ORANGE ROUGHY NORTHERN NORTH ISLAND (ORH 1)

1. FISHERY SUMMARY

Allowances, TACCs, and TACs are shown in Table 1.

Table 1: Recreational and Customary non-commercial allowances, other mortality, TACCs, and TACs (t) for ORH 1.

Fishstock	Recreational allowance	Customary non-commercial allowance	Other sources of mortality	TACC	TAC
ORH 1	0	0	70	1 400	1 470

1.1 Commercial fisheries

The ORH 1 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 2). 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. Figure 1 shows the historical landings and TACC values for ORH 1.

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 2: Reported landings (t) and TACCs (t) from 1982–83 to present. - no TACC. The reported landings do not include catches taken under an exploratory special permit of 699 t in 1998–99 and 704 t in 1999–2000. QMS data from 1986-present.

	Reported landings					Reported landings			
Fishing year	West coast	North-east coast	Total	TACC	Fishing year	West coast	North-east coast	Total	TACC
1982–83*	< 0.1	0	< 0.1	-	2006–07	+	+	1 036	1 400
1983–84*	0.1	0	0.1	-	2007–08	+	+	1 104	1 400
1984–85*	< 0.1	96	96	-	2008–09	+	+	905	1 400
1985–86*	< 1	2	2	-	2009–10	+	+	825	1 400
1986–87*	0	< 0.1	< 0.1	10	2010–11	+	+	772	1 400
1987–88	0	0	0	10	2011–12	+	+	1 114	1 400
1988–89	0	19	19	10	2012–13	+	+	1 171	1 400
1989–90	37	49	86	190	2013–14	+	+	1 055	1 400
1990–91	0	200	200	190	2014–15	+	+	1 181	1 400
1991–92	+	+	112	190	2015–16	+	+	1 004	1 400
1992–93	+	+	49	190	2016–17	+	+	775	1 400
1993–94	0	189	189	190	2017–18	+	+	881	1 400
1994–95	0	244	244	190	2018–19	+	+	592	1 400
1995–96	55	910	965	1 190	2019–20	+	+	679	1 400
1996–97	+	+	1 021	1 190	2020–21	+	+	680	1 400
1997–98	+	+	511	1 190	2021–22	+	+	598	1 400
1998–99	+	+	845	1 190	2022–23	+	+	332	1 400
1999–00	+	+	771	1 190	2023–24	+	+	339	1 400
2000–01	+	+	858	800					
2001–02	+	+	1 294	1 400					
2002–03	+	+	1 123	1 400					
2003–04	+	+	986	1 400					
2004–05	+	+	1 151	1 400					
2005–06	+	+	1 207	1 400					

* FSU data. + Unknown distribution of catch.

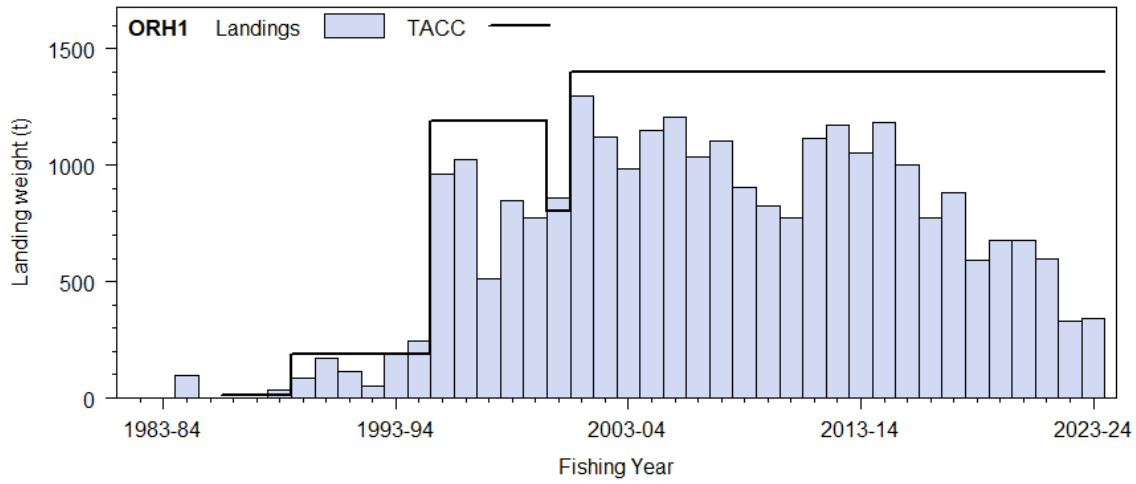

Figure 1: Reported commercial landings and TACC for ORH 1 (Auckland).

1.2 Recreational fisheries

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

1.3 Customary non-commercial fisheries

No customary non-commercial fishing for orange roughy is known in this area.

1.4 Illegal catch

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

1.5 Other sources 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 several hills in the western Bay of Plenty as well as from features in the western regions of ORH 1. 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 ($B_{current}$) 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).

3.1 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 3). The biomass index of the latter survey was much lower than 1995, and because of warmer water temperatures it was uncertain whether the 1998 results were directly comparable to the 1995 results. 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 3. The trawl survey indices had CVs of 0.27, 0.39 and 0.29 for 1995, 1998, and 2000 respectively.

Table 3: 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	1993–94	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 CV 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. 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 4).

Table 4: 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).

3.2 Biomass estimates

The estimated virgin biomass (B_0) is very similar for all three alternative assessments (Table 5). 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 5: Biomass estimates (with 95% confidence intervals in parentheses) for stock assessments with the three alternatives of Table 4. B0 is virgin biomass; BMSY is interpreted as BMAY, which is 30%B0; Bcurrent is mid-season 1999–00; and Bbeg is the biomass at the beginning of the 2000–01 fishing year. Estimates are rounded to the nearest 100 t (for B0), 10 t (for other biomasses), or 1%.

Biomass	Alternative 1		Alternative 2		Alternative 3	
B_0 (t)	3 200	(3 000, 3 600)	3 000	(3 000, 3 500)	3 000	(3 000, 3 300)
B_{MSY} (t)	960	(900, 1 080)	900	(900, 1 050)	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.

3.3 Yield estimates and projections

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 6). Estimates of current yields ($MCY_{current}$ and CAY) lie between 16 t and 35 t; long-term yields ($MCY_{long\text{-}term}$ and MAY) lie between 44 t and 67 t.

Table 6: Yield estimates (t) for stock assessments with the three alternatives of Table 4.

Yield	Alternative 1		Alternative 2		Alternative 3	
MCY_{curren}	35	(22, 53)	22	(22, 51)	22	(22, 44)
$MCY_{long\text{-}term}$	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 2), each with total catch and "feature" catch limits (Table 7) (a "feature" was defined as being within a 10 n. mile radius of the shallowest point).

Table 7: Description of control rules implemented in the ORH 1 AMP.

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.

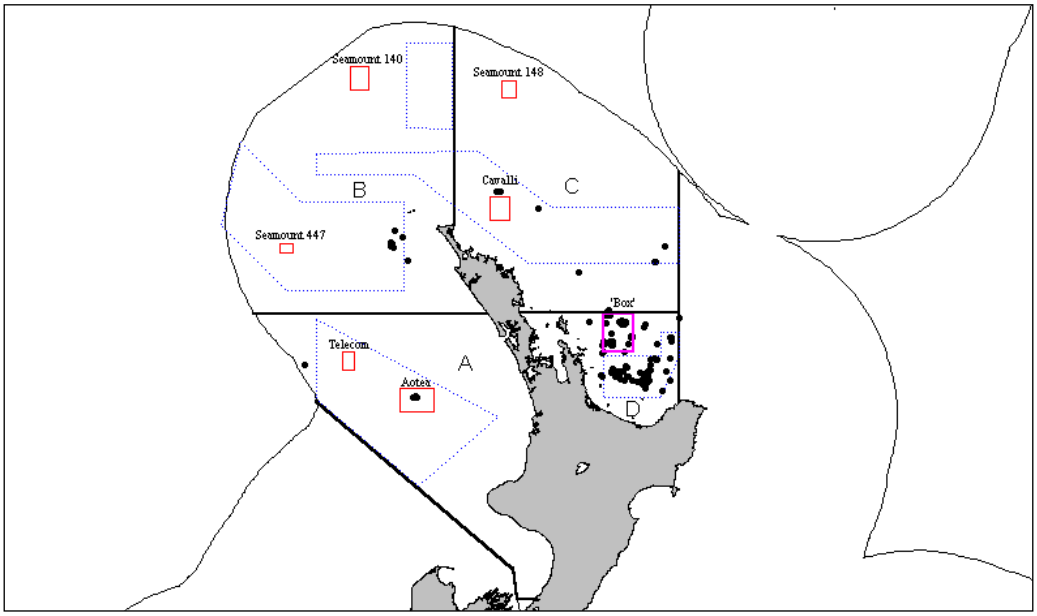

Figure 2: Four sub-management areas for the ORH 1 AMP (labelled A-D). Dotted lines enclose the exploratory fishing areas defined in the special permit issued on 6 July 1998. Solid lines enclose seamount closures and the Mercury-Colville Ohena 'box' (labelled at their top). Trawls (dots) where orange 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.

From 1 October 2007 the stock is no longer part of the Adaptive Management Programme but stakeholders have agreed to continue with the sub-area and feature limits within the overall ORH 1 TACC.

Review of ORH 1 AMP in 2007

In 2007 the AMP Assessment Working Group 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 (Table 8).
- 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 8: Estimated target catches by sub-area, scaled to landings, reported landings, and TACC for ORH 1. The scaling factor is calculated as reported catch/estimated (all target) catch (source: Anderson 2007b)

	Sub-area target catch (t)				Total target	Reported	TACC	Scaling
	A	B	C	D	catch(t)	landings (t)	(t)	factor
1998	0.5	5.6	0.0	491.0	497	511	1 190	0.99
1999	5.2	575.2	165.0	724.5	1 470	1 543	1 190	0.99
2000	0.8	644.6	164.8	597.5	1 408	1 476	1 190	1.03
2001	8.5	166.3	99.4	164.6	439	858	800	1.11
2002	122.7	440.5	265.8	227.1	1 056	1 294	1 400	1.06
2003	196.7	508.1	237.9	72.2	1 015	1 123	1 400	0.98
2004	223.2	421.7	117.0	110.1	872	986	1 400	1.01
2005	277.0	389.8	173.4	174.1	1 014	1 151	1 400	1.13
2006	151.0	473.2	372.6	186.0	1 183	1 201	1 400	1.13

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 n. mile 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 three 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 ORH 1 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 Ministry fisheries 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 to be 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 ORH 1 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. From 1 October 2007 the stock is no longer part of the Adaptive Management Programme but stakeholders have agreed to continue with the sub-area and feature limits within the overall ORH 1 TACC.

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. The assessment of the Mercury-Colville box is now also considered out of date.

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

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