figure 18: Percentage of target and non-target tows by fishing year ("1980" refers to the fishing year 1979–80). Solid line and symbol "s" refers to the south Rise (target), broken line and symbol "n" the south Rise (non-target).**

The effort and catch concentrations around the major hills in the fishery are shown in Figure 19. There was a transition from the western hills, particularly Trev's Pinni and Mt Kiso, to the eastern hills such as Condoms and Big Chief around 1990. Since 1992, 60% of the South Rise orange roughy catch has come from fishing at the eastern extreme of the area, near Big Chief.

Effort has been spread over most months in most years, with more of the effort early in the fishing year and consistently low effort during the June-July spawning season of orange roughy, when fishing moves to spawning areas. An increase in effort in the months after the spawning season, August and September, is evident in most years up until 1995, but has not been seen since then (Figure 20).

### 7.6.3 Catch rates

Unstandardised catch rates of targeted flat tows peaked at about 6 t/h in 1983, declined slowly over the following 16 years to less than 1 t/h, then increased to a level of about 2 t/h in 2003 (Figure 21). Catch rates of targeted hill tows have followed a similar pattern to those of flat tows, with a decrease since the fishery developed to a low of just under 2 t/tow in 1995, followed by an increase to about 3 t/tow over the last four years. The apparent long slow decline of catch rates in the South Rise fishery shown in Figure 16 and the top left panel of Figure 21 is somewhat misleading, as the fishery is more accurately described as a sequential development of a series of hill-based fisheries, which individually experienced much sharper declines in catch rates (Figure 21).

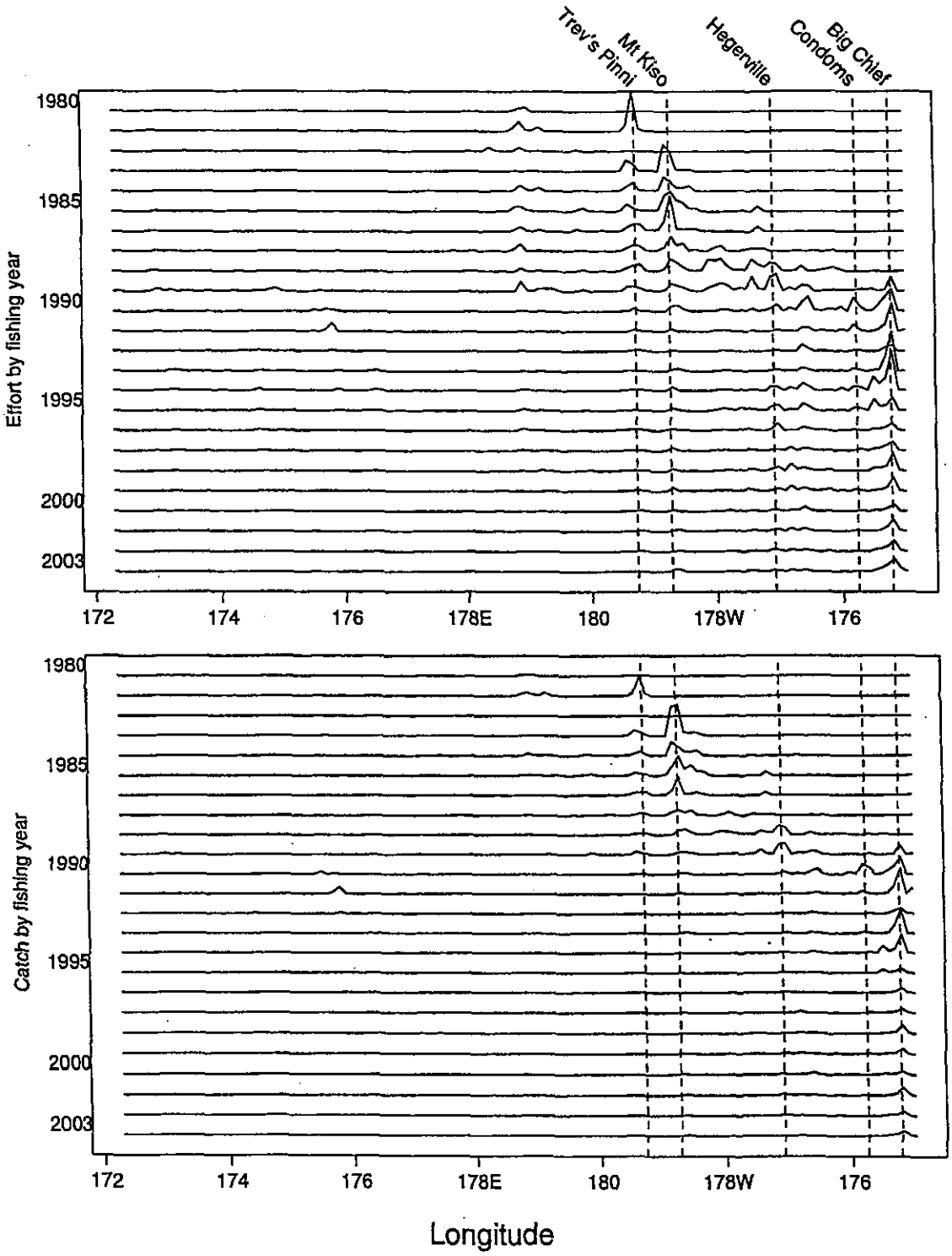


**Figure 19: Effort (upper panel) and catch (lower panel) by steps of 0.1 degree longitude by fishing year ("1981" refers to the fishing year 1980–81). The vertical interval between the lines for successive years corresponds to 250 tows (upper panel) and 2000 t (lower panel). The vertical dashed lines identify the longitudes of the five major hills in the area.**

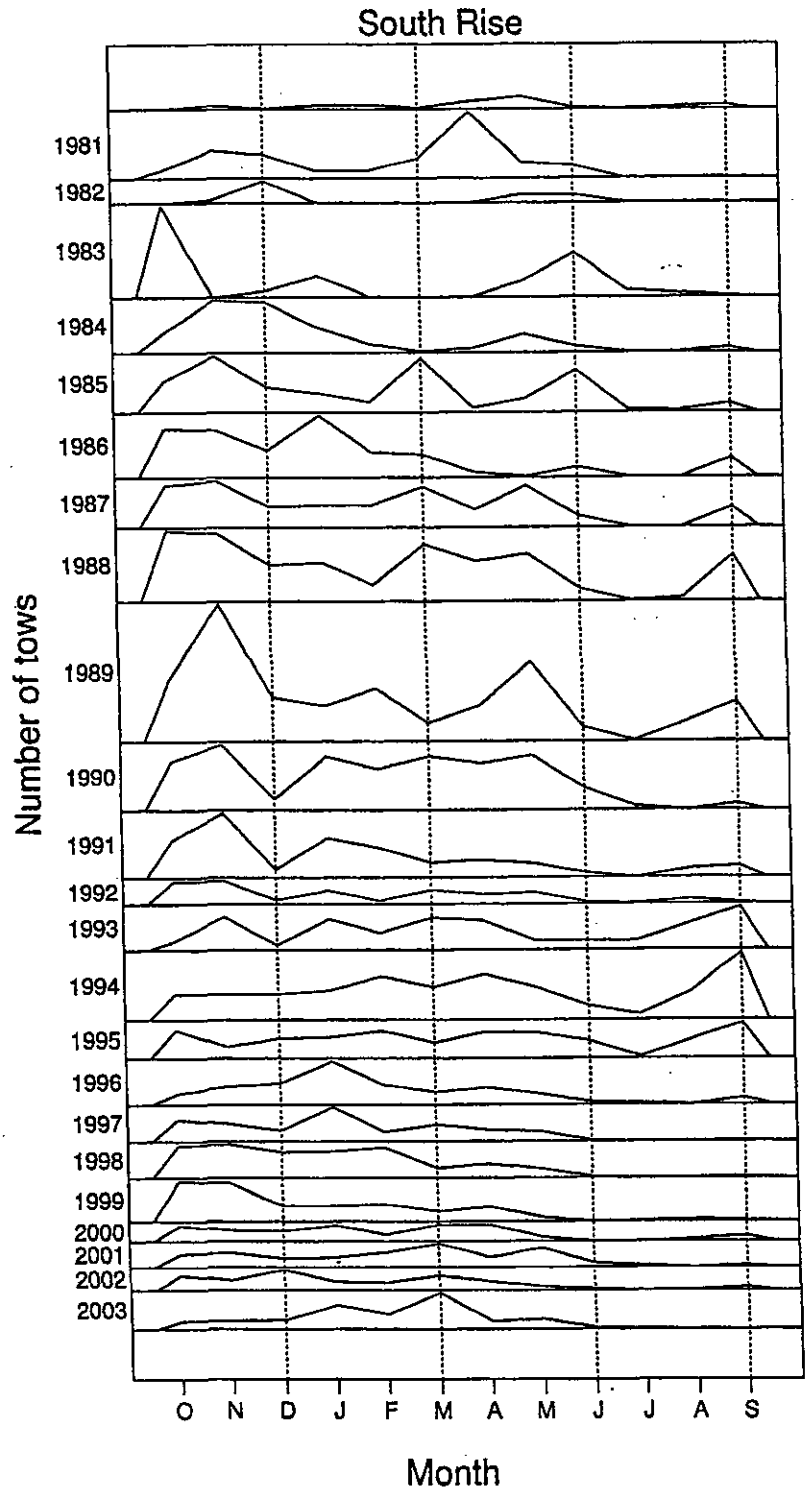


**Figure 20: Effort (number of tows) by month and fishing year ("1981" refers to the fishing year 1980–81) for the South Rise orange roughy fishery. The y–axis scale is the same for each year: the highest monthly number of tows was 716 in 1989.**

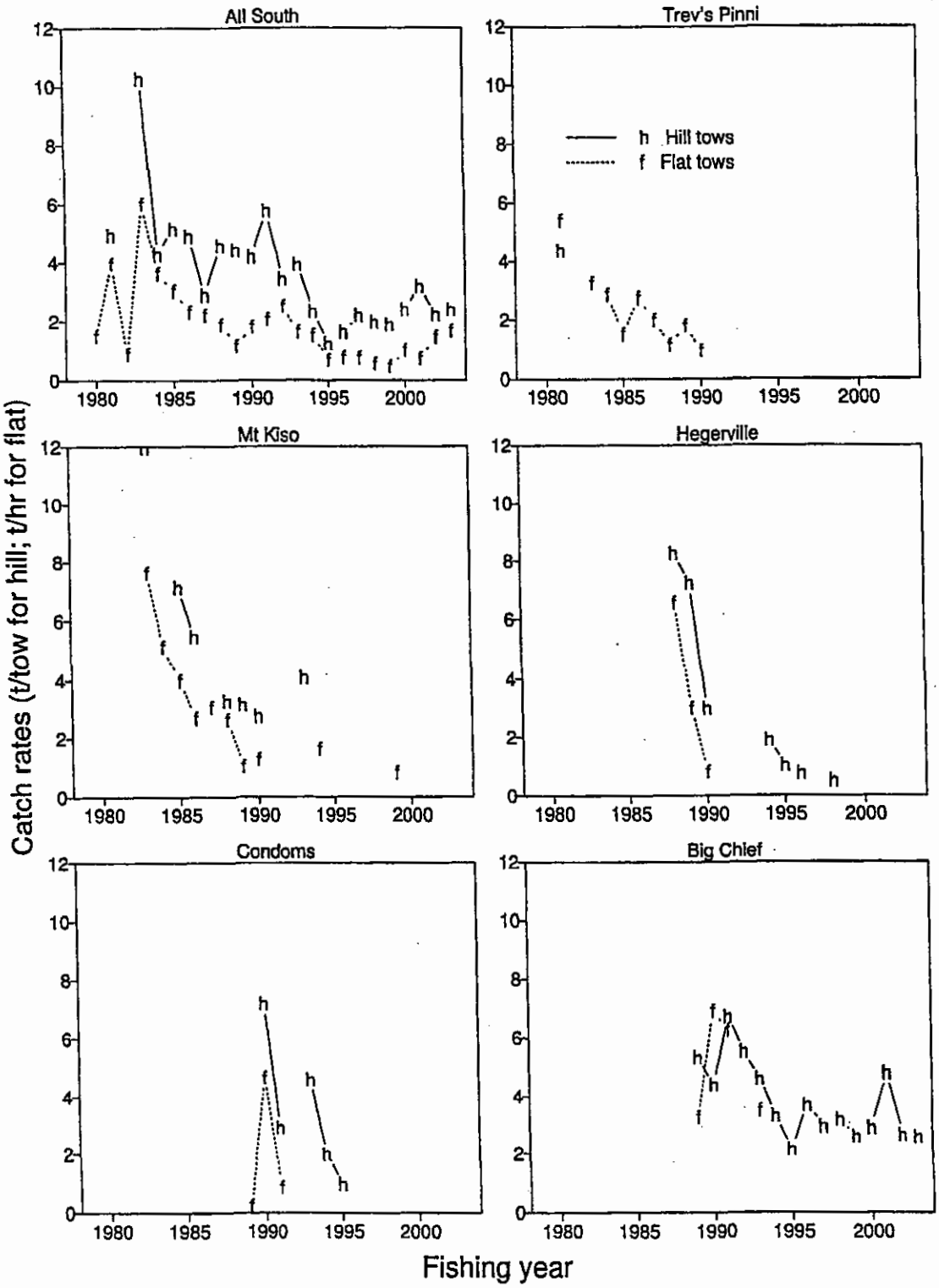


**Figure 21: Unstandardised catch rates for hill and flat tows by area and fishing year ("1981" refers to the fishing year 1980–81). Areas plotted are the entire South Rise and tows on or close to the five major hills shown in Figures 17 & 19. Tows are designated "hill" or "flat" according to whether or not their duration was less than 30 minutes. Where there were fewer than 50 tows or 50 hours fishing for a year, catch rates were not plotted.**

### 7.6.4 Bycatch

Oreos are an important bycatch in this fishery, particularly in the west. Figure 22 shows that between 172° E and 178° E, oreos constituted about 80% of the total catch, in the central area about 60–70%, and in the eastern area about 40–60%. In each area, the bycatch of oreos tended to increase over time up until about 1995, but has remained steady since.

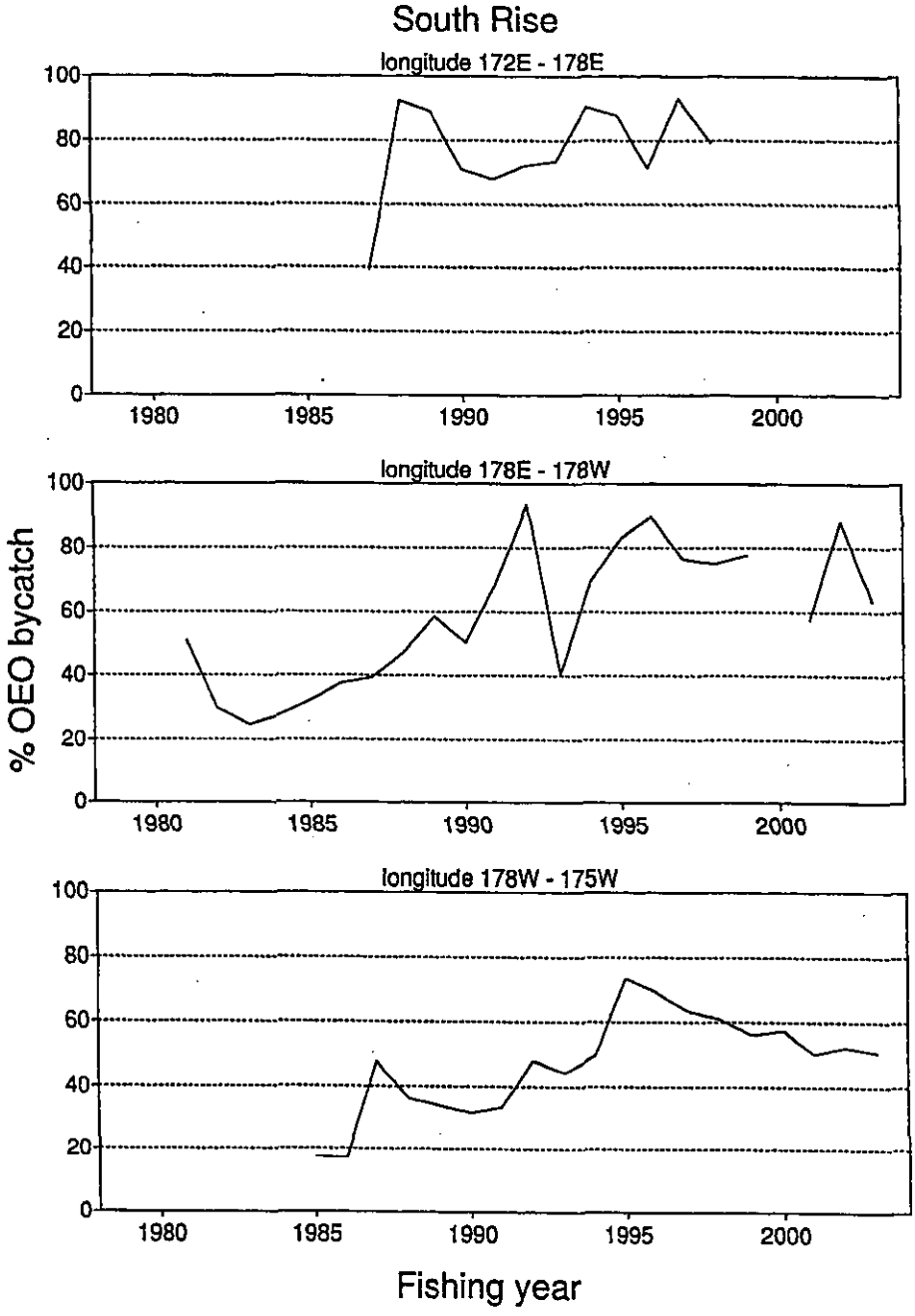


**Figure 22: Percentage bycatch of oreos (recorded as OEO, SSO, or BOE) in orange roughy target tows by fishing year ("1981" refers to the fishing year 1980–81) for each of three subareas on the South Rise. Percentage bycatch is calculated as 100 times the oreo catch divided by the total (orange roughy plus oreo) catch.**

## 8. SOUTHERN ORH 3B FISHERIES – SOUTH OF 46° S

Eight major fishing grounds have been identified in the southern area (Figure 23).

- **Antipodes.** An area of small seamounts (e.g., Barbaras, Bob's Knob) within the boundary of 49° 00'–50° 30' S and 174° 00'–177° 00' E. Although the fishery has been termed "Antipodes" by the fishing industry, the position of the fishery is on the eastern margin of the Pukaki Rise.
- **Auckland Islands.** A complex of small seamounts (e.g., Barbara Thomas, DSW, Jenny Shipley) northwest of the Auckland Islands within the boundary of 49° 50'–50° 20' S and 165° 40'–166° 10' E.
- **Bounty Platform.** An area of undulating bottom with numerous peaks and drop-offs on the slopes north of the Bounty Islands within the boundary of 46° 30'–48° 00' S and 177° 30' E–180° 00'. It is mainly a target oreo fishery, with the occasional large catch of orange roughy.
- **Macquarie Ridge.** A long ridge southwest of Puysegur Bank lying south of 48° 30' S and west of 165° 00' E. Macquarie Ridge is mainly an oreo fishery.
- **Puysegur Box.** An area of small hills (e.g., Goomzy, Godiva, Malcolm's Monument, Acne) and drop-offs (e.g., Alistair's) within the boundary of 46° 00'–47° 30' S and 165° 00'–166° 30' E.
- **Snares.** A large elongated seamount (Bob's Gun) off the Snares Islands with two smaller features to the west, lying within the boundaries of 47° 45'–48° 15' S and 164° 50'–166° 20' E. Snares is mainly an oreo fishery.
- **Pukaki.** An area of small hill features on the northern edge of the Pukaki Rise, within the boundary of 47.5–49.0° S, 174–176° E. Note that fishing activity is not plotted for this area, as most of the catch was taken by fewer than three vessels.
- **Fiordland.** An area of the west coast of the South Island, lying between the boundaries 44° 20'–46° S and 166°–168° E

Voluntary closure of the Puysegur fishery by the Orange Roughy Management Company resulted in zero catch of orange roughy during 1997–98 and 1998–99. In 1999–2000 and 2000–01, 7 t and 34 t respectively were taken as bycatch of oreo target fishing. No catches of orange roughy catch were then reported for 2001–02, and 12 t was reported from a single tow in 2002–03 (Table 21). In 2000–01, some catches were taken off Fiordland and Pukaki, which represented notable increases in catch outside the Chatham Rise and Southern fisheries (Table 21). A stock assessment has been carried out only for the Puysegur area in 1998 (Annala et al. 2004).

### 8.1 Total catch

The non–Chatham fisheries developed in the early 1990s, and were initially dominated by catches from Puysegur (Table 21). Subsequently, Auckland Islands, Snares, Bounty Platform, and Antipodes had high catches, but catches in all these areas have subsequently decreased. In 2001–02, about 67% of the non–Chatham catches were taken in the new fishery on Pukaki. Pukaki remained the largest fishery in 2002–03, accounting for about 48% of the catch, with most of the remainder coming from Bounty (19%) and Macquarie (18%). In contrast to previous years, the catch taken at the Auckland Islands was relatively small, amounting to only 67 t (about 7%) of the catch. Although a relatively recent fishery, the catches at Fiordland have decreased rapidly, to only 53 t in 2002–03.

In the Antipodes fishery, an exploratory commercial fishing trip found orange roughy concentrations in an area on the eastern margin of the Pukaki Rise in April 1996, and recorded a catch of about 200 t. This was quickly followed by full commercial fishing, and 3400 t of orange roughy was taken in 1995–96 (Table 21). There was a dramatic decline in catch to 717 t in 1996–97, and further to only 1 t in 2000–01. There were no catches or effort in 2001–02, and 2 t was recorded from 13 tows in 2002–03. Small catches of about 50 t were reported from Pukaki in 2000–01 (Table 21). In 2002–03, the fishery decreased from the previous year, with reported catches of about 500 t. However, Pukaki remained the most important fishery in the southern area in 2002–03.

**Table 21: Summary statistics from the main southern fishing locations, covering the duration of the fishery, or a maximum of the last 10 years. Note: catches are unadjusted (i.e., not scaled to the QMR total). Unstandardised catch per tow and bycatch fraction are only calculated where the number of tows is greater than 10 (–, not calculated).**

| | Total fishery | | ORH target fishery | | | | |
|---|---|---|---|---|---|---|---|
| Area & fishing year | Number of tows | Catch of ORH | Number of tows | Catch of ORH | Catch of OEO | ORH catch per tow (t) | *Bycatch fraction |
| **Auckland Is** | | | | | | | |
| 1993–94 | 158 | 206 | 154 | 177 | 264 | 1.1 | 1.5 |
| 1994–95 | 273 | 1 285 | 178 | 837 | 341 | 4.7 | 0.4 |
| 1995–96 | 249 | 405 | 239 | 372 | 425 | 1.6 | 1.1 |
| 1996–97 | 116 | 135 | 109 | 118 | 191 | 1.1 | 1.6 |
| 1997–98 | 193 | 372 | 187 | 363 | 276 | 1.9 | 0.8 |
| 1998–99 | 249 | 544 | 219 | 439 | 426 | 2.0 | 1.0 |
| 1999–00 | 174 | 235 | 132 | 151 | 264 | 1.1 | 1.7 |
| 2000–01 | 81 | 82 | 68 | 64 | 79 | 0.9 | 1.2 |
| 2001–02 | 71 | 158 | 58 | 132 | 127 | 2.3 | 1.0 |
| 2002–03 | 58 | 67 | 22 | 2 | 17 | 0.1 | 9.0 |
| **Antipodes** | | | | | | | |
| 1995–96 | 316 | 3 428 | 302 | 2 975 | 1 439 | 9.9 | 0.5 |
| 1996–97 | 601 | 717 | 595 | 650 | 2 660 | 1.1 | 4.1 |
| 1997–98 | 212 | 372 | 169 | 123 | 452 | 0.7 | 3.7 |
| 1998–99 | 74 | 124 | 59 | 56 | 60 | 0.9 | 1.1 |
| 1999–00 | 40 | 2 | 28 | 0.1 | 46 | 0.01 | 460.0 |
| 2000–01 | 13 | 1 | 8 | 0 | 2 | – | – |
| 2001–02 | 0 | 0 | 0 | – | – | – | – |
| 2002–03 | 13 | 2 | 0 | – | – | – | – |
| **Bounty** | | | | | | | |
| 1993–94 | 10 | 4 | 0 | – | – | – | – |
| 1994–95 | 19 | 54 | 5 | 0 | 28 | – | – |
| 1995–96 | 73 | 225 | 34 | 0.4 | 38 | 0.01 | 95.0 |
| 1996–97 | 53 | 147 | 14 | 22 | 3 | 1.6 | 0.1 |
| 1997–98 | 132 | 281 | 111 | 235 | 357 | 2.1 | 1.5 |
| 1998–99 | 211 | 181 | 168 | 152 | 181 | 0.9 | 1.2 |
| 1999–00 | 89 | 191 | 71 | 172 | 69 | 2.4 | 0.4 |
| 2000–01 | 74 | 150 | 55 | 147 | 143 | 2.7 | 1.0 |
| 2001–02 | 51 | 38 | 31 | 37 | 163 | 1.2 | 4.4 |
| 2002–03 | 71 | 196 | 35 | 119 | 40 | 3.4 | 0.3 |
| **Macquarie** | | | | | | | |
| 1993–94 | 13 | 0 | 13 | 0 | 116 | 0 | – |
| 1994–95 | 2 | 2 | 1 | 2 | 8 | – | – |
| 1995–96 | 71 | 12 | 65 | 10 | 399 | 0.2 | 39.9 |
| 1996–97 | 75 | 11 | 69 | 5 | 170 | 0.1 | 34.0 |
| 1997–98 | 48 | 4 | 42 | 2 | 168 | 0.1 | 84.0 |
| 1998–99 | 76 | 40 | 33 | 28 | 88 | 0.8 | 3.1 |
| 1999–00 | 73 | 15 | 28 | 1 | 48 | 0.1 | 48.0 |
| 2000–01 | 231 | 510 | 142 | 358 | 120 | 2.5 | 0.3 |
| 2001–02 | 81 | 92 | 21 | 43 | 83 | 2.1 | 2 |
| 2002–03 | 100 | 187 | 25 | 39 | 14 | 1.5 | 0.3 |

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

**Table 21** —*Continued*

| Area & fishing year | Total fishery | | ORH target fishery | | | | |
|---|---|---|---|---|---|---|---|
| | Number of tows | Catch of ORH | Number of tows | Catch of ORH | Catch of OEO | ORH catch per tow (t) | *Bycatch fraction |
| **Pukaki** | | | | | | | |
| 2000–01 | 39 | 44 | 12 | 19 | 12 | 1.6 | 0.6 |
| 2001–02 | 42 | 623 | 19 | 549 | 7 | 28.9 | 0.01 |
| 2002–03 | 62 | 490 | 38 | 483 | 2 | 12.7 | 0.01 |
| **Puysegur** | | | | | | | |
| 1993–94 | 1 264 | 2 579 | 1 259 | 2 377 | 1 830 | 1.9 | 0.8 |
| 1994–95 | 183 | 1 557 | 157 | 1 252 | 308 | 7.9 | 0.2 |
| 1995–96 | 318 | 804 | 302 | 728 | 266 | 2.4 | 0.4 |
| 1996–97 | 201 | 344 | 191 | 493 | 89 | 2.6 | 0.2 |
| 1997–98 | 0 | 0 | 0 | – | – | – | – |
| 1998–99 | 0 | 0 | 0 | – | – | – | – |
| 1999–00 | 17 | 7 | 0 | – | – | – | – |
| 2000–01 | 10 | 34 | 0 | – | – | – | – |
| 2001–02 | 2 | 0 | 0 | – | – | – | – |
| 2002–03 | 1 | 12 | 0 | – | – | – | – |
| **Snares** | | | | | | | |
| 1993–94 | 349 | 41 | 333 | 34 | 1 721 | 0.1 | 50.6 |
| 1994–95 | 30 | 31 | 26 | 20 | 120 | 0.8 | 6.0 |
| 1995–96 | 78 | 9 | 77 | 8 | 667 | 0.1 | 83.4 |
| 1996–97 | 85 | 59 | 81 | 54 | 588 | 0.7 | 10.9 |
| 1997–98 | 82 | 161 | 65 | 98 | 708 | 1.5 | 7.2 |
| 1998–99 | 92 | 92 | 29 | 38 | 77 | 1.3 | 2.0 |
| 1999–00 | 42 | 15 | 14 | 4 | 22 | 0.3 | 5.5 |
| 2000–01 | 46 | 24 | 14 | 15 | 19 | 1.1 | 1.3 |
| 2001–02 | 30 | 15 | 6 | 2 | 27 | – | – |
| 2002–03 | 33 | 14 | 0 | – | – | – | – |
| **Fiordland** | | | | | | | |
| 1998–99 | 0 | 0 | 0 | – | – | – | – |
| 1999–00 | 7 | 2 | 0 | – | – | – | – |
| 2000–01 | 319 | 490 | 316 | 481 | 228 | 1.5 | 0.5 |
| 2001–02 | 117 | 223 | 117 | 223 | 39 | 1.9 | 0.2 |
| 2002–03 | 55 | 53 | 47 | 53 | 12 | 1.1 | 0.2 |

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

Catches from the Auckland Islands fishery peaked in the mid-1990s at about 1300 t (Table 21). Although catches have been variable since that period, they have generally declined, with the lowest catch of 67 t taken in 2002–03.

Small catches of orange roughy were reported from the Bounty Platform from 1990–91 to 1993–94 as a bycatch in the developing oreo fishery (Table 21). Catches increased rapidly to 225 t in 1995–96. In 2001–02 catches were low, but in 2002–03 recovered to a level similar to previous years.

The Macquarie Ridge fishery is almost solely based on oreos, and the mean annual oreo catch since 1995–96 has been 1400 t, with only small tonnages of orange roughy taken in any year (Table 21). The second highest catches of orange roughy reported were taken in 2002–03.

Orange roughy catches in the Snares fishery have generally been small and have fluctuated widely. Total catch has been under 100 t in most years (Table 21), except in 1992–93, when more than 500 t were taken, and 1997–98, when the catch was about 160 t. Catches remained low in 2002–03.

## 8.2 Distribution of catch and effort

The distribution of effort and catches are shown in Figure 23. In general, the distribution of fishing effort is similar in 2001–02 and 2002–03, with no new areas being fished.

## 8.3 Catch rates

In the Auckland Islands fishery, unstandardised catch rates (t/tow) have been variable, but peaked at about 2 t in 1997–98 and 1998–99, before declining for 2 years, and then increasing to 2.3 t in 2001–02 (Table 21). However, in 2002–03 the effort, catch, and catch rate dropped to the lowest recorded. In the Antipodes fishery, unstandardised catch rates (t/tow) in 2000–01 were only 0.1% of the catch rate in 1995–96 (Clark et al. 2002). There were no tows targeting orange roughy in either 2001–02 or 2002–03 (Table 21).

On the Bounty Platform, mean catch per tow has varied considerably between years, as both catch and effort have fluctuated. The number of tows, and more substantially the unstandardised catch rate, declined from 2000–01 to 2001–02. In 2002–03 effort increased, and catches increased substantially, to give the highest recorded catch rate (Table 21). In the Macquarie Ridge fishery, effort increased markedly in 2000–01, and resulted in the highest recorded catch of orange roughy from that fishery. In 2001–02, effort, catch and catch rate declined, returning to levels more similar to those of previous years, but in 2002–03 effort and catch increased, but catch rate dropped by about 30% (Table 21).

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

In the Auckland Islands, the seasonal patterns of effort and catches were similar in 2001–02 and 2002–03, with most effort in the first half, and at the end, of the fishing year (Figures 24 and 25). The highest catch rates were made in August. In the Antipodes fishery, there was no effort in 2001–02, and effort was restricted to November, March, and May in 2002–03 (Figures 24 and 25).

On the Bounty Platform, most effort and catches were mostly taken at the end of the fishing year in both 2001–02 and 2002–03, but also in the first two months, October and November in 2002–03 (Figures 24 and 25). In the Macquarie Ridge fishery, effort was concentrated in the first half of the year, between October and March, in both 2001–02 and 2002–03, with highest catch rates in January in 2001–02, and December in 2002–03 (Figures 24 and 25).

In the Pukaki fishery almost all effort and high catch rates occurred during April in 2001–02, and October in 2002–03 (Figures 24 and 25). Effort was spread through the year in the Fiordland fishery in 2001–02, with no seasonal peak in catch rates, and concentrated in only November, June and August in 2002–03, again with no seasonal peak in catch rates (Figures 24 and 25).

There was no clear pattern of effort or high catch rates in either Puysegur, nor in the Snares fishery in 2002–03 (Figures 24 and 25). However, in the Snares fishery in 2001–02, effort occurred between October and April, and in September (Figure 24).

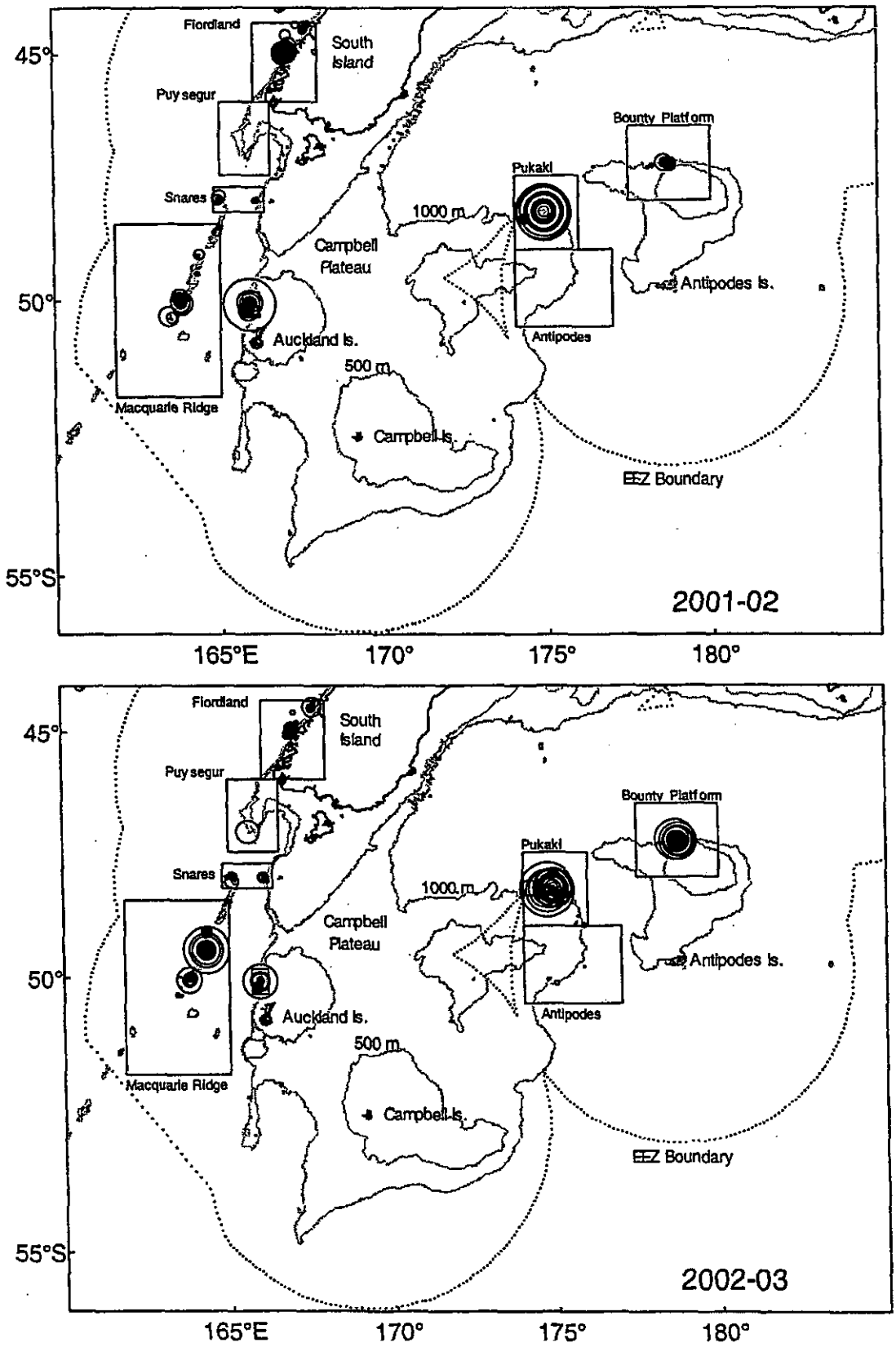


**Figure 23: Distribution of trawl positions and unstandardised catch rates (circles, t per tow) for orange roughy targeted or caught in the southern ORH 3B area during 2001–02 and 2002–03 (circle area is proportional to catch rate; maximum is 80 t).**

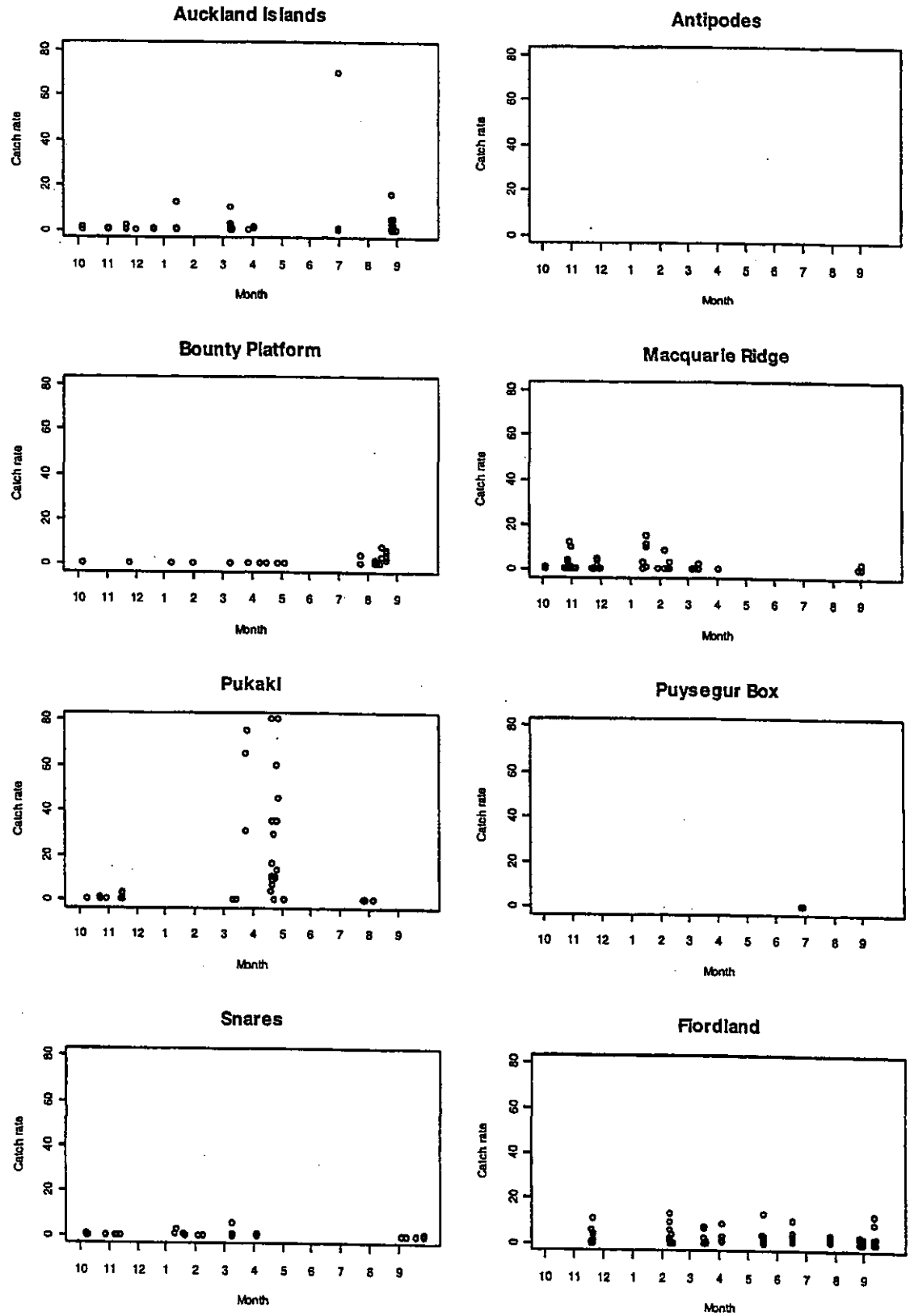


Figure 24: Daily unstandardised catch rate profiles (t/tow) of orange roughy in the southern ORH 3B stocks for 2001–02.

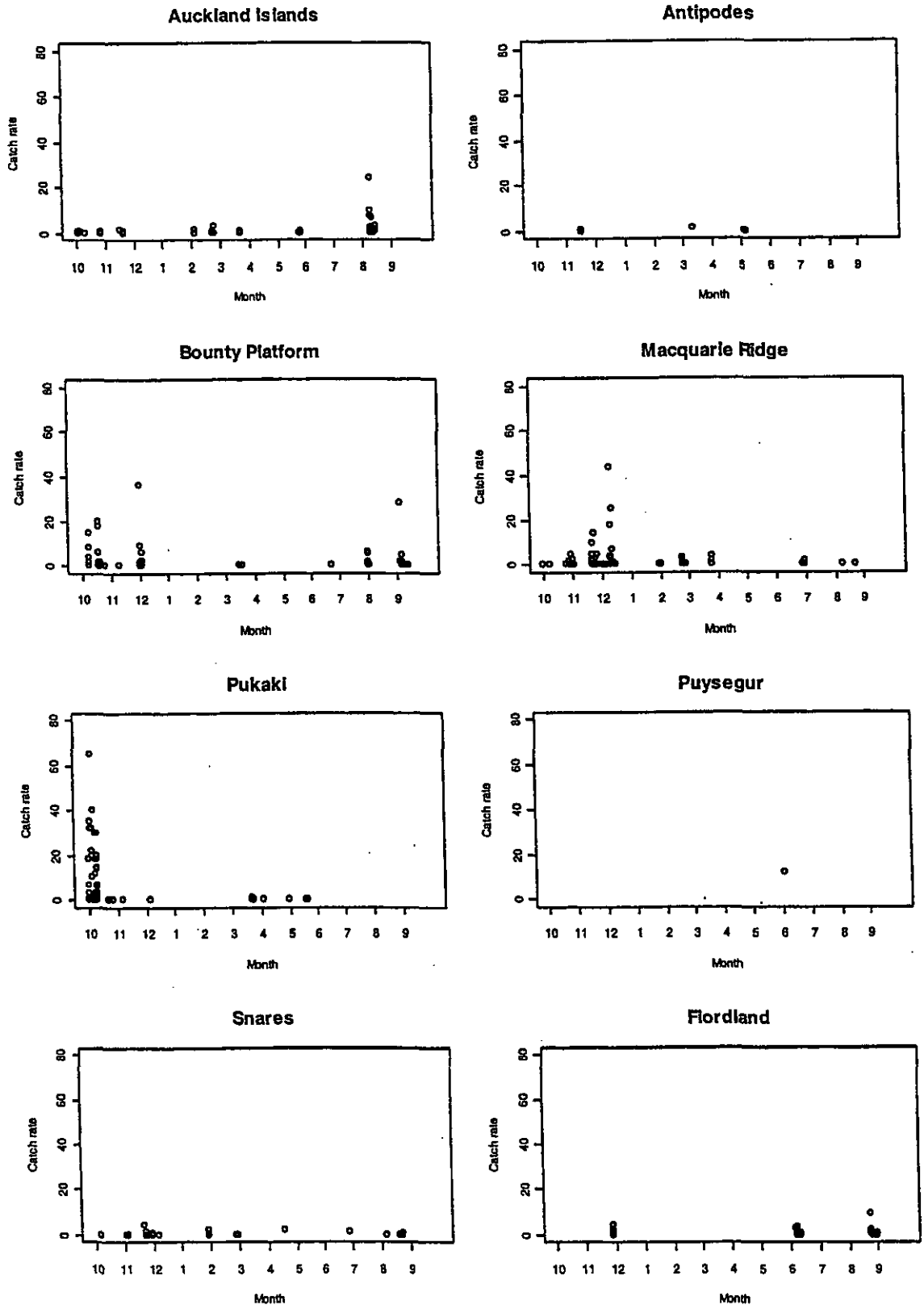


Figure 25: Daily unstandardised catch rate profiles (t/tow) of orange roughy in the southern ORH 3B stocks for 2002–03.

## 9. West coast South Island

Quota Management Area ORH 7B covers an area off the west coast of the South Island from near Westport to south of Jackson Head (Figure 26). The west coast South Island fishery is defined as the area between latitudes 42° and 44.25° S, and longitudes 166° and 171.5° E. This area includes domestic fishing return areas 033, 034, 705, 706, and the northern part of 032 (Figure 26). The most recent stock assessment was conducted in 2004 (McKenzie, in press).

### 9.1 Total catch

The fishery first developed in the mid 1980s, with a rapid increase in catches in 1985–86, when aggregations of spawning orange roughy were targeted in winter (Table 22). Catches from 1992–93 to 1994–95 were well below the TACC of 1708 t. The TACC was reduced to 430 t in 1995–96, but was only reached for the 1995–96 and 1996–97 fishing years. The TACC was further reduced in the 2000–01 fishing year to 110 t.

**Table 22: Reported landings (t) of orange roughy and TACs (t) for ORH 7B from 1983–84 to 2002–03. "*" denotes FSU data; "‡" QMS data, reproduced from Annala et al. (2004).**

| Fishing year | Catches | TACC |
|---|---|---|
| 1983–84* | 2 | – |
| 1984–85‡ | 282 | – |
| 1985–86‡ | 1763 | 1558 |
| 1986–87‡ | 1446 | 1558 |
| 1987–88‡ | 1413 | 1558 |
| 1988–89‡ | 1750 | 1708 |
| 1989–90‡ | 1711 | 1708 |
| 1990–91‡ | 1683 | 1708 |
| 1991–92‡ | 1604 | 1708 |
| 1992–93‡ | 1139 | 1708 |
| 1993–94‡ | 701 | 1708 |
| 1994–95‡ | 290 | 1708 |
| 1995–96‡ | 446 | 430 |
| 1996–97‡ | 425 | 430 |
| 1997–98‡ | 330 | 430 |
| 1998–99‡ | 405 | 430 |
| 1999–00‡ | 284 | 430 |
| 2000–01‡ | 161 | 430 |
| 2001–02‡ | 95 | 110 |
| 2002–03‡ | 90 | 110 |

### 9.2 Distribution of catch and effort

There have been some changes in the geographical distribution of effort over the course of the fishery (Figure 27). Initially, effort was concentrated in a very small area at the intersection of statistical areas 033, 034, and 705. Effort became more dispersed in 1992–93 as fishers ranged widely in an attempt to catch the available quota, and has remained widespread.

Catch rate plots (Figure 28) show high catch rates in Cook Canyon in the early years of the fishery. Catch rates have decreased as the fishery dispersed, but relatively high catches were taken in Moeraki Canyon to the south in 1992–93 and 1993–94. Unstandardised catch rates have been low throughout ORH 7B in 1997–2003, with very few catches over 5 t.

Historically most effort (Table 23) and catch (Table 24) in the west coast South Island fishery has been concentrated in the winter spawning period (June and July) with a much smaller, secondary peaks in catch and effort in September and October. Since 1996–97, effort has tended to be more spread throughout the year.

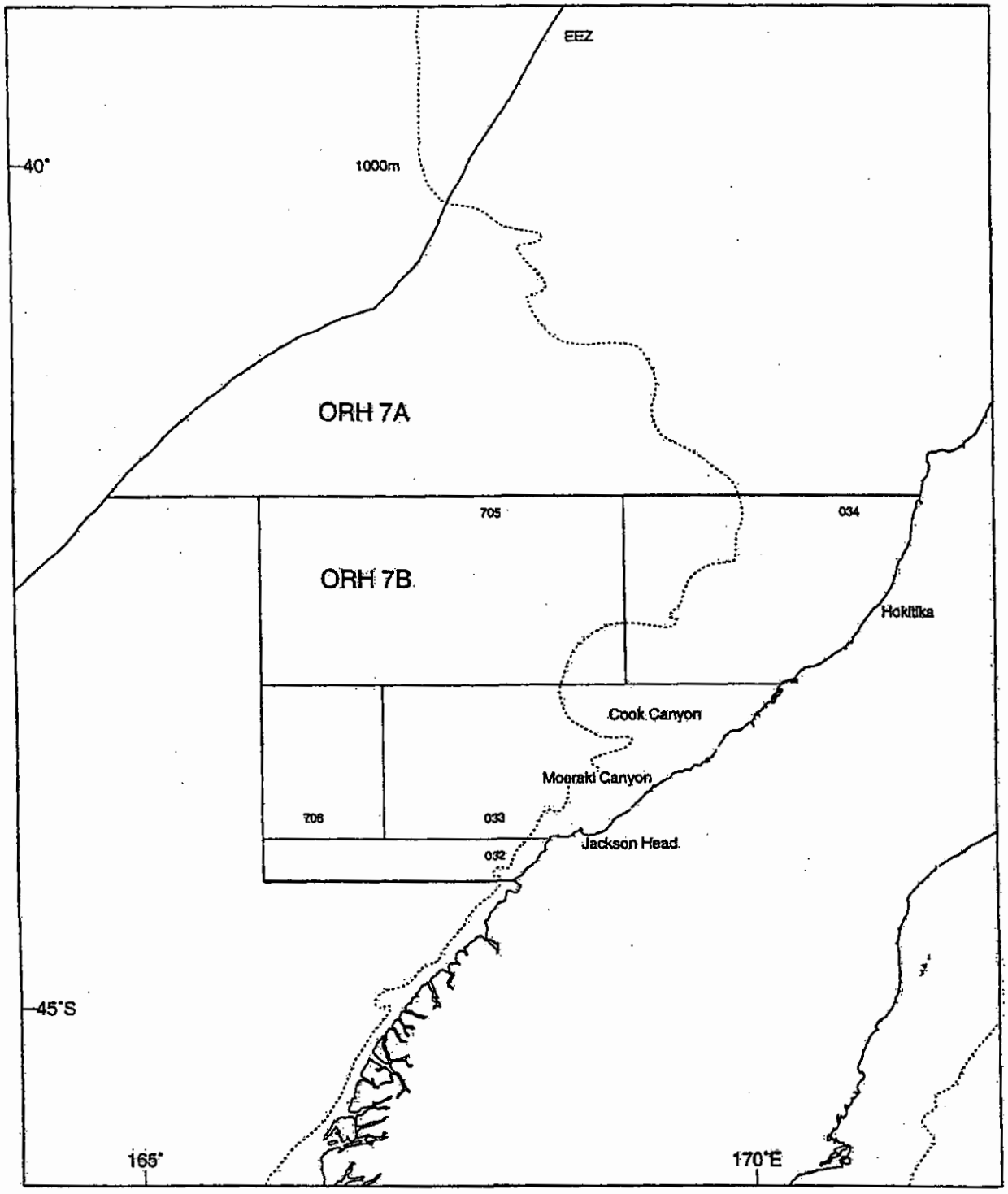


**Figure 26: Location of the west coast South Island orange roughy fishery showing the extent of ORH 7B QMA, and also the domestic fishing return areas (statistical areas).**

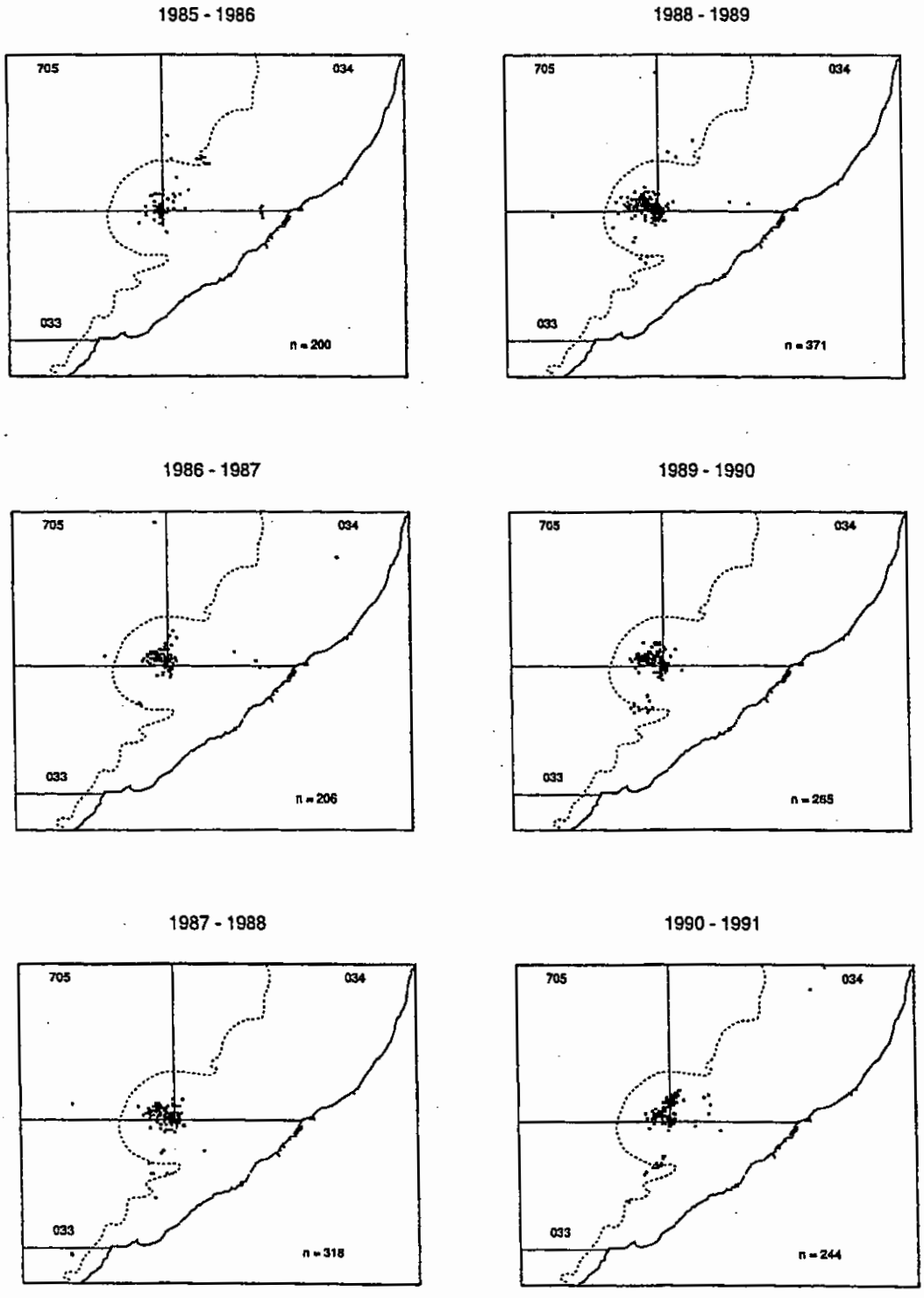


**Figure 27: Positions of tows which targeted or caught orange roughy in the west coast South Island fishery from 1997–98 to 2002–2003. Dotted line is 1000 m isobath, n is number of tows.**

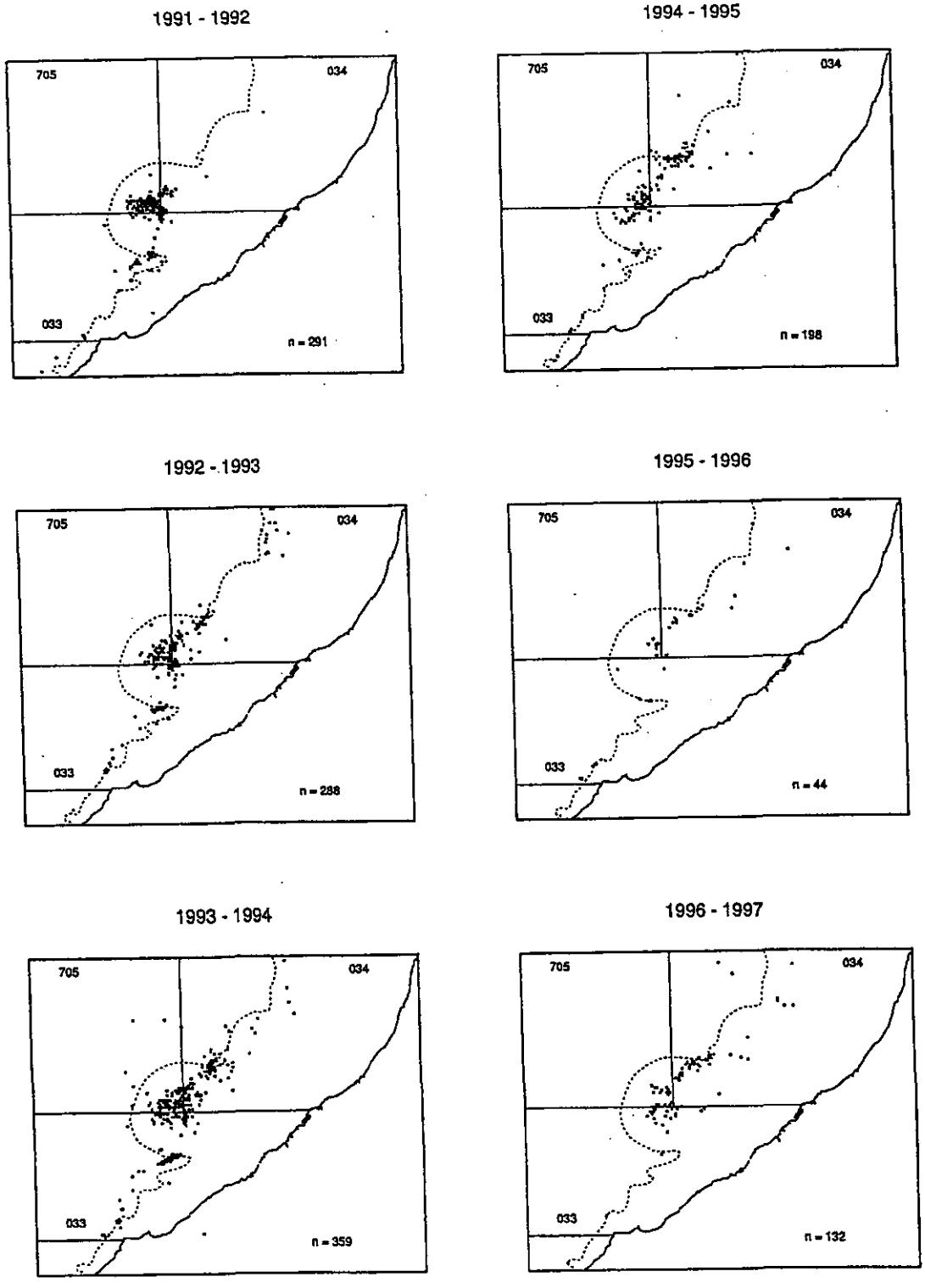


**Figure 27 (cont.): Positions of tows which targeted or caught orange roughy in the west coast South Island fishery from 1997–98 to 2002–2003. Dotted line is 1000 m isobath, n is number of tows.**

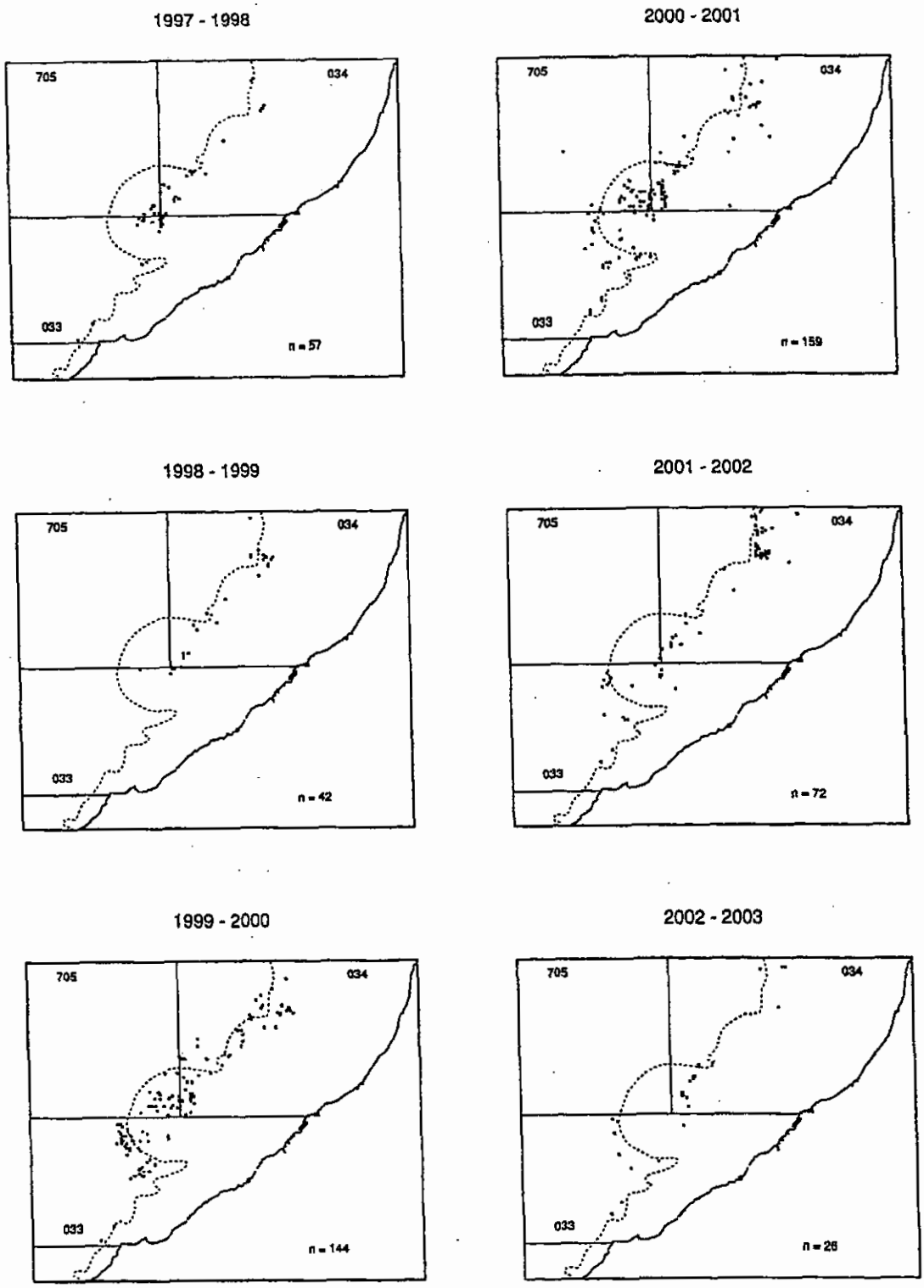


**Figure 27: Positions of tows which targeted or caught orange roughy in the west coast South Island fishery from 1997–98 to 2002–2003. Dotted line is 1000 m isobath, n is number of tows.**

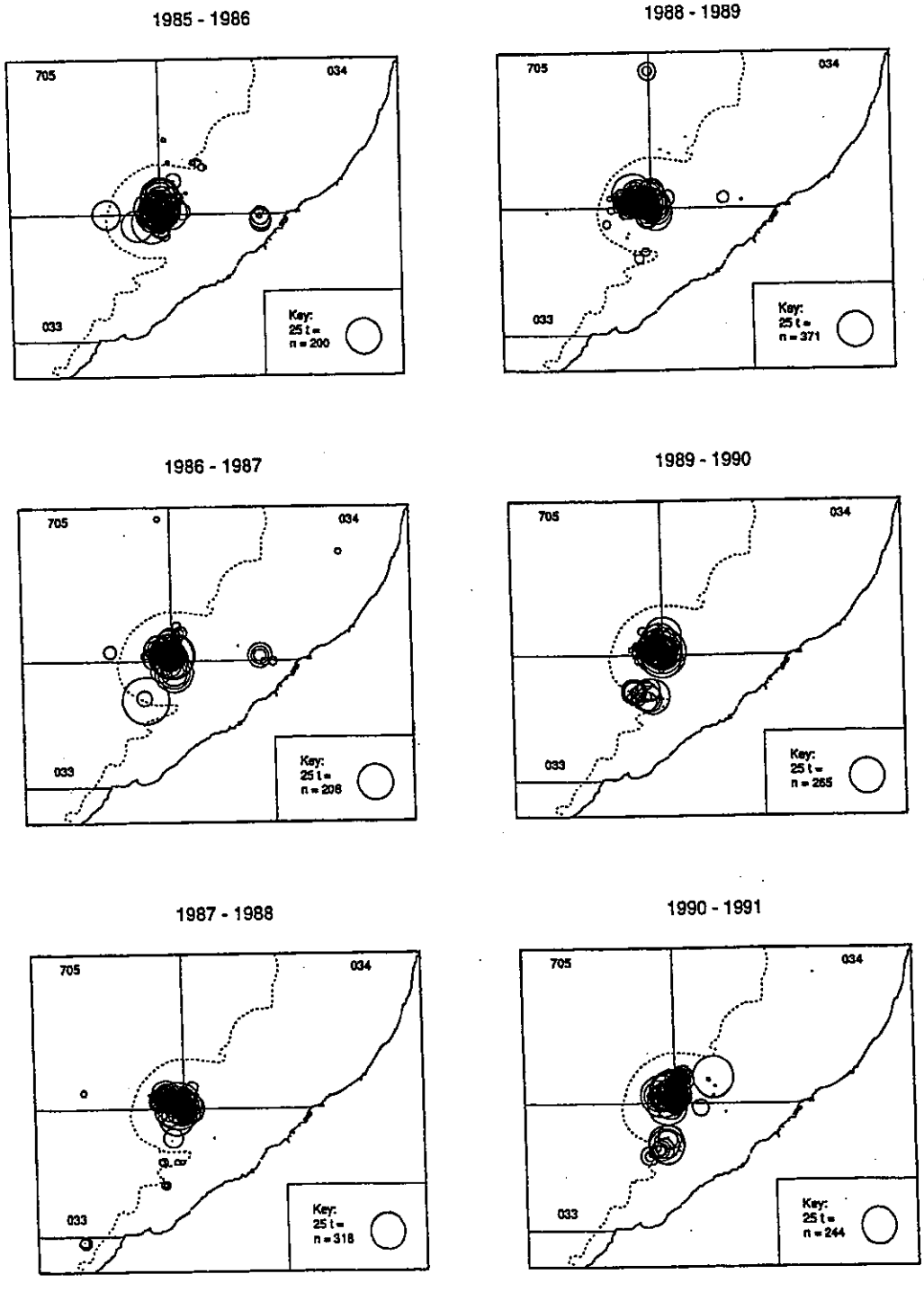


**Figure 28: Unstandardised catch rates of tows which targeted or caught orange roughy in the west coast South Island fishery from 1997–98 to 2002–2003. Circle area is proportional to t/tow, n is number of tows.**

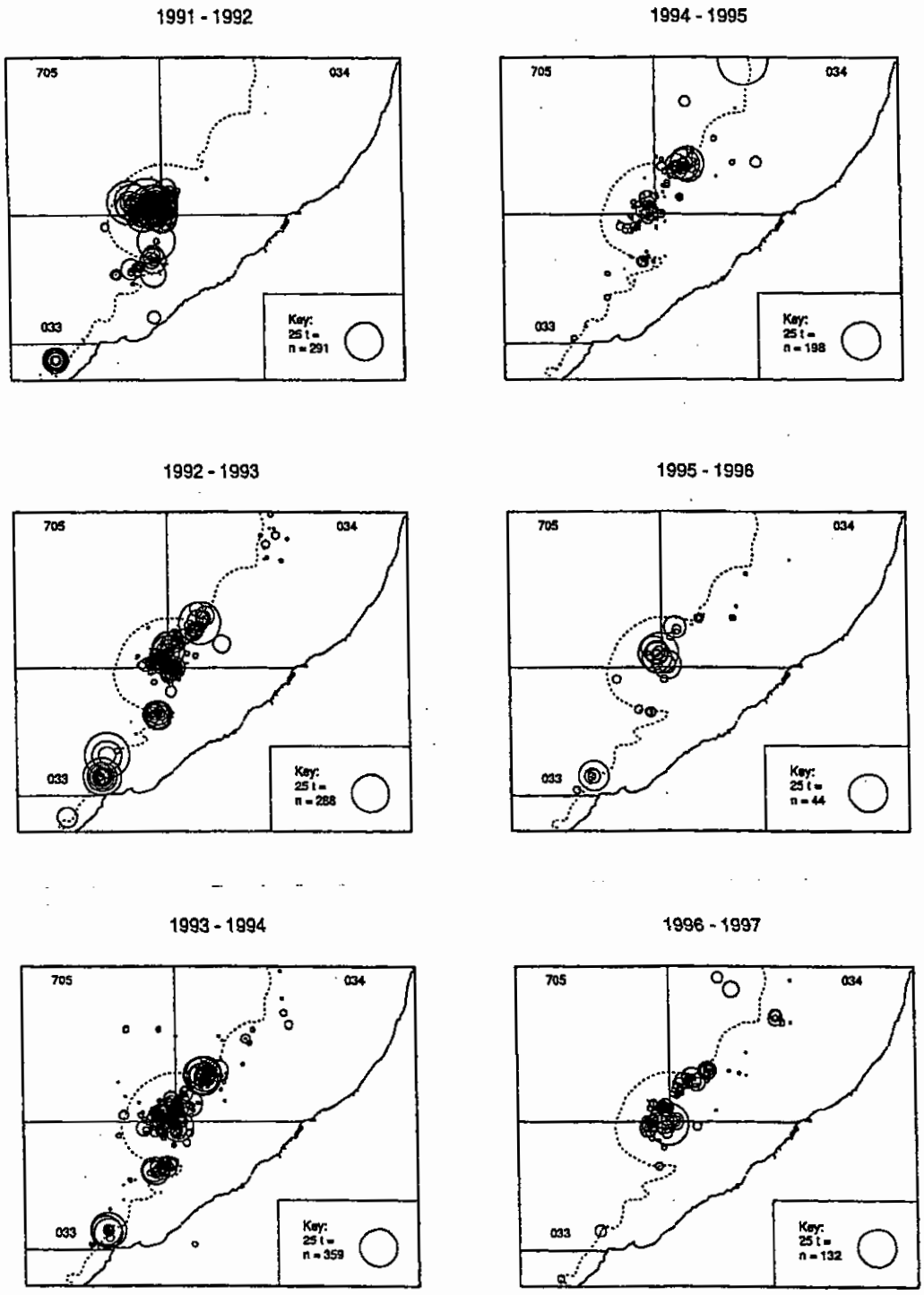


**Figure 28 (cont.): Unstandardised catch rates of tows which targeted or caught orange roughy in the west coast South Island fishery from 1997–98 to 2002–2003. Circle area is proportional to t/tow, n is number of tows.**

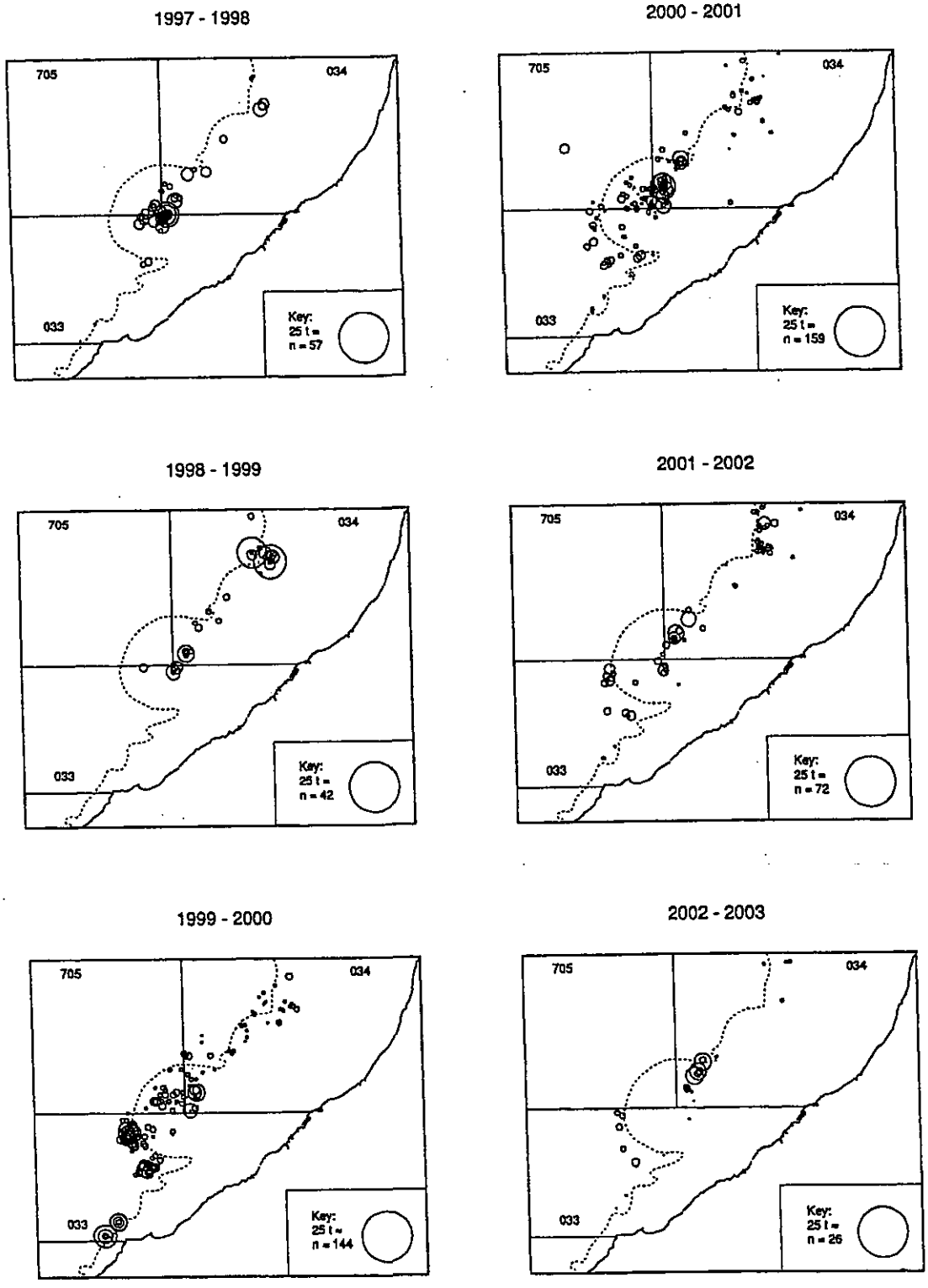


**Figure 28 (cont.): Unstandardised catch rates of tows which targeted or caught orange roughy in the west coast South Island fishery from 1997–98 to 2002–2003. Circle area is proportional to t/tow, n is number of tows.**

**Table 23: Monthly distribution of effort (number of tows) in the west coast South Island orange roughy fishery.**

| Fishing year | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1985–86 | 129 | 4 | 0 | 9 | 2 | 0 | 24 | 45 | 104 | 4 | 8 | 28 |
| 1986–87 | 111 | 14 | 0 | 0 | 1 | 0 | 2 | 1 | 238 | 2 | 33 | 3 |
| 1987–88 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 23 | 359 | 30 | 6 | 0 |
| 1988–89 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 43 | 229 | 11 | 51 | 34 |
| 1989–90 | 0 | 0 | 4 | 0 | 0 | 0 | 21 | 0 | 204 | 77 | 50 | 0 |
| 1990–91 | 88 | 26 | 3 | 22 | 2 | 0 | 12 | 77 | 228 | 115 | 4 | 55 |
| 1991–92 | 26 | 16 | 0 | 0 | 0 | 3 | 0 | 24 | 416 | 285 | 39 | 1 |
| 1992–93 | 72 | 0 | 0 | 0 | 0 | 0 | 0 | 43 | 185 | 436 | 15 | 33 |
| 1993–94 | 28 | 15 | 5 | 27 | 9 | 11 | 5 | 7 | 206 | 367 | 22 | 6 |
| 1994–95 | 2 | 21 | 15 | 13 | 2 | 13 | 1 | 35 | 76 | 149 | 24 | 10 |
| 1995–96 | 11 | 4 | 0 | 0 | 0 | 1 | 0 | 2 | 53 | 79 | 0 | 0 |
| 1996–97 | 6 | 1 | 0 | 2 | 0 | 0 | 0 | 7 | 127 | 39 | 0 | 0 |
| 1997–98 | 14 | 2 | 3 | 3 | 0 | 7 | 8 | 3 | 77 | 47 | 1 | 63 |
| 1998–99 | 33 | 28 | 12 | 48 | 11 | 42 | 25 | 25 | 128 | 76 | 0 | 138 |
| 1999–2000 | 22 | 23 | 12 | 15 | 4 | 10 | 79 | 65 | 208 | 96 | 16 | 97 |
| 2000–01 | 1 | 21 | 7 | 0 | 4 | 4 | 15 | 50 | 188 | 60 | 21 | 71 |
| 2001–02 | 1 | 6 | 0 | 16 | 0 | 21 | 14 | 17 | 44 | 64 | 20 | 79 |
| 2002–03 | 10 | 0 | 3 | 6 | 0 | 18 | 15 | 97 | 81 | 4 | 15 | 43 |

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

| Fishing year | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1985–86 | 419 | 1 | | 15 | 1 | | 22 | 68 | 855 | 91 | 9 | 64 |
| 1986–87 | 144 | 0 | | | 1 | | 0 | 0 | 994 | 19 | 44 | 48 |
| 1987–88 | | | | 0 | | | | 78 | 888 | 210 | 75 | |
| 1988–89 | | | | | | | | 85 | 535 | 116 | 81 | 9 |
| 1989–90 | | | 6 | | | | 14 | | 248 | 827 | 188 | |
| 1990–91 | 184 | 34 | 12 | 30 | 1 | | 3 | 62 | 474 | 734 | 12 | 111 |
| 1991–92 | 6 | 6 | | | | 0 | | 3 | 659 | 879 | 48 | 0 |
| 1992–93 | 30 | | | | | | | 17 | 494 | 531 | 19 | 36 |
| 1993–94 | 33 | 7 | 10 | 5 | 13 | 1 | 1 | 2 | 106 | 375 | 86 | 22 |
| 1994–95 | 0 | 43 | 10 | 3 | 2 | 5 | 0 | 8 | 76 | 164 | 3 | 3 |
| 1995–96 | 2 | 0 | | | | 2 | | 0 | 156 | 114 | | |
| 1996–97 | 2 | 0 | | 2 | | | | 5 | 203 | 33 | | |
| 1997–98 | 20 | 0 | 0 | 0 | | 1 | 1 | 0 | 28 | 57 | 0 | 62 |
| 1998–99 | 45 | 31 | 7 | 22 | 2 | 10 | 10 | 3 | 94 | 68 | | 69 |
| 1999–2000 | 7 | 12 | 7 | 4 | 0 | 1 | 27 | 13 | 91 | 57 | 3 | 38 |
| 2000–01 | 0 | 13 | 1 | | 0 | 1 | 3 | 20 | 56 | 28 | 15 | 23 |
| 2001–02 | 0 | 1 | | 5 | | 11 | 3 | 4 | 16 | 18 | 4 | 15 |
| 2002–03 | 2 | | 0 | 4 | | 8 | 6 | 32 | 41 | 4 | 3 | 12 |

## 9.3 Unstandardised catch rates

There was drop in the number of vessel days and tows in 2001–02 associated with the reduction in TACC (Table 25). Catch rates, both catch per tow and catch per hour, have remained relatively low since 1997–98, with the mean of the last six fishing years being less than 10% of the catch rate at the start of the fishery. In the last four fishing years, the mean tow length has increased to more than three times the initial level.

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

| Fishing year | No. of vessel days | No. of tows | Total recorded catch (t) | Mean daily catch rate (t/tow) | Mean daily catch rate (t/hr) | Mean tow speed* (kt) | Mean tow duration* (h) | Mean tow length* (nm) |
|---|---|---|---|---|---|---|---|---|
| 1985–86 | 138 | 357 | 1544 | 4.5 | 2.9 | 2.3 | 1.8 | 4.4 |
| 1986–87 | 132 | 405 | 1250 | 4.0 | 2.7 | 2.3 | 1.9 | 4.3 |
| 1987–88 | 132 | 420 | 1250 | 3.4 | 2.3 | 2.8 | 1.6 | 4.6 |
| 1988–89 | 133 | 368 | 827 | 2.5 | 1.6 | 2.9 | 1.7 | 4.9 |
| 1989–90 | 123 | 356 | 1282 | 4.5 | 5.6 | 2.8 | 1.6 | 4.4 |
| 1990–91 | 208 | 632 | 1657 | 2.8 | 3.3 | 2.9 | 1.6 | 4.7 |
| 1991–92 | 238 | 810 | 1601 | 2.0 | 1.4 | 2.9 | 1.9 | 5.4 |
| 1992–93 | 258 | 784 | 1128 | 1.5 | 2.3 | 3.0 | 1.7 | 5.2 |
| 1993–94 | 298 | 708 | 660 | 1.1 | 0.9 | 2.8 | 2.3 | 6.6 |
| 1994–95 | 162 | 361 | 320 | 0.9 | 1.6 | 2.9 | 2.0 | 5.8 |
| 1995–96 | 66 | 150 | 275 | 2.2 | 1.7 | 2.9 | 2.1 | 6.1 |
| 1996–97 | 90 | 182 | 244 | 1.3 | 7.5 | 2.8 | 3.1 | 8.6 |
| 1997–98 | 96 | 228 | 170 | 0.7 | 0.3 | 2.8 | 2.5 | 7.0 |
| 1998–99 | 188 | 566 | 359 | 0.6 | 0.2 | 2.6 | 2.6 | 6.8 |
| 1999–2000 | 213 | 647 | 259 | 0.4 | 0.1 | 3.5 | 4.5 | 16.4 |
| 2000–01 | 149 | 442 | 162 | 0.4 | 0.1 | 3.5 | 3.5 | 12.5 |
| 2001–02 | 117 | 282 | 76 | 0.3 | 0.1 | 3.8 | 4.7 | 17.8 |
| 2002–03 | 97 | 292 | 112 | 0.4 | 0.2 | 3.8 | 3.6 | 14.1 |

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