

ORANGE ROUGHY NORTHERN NORTH ISLAND (ORH 1)

1. FISHERY SUMMARY

(a) Commercial fisheries

This region extends northwards from west of Wellington around to Cape Runaway. Prior to 1993–94 there was no established fishery, and reported landings were generally small (Table 1). A new fishery developed in winter 1994, when aggregations were fished on two hill complexes in the western Bay of Plenty. In 1996 catches were also taken off the west coast of Northland.

A TACC of 190 t was set from 1989–90. Prior to that there had been a 10 t TAC and various levels of exploratory quota. From 1995–96, ORH 1 became subject to a five year adaptive management programme, and the TACC was increased to 1190 t. A catch limit of 1000 t was applied to an area in the western Bay of Plenty (Mercury-Colville ‘box’), with the former 190 t TACC applicable to the remainder of ORH 1. In 1994 and 1995, research fishing was also carried out under Special Permit (not included in the TACC). For the period June 1996–June 1997, a Special Permit was approved for exploratory fishing. This allowed an additional 800 t (not included in the TACC) to be taken in designated areas, although catches were limited from individual features (hills and seamounts etc).

Table 1: Reported landings (t) and TACs (t) from 1982–83 to 2005–06. – no TAC. The reported landings do not include catches taken under an exploratory special permit of 699 t in 1998–99 and 704 t in 1999–00.

Fishing year	West coast	North–east coast	Reported landings	
			Total	TAC
1982–83*	< 0.1	0	< 0.1	–
1983–84*	0.1	0	0.1	–
1984–85*	< 0.1	96	96	–
1985–86*	< 1	2	2	–
1986–87*	0	< 0.1	< 0.1	10
1987–88†	0	0	0	10
1988–89†	0	19	19	10
1989–90†	37	49	86	190
1990–91†	0	200	200	190
1991–92†	+	+	112	190
1992–93†	+	+	49	190
1993–94†	0	189	189	190
1994–95†	0	244	244	190
1995–96†	55	910	965	1190
1996–97†	+	+	1021	1190
1997–98†	+	+	511	1190
1998–99†	+	+	845	1190
1999–00†	+	+	771	1190
2000–01†	+	+	858	800
2001–02†	+	+	1294	1400
2002–03†	+	+	1123	1400
2003–04†	+	+	986	1400
2004–05†	+	+	1 151	1400
2005–06†	+	+	1 207	1400

* FSU data.

† QMS data.

+ Unknown distribution of catch.

Reported catches have varied considerably between years, and the location of the catch in the late 1980s/early 1990s is uncertain, as some may have been taken from outside the EEZ, as well as misreported from other areas. Research fishing carried out under Special Permit in 1994 and 1995 resulted in catches of 45.2 t and 200.7 t, respectively (not included in Table 1).

Based on an evaluation of the results of an Adaptive Management Programme (AMP) for the Mercury-Colville box initiated in 1995, the AMP was concluded and the TACC was reduced to 800 t for the 2000–01 fishing year. Catch limits of 200 t were established in each of four areas in ORH 1, with an individual seamount feature limit of 100 t. From 1 October 2001, ORH 1 was reintroduced into the AMP with different design parameters for five years, and the TACC was increased from 800 to 1400 t.

In recent years the fishery has also developed off the west coast and sizeable catches have been taken off the Tauroa Knoll and West Norfolk Ridge. The current management of the fishery is described in section 4 (Analysis of adaptive management programme) with a 2007 review of the performance of the AMP.

2005-06 Fishery (Anderson 2007)

The pattern of catch and effort in 2005–06 was different to 2004–05 in several areas. While most fishing again took place within the main recognised fishing regions, the distribution of catches amongst and within these regions was quite different. Effort and catches in the Northland fishery were greater than in 2004–05 with several large catches in the southwest of this area. The several good catches reported from North Colville in 2004–05 were not repeated in 2005–06, with almost no effort or catch in this fishery. Catch sizes were also much smaller in Manukau in 2005–06, although they were from approximately the same positions. Elsewhere, in the West Norfolk Ridge and Bay of Plenty fisheries, the pattern of fishing between the two years was much the same. The focus of catch and effort in the West Norfolk Ridge continues to be in the northwest, close to the limits of the EEZ.

Following the exploratory development of the fishing grounds through the mid–late 1990s, large annual catches have been reported regularly from Tauroa Knoll, the West Norfolk Ridge, and the north Colville Ridge. Catches on Tauroa Knoll increased from a relatively low level in 2004–05 to be similar in 2005–06 to the level of the three years prior to 2004–05. Catches and catch rates in the West Norfolk Ridge fishery peaked at about 350 t in 2001–02, and since then have remained steady at a level of 150–250 t. The catch in 2005–06 in this fishery was similar to recent years, but with relatively low effort and a high overall catch rate. Despite double the effort of any previous year, catches were down in the Manukau fishery, and the catch rate fell below 1 t per tow for the first time. Newly developed grounds in the Northland fishery provided a boost to the catches and catch rate in this fishery, the catch of 332 t being more than three times that of any previous year, and the catch rate almost double the previous high of 1.5 t/tow recorded in 1997–98. Effort was relatively low in the North Colville, Mercury-Colville, and Aldermen fisheries, with only 30 orange roughy target tows in total for these areas. Catches in the White Is. fishery have fluctuated over time and the 74 t caught in 2005–06 is slightly below the median level of the nine years of this fishery, although the 3.7 t/tow catch rate is the highest recorded.

The catch limit for the Mercury–Colville Box was reduced to 30 t in 2000–01, and although catches and effort increased in 2001–02, well beyond this catch limit, catches have been closer to this limit since 2002–03. Only in 2003–04 was this 30 t limit not exceeded. Within the Mercury-Colville Box, on Colville Knoll, only about 9 t were caught from 25 tows in 2005–06 (the 13 ORH target tows caught only 50 kg, the remainder being caught as bycatch from cardinalfish fishing). Catch rates were better on Mercury Knoll, where 29 t were caught from 18 tows.

(b) Recreational fisheries

There is no known non–commercial fishery for orange roughy in this area.

(c) Maori customary fisheries

No Maori customary fishing for orange roughy is known in this area.

(d) Illegal catch

No quantitative information is available on the level of illegal catch in this area.

(e) Other sources of mortality

There may be some overrun of reported catch because of fish loss with trawl gear damage and ripped nets. In other orange roughy fisheries, a level of 5% has been estimated.

2. STOCKS AND AREAS

Orange roughy are distributed throughout the area. Spawning is known from hills in the western Bay of Plenty. Stock status/affinities within the QMA are unknown. The Mercury-Colville grounds in the Bay of Plenty are about 120 n.miles from fishing grounds at East Cape (ORH 2A North), and spawning occurs at a similar time. Hence, it is likely that these are separate stocks. The Mercury and Colville Knolls in the Bay of Plenty are about 25 miles apart and may form a single stock. Stock affinities with other fishing hills in the southern and central Bay of Plenty are unknown. The Tauroa Knoll and outer Colville Ridge seamounts are distant from other commercial grounds, and these fish may also represent separate stocks.

3. STOCK ASSESSMENT

An assessment for the Mercury-Colville box was carried out in 2001 and is repeated here. A deterministic stock reduction technique (*after* Francis 1990) was used to estimate virgin biomass (B_0) and current biomass (B_{curr}) for the Mercury-Colville orange roughy stock. The model was fitted to the biomass indices using maximum likelihood and assuming normal errors. In common with other orange roughy assessments, the maximum exploitation rate was set at 0.67. The model treats sexes separately, and assumes a Beverton-Holt stock-recruit relationship. Confidence intervals of the biomass estimates were derived from bootstrap analysis (Cordue & Francis 1994).

(a) Estimates of fishery parameters and abundance

A series of trawl surveys of the Mercury-Colville box to estimate relative abundance were agreed under an Adaptive Management Programme. The first survey was carried out in June 1995 with a second survey in winter 1998 (Table 2). The biomass index of the latter survey was much lower than 1995, and it was uncertain whether the 1998 results were directly comparable to the 1995 results because of warmer water temperatures. They were not incorporated in the decision rule for the adaptive management programme. A third survey was carried out in June 2000, with the results suggesting that the abundance of orange roughy in the box had decreased considerably and was at low levels. However, these estimates are uncertain because of the suggestion that environmental factors may have influenced the distribution of orange roughy. The abundance indices from trawl survey and commercial catch-effort data used in the assessment are given in Table 2. The trawl survey indices had *c.v.*'s of 0.27, 0.39 and 0.29 for 1995, 1998, and 2000 respectively.

Table 2: Biomass indices and reported catch used in estimation of B_0 . Values in square brackets are included for completeness; they are not used in the assessment.

Year	1993-4	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00
Trawl survey	–	76 200	–	–	[2 500]	–	3 800
CPUE	8.3	9.1	5.4	4.2	[0.5]	1.5	(2.0)
Catch (t)	230	440	915	895	295	140	250

The CPUE series is mean catch per tow (sum of catches divided by number of tows, target ORH) from Mercury Knoll in the month of June. This is the only month when adequate data exist from the fishery to compare over time. A *c.v.* of 0.30 was assigned to the CPUE data.

Catch history information is derived from TCEPR records, scaled to the reported total catch for ORH 1. Figures differ slightly from unscaled data summarised by Clark (1999), but this would make little difference to the assessment. Overrun of reported catch (e.g., burst bags, inappropriate conversion factors) was assumed to be zero, as even if there was some, it is likely that it was similar between years. The catch in 1999–00 was assumed to be 250 t.

Assessments were carried out for three alternative sets of biomass indices (Table 3).

Table 3: Three alternative sets of biomass indices used in the stock assessment.

Alternative	Trawl survey indices	CPUE indices
1	1995, 2000	All except 1998
2	1995, 2000	None
3	1995, 2000	All except 1998 and 2000

Biological parameters used are those for the Chatham Rise stock, except for specific Bay of Plenty values for the maturity and recruitment ogives (Annala et al., 2000).

(b) Biomass estimates

The estimated virgin biomass (B_0) is very similar for all three alternative assessments (Table 4). With alternative 1 the estimated B_0 is 3200 t, with a current biomass of 15% B_0 . For both alternatives 2 and 3, the estimated B_0 is 3000 t, which is B_{min} , the minimum stock size which enables the catch history to be taken given a maximum exploitation rate of 0.67.

Table 4: Biomass estimates (with 95% confidence intervals in parentheses) for stock assessments with the three alternatives of Table 3. B_0 is virgin biomass; B_{MSY} is interpreted as B_{MAY} , which is 30% B_0 ; $B_{current}$ is mid-season 1999–00; and B_{beg} is the biomass at the beginning of the 2000–01 fishing year. Estimates are rounded to the nearest 100 t (for B_0), 10 t (for other biomasses), or 1%.

Biomass	<u>Alternative 1</u>		<u>Alternative 2</u>		<u>Alternative 3</u>	
B_0 (t)	3200	(3000, 3600)	3000	(3000, 3500)	3000	(3000, 3300)
B_{MSY} (t)	960	(900, 1080)	900	(900, 1050)	900	(900, 990)
$B_{current}$ (t)	490	(290, 890)	290	(290, 790)	290	(290, 590)
$B_{current}$ (% B_0)	15	(10, 25)	10	(10, 23)	10	(10, 18)
B_{beg} (t)	480	(270, 900)	270	(270, 800)	270	(270, 590)

The model fits the CPUE data reasonably well but estimates a smaller decline than is implied by the two trawl survey indices.

(c) Estimates of Yield

Yield estimates were determined using the simulation method described by Francis (1992) and the relative estimates of MCY, E_{CAY} and MAY, as given by Annala et al. (2000).

Yield estimates are all much lower than recent catches (Table 5). Estimates of current yields ($MCY_{current}$ and CAY) lie between 16 t and 35 t; long-term yields ($MCY_{long-term}$ and MAY) lie between 44 t and 67 t.

Table 5: Yield estimates (t) for stock assessments with the three alternatives of Table 3.

Yield	<u>Alternative 1</u>		<u>Alternative 2</u>		<u>Alternative 3</u>	
$MCY_{current}$	35	(22,53)	22	(22,51)	22	(22,44)
$MCY_{long-term}$	47	(44,53)	44	(44,51)	44	(44,49)
CAY	29	(16,54)	16	(16,48)	16	(16,36)
MAY	67	(58,70)	58	(58,68)	58	(58,64)

CSP for this stock is just under 100 t for any B_0 between 3000 t and 3600 t.

4. ANALYSIS OF ADAPTIVE MANAGEMENT PROGRAMME

The ORH 1 TACC was increased from 800 to 1400 t in October 2001/02 under the Adaptive Management Programme. The objectives of this AMP were to determine stock size, geographical extent, and long-term sustainable yield of the ORH 1 stock. This is a complex AMP, with ORH 1 divided into four sub-areas (see Figure 1), each with total catch and “feature” catch limits (a “feature” was defined as being within a 10 nm radius of the shallowest point).

ORH 1 Subarea	Proposed Catch Limit	Feature Limit (t/fishing year)
Area A	200 t	100 t
Area B	500 t	150 t
Area C	500 t	150 t
Area D	200 t	75 t

Feature limits also serve as limits to the total catch in any area due to the limited number of available productive features. The Mercury-Colville “Box” (located within Area D) has been given a specific limit of 30 t per year to allow for the bycatch of orange roughy when fishing for black cardinalfish. The catch of orange roughy in the Mercury-Colville “Box” is included in the overall limit for Area D.

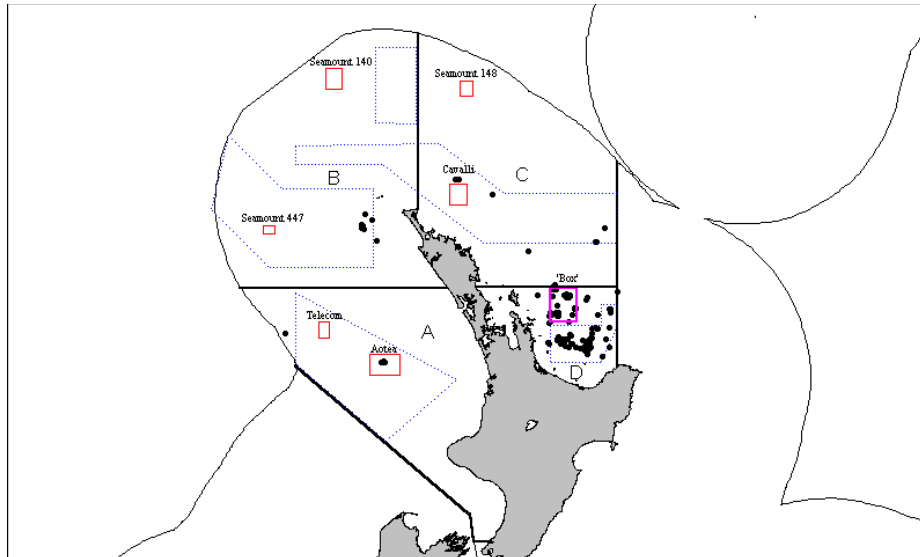


Figure 1. Four sub-management areas for the ORH 1 AMP (labelled A-D). Dotted lines enclose the exploratory fishing areas defined in the special permit issued on 6 July 1998. Solid lines enclose seamount closures and the Mercury-Colville Ohena ‘box’ (labelled at their top). Trawls (dots) where orange roughy were reported as the target species and caught during 1997–98 and 1998–99 are shown. Note that the lines separating Areas A and D from Areas B and C are incorrectly drawn at 36° S latitude rather than 35°30’ S latitude.

Review of ORH 1 AMP in 2007

In 2007 the AMP FAWG reviewed the performance of the AMP after the full 5-year term.

Fishery Characterisation

- In most years, the total catch has been less than the TACC.
- The area splits into A, B, C and D only occurred in 2001.
- Main fishery is in area B; the fishery in area A only began in 2002.
- Two main goals of the AMP:
 - Reduce fishing in area D, in particular the Mercury-Colville “box”.
 - Look for new fishing areas, distributing effort across the QMA, with feature limits to reduce the possibility of localised overfishing

Table 6: Estimated target catches by sub-area , reported landings and TACC for ORH 1.

	Sub-area target catch (t)				Total target catch(t)	Reported landings (t)	TACC (t)
	A	B	C	D			
1997–98	0.5	6	0	491	497	511	1190
1998–99	5	575	165	725	1470	1543	1190
1999–00	1	645	165	598	1408	1476	1190
2000–01	9	166	99	165	439	858	800
2001–02	123	441	266	227	1056	1294	1400
2002–03	197	508	238	72	1015	1123	1400
2003–04	223	422	117	110	872	986	1400
2004–05	277	390	173	174	1014	1151	1400

CPUE Analysis

- Unstandardised CPUE is in kg/tow. The short time series, the nature of the fishery (fishing aggregations spread over a wide area in different seasons) and the impact of catch limits on features and sub-areas prevent any useful relative abundance indices from being developed at this point for ORH 1.
- Where features are less than 10 nm apart, catch is apportioned according to the distance to the feature. Industry in-season reporting is based on the feature closest to the start of the tow.
- Possible problems with the area A observations in 2005-06, as there seem to be more reported tows than expected given the number of vessels operating in the area.

Observer Programme

- 50% observer coverage prior to 1 October 2006 (a high level relative to that for other deepwater stocks, with a large number of samples taken relative to the size of the fishery). From 1 October 2006, 100% coverage was requested by the Minister, but this has not been fully achieved, as some ORH 1 is taken as bycatch on trips that do not predominantly target ORH.
- The size frequency data show high levels of stock variability between fisheries on features or feature groups. Size variation does not seem to be linked to exploitation rate.

Environmental Effects

- Observer data from 2000 to 2003 indicated that incidental captures of seabirds did not occur in the ORH 1 target fishery (Baird 2005). Marine mammal interactions are also not a problem.
- Only 3 non-fish bycatch records have been reported from observed trips (in 1994 and 1995). All were shearwaters that landed on deck and were released alive. It was verified that observers were briefed in the same way as for other MFish trips including recording non-fish bycatch i.e. seabirds and marine mammals. Note that this does not include benthic organisms.
- The overall impact of bottom trawling on seamounts in ORH1 is not known. A number of seamounts have been closed to fishing and the Norfolk Deep BPA is included in the industry accord relating to benthic protection areas within New Zealand's EEZ.

Sub-area D Directed Adaptive Exploratory Fishing Programme

- The purpose of this exercise was to establish whether fish populations shift between features in different years in sub-area D.
- Based on the results from the exploratory fishing from 2002 to 2005 it is evident that catches from all features contained a high proportion of ripe or ripe running females and that synchronised spawning occurs on a range of hills during winter.
- In 2006 the AMP Working Group recommended some changes to the design of the exploratory survey; however, this was not achieved during the 2006 survey.

The abbreviated checklist questions for full- and mid-term reviews are:

1. *Is stock abundance adequately monitored?*

The working group concluded that CPUE does not seem to be a proportional measure of abundance for this stock. However, CPUE is used in ORH 1 as a management tool. When CPUE drops on a feature, fishers are meant to move to another feature.

2. *Is logbook coverage sufficient?*

As there are MFish observers on these vessels, fishers are not required to complete detailed logbooks for the AMP. This is the highest level of monitoring of any ORH fishery in New Zealand.

3. *Are additional analyses of current data necessary?*

No. The Working Group concluded that no other information can currently be extracted from the existing data that will provide insight into the status of the ORH 1 stocks. However, a potential problem with the 2005-06 catch records from Area A still needs to be checked.

4. *Based on the biomass index, is current harvest sustainable?*

Unknown. The purpose of the AMP was to spread effort in an attempt to reduce fishing pressure on any one sub-area or feature (and Area D in particular). ORH 1 is a large area, with orange roughy aggregations spread across a number of areas and features. The amount of fishing in some areas appears to be low, but without any indication of current abundance, there is no way to determine if this level of fishing is in fact sustainable, or if current feature limits will avoid overexploitation of localised areas.

5. *Where is stock, based on weight of evidence, in relation to B_{msy} ?*

Unknown. In 2001, when the AMP was initiated, the Working Group stated that the stock was likely above B_{MSY} ; while the information collected since that time has not improved the understanding about the status of the stock, the intent of the AMP

design for ORH1 was to spread effort to reduce the likelihood of the biomass declining below B_{MSY} .

ORH 1 is unlikely to be a single biological stock, and probably includes a number of constituent stocks. The Working Group concluded that it is not possible to estimate B_{MSY} for any of the individual stocks, let alone aggregate up to an estimate for ORH 1 as a whole. Moreover, a better understanding is not possible in the near future. B_{MSY} is difficult to estimate in situations involving an unknown number of constituent stocks.

6. *Are the effects of fishing adequately monitored?*

Yes, there is good observer coverage. The Working Group noted that one consequence of deliberately spreading effort was to increase the possible benthic impact.

7. *Are rates of non-fish bycatch acceptable?*

Yes.

8. *Should the AMP be reviewed by the plenary?*

This AMP does not need to be reviewed by the Plenary.

5. STATUS OF THE STOCKS

From 1 October 2001, the TACC for ORH 1 was increased to 1400 t within the AMP, with sub-area and feature limits. In most years the total catch has been less than the TACC. However, it is not known if recent catch levels or current TACCs are sustainable in the long term. Except for the small area of the Mercury-Colville box no assessment of stock status is currently available.

An assessment of the Mercury-Colville box in 2001 indicated that biomass had been reduced to 10–15% B_0 (compared to an assumed B_{MSY} of 30% B_0). As the stock was considered to be well below B_{MSY} , a catch limit of 30 t was set for the box. The assessment indicated that a catch level of about 100 t would probably maintain the stock at the 2000 stock size (assuming deterministic recruitment) and catch levels from 16 to 35 t (consistent with CAY or MCY strategies) might allow the stock to rebuild slowly.

In other areas of ORH 1 the status of the constituent stocks is unknown. The amount of fishing in some areas appears to be low, but without any indication of current abundance, there is no way to determine if this level of fishing is in fact sustainable or if current feature limits will avoid overexploitation of localised areas.

6. FOR FURTHER INFORMATION

- Anderson, O.F. (2007). Descriptive analysis of catch and effort data from New Zealand orange roughy fisheries in ORH 1 to the end of the 2005–06 fishing year. Deepwater-WG-07/39. 11p
- Anderson, O.F.; Dunn, M.R. (2006). Descriptive analysis of catch and effort data from New Zealand orange roughy fisheries in ORH 1, 2A, 2B, 3A, 3B, and 7B to the end of the 2003–04 fishing year. *New Zealand Fisheries Assessment Report 2006/20*. 59p
- Annala, J.H.; Sullivan, K.J.; O'Brien, C.J. (2000). Report from the Fishery Assessment Plenary, May 2000: stock assessments and yield estimates. (unpublished report held in NIWA library, Wellington.)
- Baird, S.J. (2005a). Incidental capture of seabird species in commercial fisheries in New Zealand waters, 2002–03. *New Zealand Fisheries Assessment Report 2005/2*. 50 p.
- Clark, M.R. (2001). A description of the orange roughy fishery in northern North Island waters (ORH 1) for 1997–98 to 1999–2000: an update of commercial catch and effort information. *New Zealand Fisheries Assessment Report 2001/76*. 23 p.
- Clark, M.R.; Tracey, D.M. (1988). Assessment of the west coast South Island and northern North Island orange roughy fisheries. N.Z. Fisheries Assessment Research Document 88/20. 11 p.
- Clark, M.R.; King, K.J. (1989). Deepwater fish resources off the North Island, New Zealand: results of a trawl survey, May 1985 to June 1986. *N.Z. Fisheries Technical Report No. 11*. 56 p.
- Clark, M.R.; Field, K.D. (1998). Distribution, abundance and biology of orange roughy in the western Bay of Plenty: results of a trawl survey, June 1995 (SMT9501). *NIWA Technical Report 14*. 29 p.
- Cordue, P.L.; Francis, R.I.C.C. (1994). Accuracy and choice in risk estimation for fisheries assessment. *Canadian journal of Fisheries and Aquatic Sciences 51*: 817–829.
- Francis, R.I.C.C. (1990). A maximum likelihood stock reduction method. *N.Z. Fisheries Assessment Research Document 90/4*. 8 p.
- Francis, R.I.C.C. (1992). Recommendations concerning the calculation of maximum constant yield (MCY) and current annual yield (CAY). *N.Z. Fisheries Assessment Research Document 92/8*. 27 p.
- SeaFIC (2006). 2006 Report to the Adaptive Management Programme Fishery Assessment Working Group: Full Term Review of the ORH1 Adaptive Assessment Programme. AMP-WG-06-
- Starr, P.; Clark, M.R.; Francis, R.I.C.C. (1996). ORH 1: blueprint for controlled development of an orange roughy fishery? *Seafood New Zealand 4*(2): 29–31.