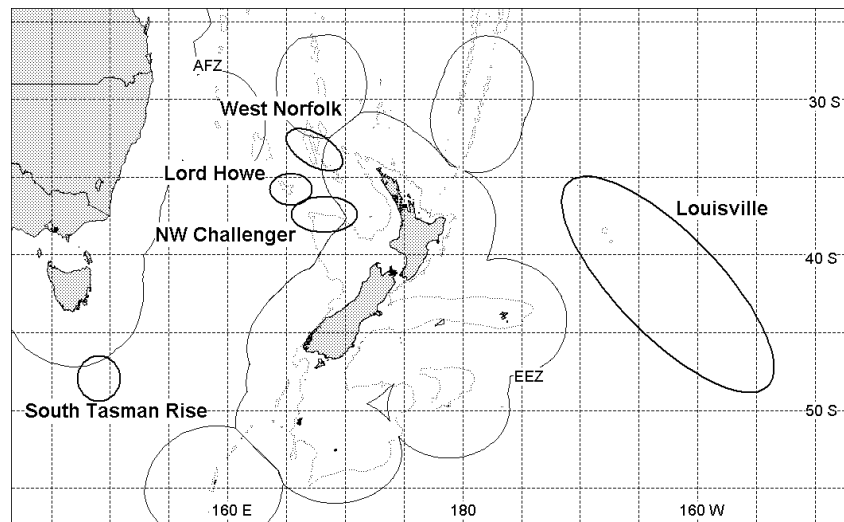


ORANGE ROUGHY OUTSIDE THE EEZ (ORH ET)



1. FISHERY SUMMARY

1.1 Commercial fisheries

Fisheries outside the EEZ in the New Zealand region occur on ridge systems and seamount chains in the Tasman Sea and southwest Pacific Ocean. There are five main fishing areas: Lord Howe Rise, Northwest Challenger Plateau, West Norfolk Ridge, South Tasman Rise, and Louisville Ridge (see figure above).

The first orange roughy fishery outside the EEZ developed on the “Westpac Bank” close to the main fishing grounds on the southwest Challenger Plateau in the early–mid 1980s. Catches were recorded as part of the straddling stock crossing into ORH 7A, and therefore excluded from this chapter, up until 2007. Further exploration in the region resulted in the development of commercial fisheries on the Lord Howe Rise in 1987–88, Northwest Challenger Plateau in 1988–89, Louisville Ridge in 1993–94, South Tasman Rise in 1997–98, and West Norfolk Ridge in 2001–02. Catches from all of these fisheries are tabulated by fishing year up to 2006–07, excluding Westpac catches (Table 1), and by calendar year from 2007 to present (Table 2), as required by the South Pacific Fisheries Management Organisation (SPRFMO).

Table 1: Estimated catches (t) of orange roughy for ORH ET fisheries from 1987–88 to 2006–07. (Data from New Zealand (FSU, QMS), Australia (AFMA), and various sources for other countries. Note that the fishing year for South Tasman Rise is March to February, all others are October to September). See Table 2 for catches from 2007 onwards.

Fishing year	Lord Howe	NW Challenger	Louisville	West Norfolk	South Tasman	Total ET
1987–88	4 000	5	0	0	0	4 005
1988–89	2 430	297	0	0	0	2 727
1989–90	927	425	0	0	0	1 352
1990–01	282	123	0	0	0	405
1991–02	859	620	0	0	0	1 479
1992–03	2 300	2 463	0	0	0	4 763
1993–04	840	1 731	689	0	0	3 260
1994–05	761	1 138	13 252	0	0	15 151
1995–06	5	500	8 816	0	0	9 321
1996–07	139	332	3 209	0	5	3 685
1997–08	26	397	1 404	0	3930	5 757
1998–09	440	961	3 164	0	705	5 270
1999–00	52	473	1 369	0	4 110	6 004
2000–01	428	1 228	1 598	10	830	4 094
2001–02	120	2 075	1 004	649	170	3 729
2002–03	272	1 010	1 296	94	110	2 782
2003–04	324	654	1 419	90	3	2 490
2004–05	430	464	1 510	277	55	2 736
2005–06	240	201	675	727	12	1 855
2006–07	40	96	323	552	0	1 011

Catch totals include data from New Zealand and Australian vessels available from tow by tow fishing records, with estimated catches added for vessels from Japan, USSR, Korea, Norway, South Africa and China. Catch statistics are likely to be incomplete.

These fisheries were historically unregulated, with the exception of the South Tasman Rise area, where catches by Australian and New Zealand vessels have at times been restricted by a TAC imposed under a Memorandum of Understanding between the two countries. The South Tasman Rise fishery is currently closed.

South Pacific Regional Fisheries Management Organisation (SPRFMO) Convention Area

Regulation of these fisheries was implemented following adoption of the SPRFMO interim measures in May 2007, and specific high sea fishing permits for the SPRFMO Area have been issued since 2007–08. Table 2 shows the number of New Zealand vessels that fished and their orange roughy catch by area. Since 2007, an orange roughy catch limit has been applied for New Zealand vessels, being the average annual catch between 2002 and 2006 (1852 t). Australia implements analogous limits for its vessels based on average catches between 2002 and 2006, and no other nations are currently fishing.

Table 2: Annual catch (t) and effort data for orange roughy from New Zealand vessels for the SPRFMO Area (calendar years). Westpac Bank is on the Challenger Plateau but is considered part of the straddling stock ORH 7A so landings from that area are tabulated separately. Australian catches over this period, mostly from the Tasman Sea, ranged from 0 to 148 t, mean 46 t per annum. No other nations fished. 2018 numbers are preliminary.

Year	Number of Vessels	Number of tows	Lord Howe	NW Challenger	Westpac	Louisville	West Norfolk	Other	All areas
2007	8	415	34	36	-	280	515	-	866
2008	4	208	380	31	-	-	426	-	837
2009	6	545	403	238	23	-	233	31	928
2010	7	1 170	385	415	5	584	79	6	1 474
2011	7	1 158	1	675	5	285	113	-	1 079
2012	6	652	121	247	8	288	49	8	721
2013	5	760	344	230	3	565	19	3	1 164
2014	5	403	79	57	54	754	-	54	998
2015	5	959	157	530	118	462	20	-	1 287
2016	6	943	208	486	234	27	-	-	954
2017	5	1 423	215	307	129	420	22	-	1 093
2018	6	1 003	180	399	569	81	5	-	1 232

The SPRFMO Convention was closed for signature in January 2011 and formally entered into force in August 2012. Since that time, monitoring and assessment of catches and fisheries, including for orange roughy, has been overseen by the SPRFMO Scientific Committee.

South Tasman Rise

Exploratory fishing south of Tasmania located aggregations of orange roughy on the South Tasman Rise just outside the Australian Fishing Zone (AFZ) in late 1997. The fishery rapidly increased in the next four years (Table 3), with Australian and New Zealand vessels working several small hill features on the Rise. However, New Zealand vessels have not fished the South Tasman Rise since 2000–01. Effort dropped continuously from 2001–02, and mean catch per tow in 2004–05 was about 1 t/tow. Note that insufficient vessels have fished since 2005–06 to enable presentation of catch or effort summaries.

Table 3: Catch and effort data from the South Tasman Rise (combined Australian and New Zealand data).

Fishing year	Number of tows	Total recorded catch (t)	Mean tow length (h)	Mean catch rate (t/tow)	Mean catch rate (t/h)
1996–97	61	4	0.6	0.1	0.5
1997–98	1 132	3 930	0.7	3.5	17.4
1998–99	1 332	1 705	0.6	1.3	10.4
1999–00	1 086	3 360	0.5	3.1	21.1
2000–01	1 155	830	0.4	0.7	6.7
2001–02	201	170	0.8	1.0	3.5
2002–03	164	110	0.5	0.9	7.9
2003–04	67	2	0.3	0.1	0.4
2004–05	47	55	0.3	1.2	14.7

ORANGE ROUGHY (ORH ET)

The fishery was formally regulated by a Memorandum of Understanding between Australia and New Zealand from December 1998. A precautionary TAC of 2100 t was applied, increased to 2400 t in 2000–01, and then progressively reduced to 600 t for 2004–05. The fishery was closed to all trawling in 2007.

1.2 Summary of trends in commercial fisheries

Information presented to the SPRFMO Scientific Committee shows that New Zealand catches of orange roughy have declined since the early 2000s and have been relatively stable at about 1000 t since about 2006 (Figure 1). This is well below the catch limit of 1 852 t. The distribution of catches between areas has varied substantially.

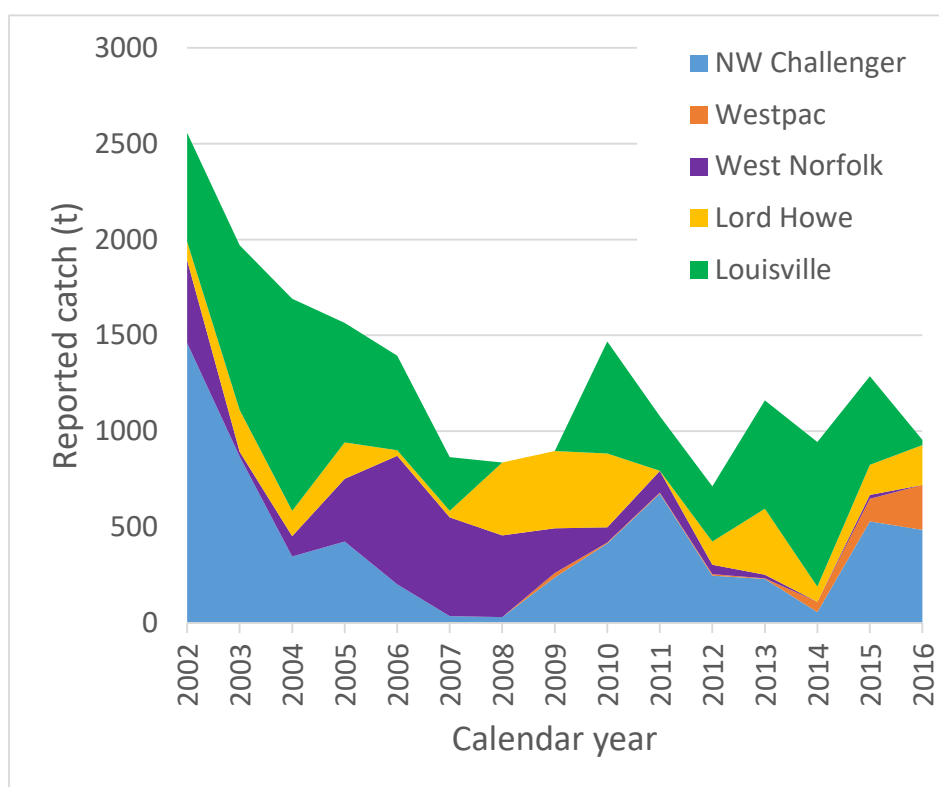


Figure 1: Reported catch by area by New Zealand vessels, 2002–2016.

Catch rates have varied considerably. Roux and Edwards (2017) developed a spatially-disaggregated CPUE index of stock abundance that corrects for some of the known issues with CPUE for orange roughy (Figure 2). This index shows less variability between years than unstandardized or standard GLM modelled-CPUE, but it is still not known whether it indexes biomass.

1.3 Recreational fisheries

There is no non-commercial fishery for orange roughy in these areas.

1.4 Customary non-commercial fisheries

There is no customary non-commercial fishing for orange roughy in these areas.

1.5 Illegal catch

In most of these areas, there were no regulations regarding limits on catch in international waters before 2007. The South Tasman Rise region has been subject to catch restrictions for Australian and New Zealand vessels under a Memorandum of Understanding between the two countries. In 1999–2000 vessels registered in South Africa and Belize fished the region. The estimated catch of at least 750 t has been included in the catch total for that year. No other information is available on any possible illegal catch on the South Tasman Rise, or the Westpac Bank part of ORH 7A.

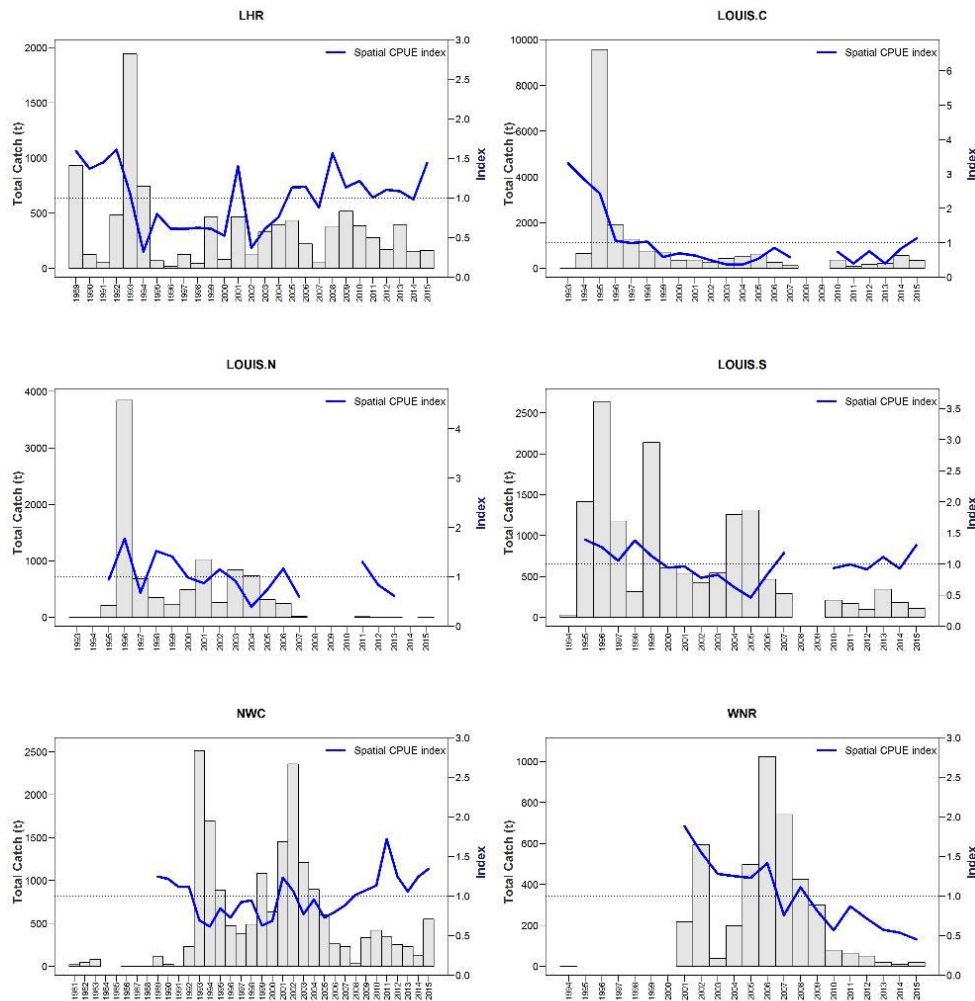


Figure 2: Spatial CPUE indices from Roux & Edwards (2017) for the six orange roughy management areas considered in stock assessments presented to the SPRFMO Scientific Committee in 2017, with annual catch series (histograms).

1.6 Other sources of mortality

There may be some overrun of reported catch because of fish loss with trawl gear damage, ripped nets, discards, and conversion factor inaccuracies. In a number of other orange roughy fisheries, a current level of 5% has been applied (higher in the past). No corrections are made here because of limited information on the sources which may differ with each fishery.

2. STOCKS AND AREAS

Stock structure is uncertain but Clark et al (2016) analysed multiple data sets and recommended that fishing grounds in the following areas be considered as separate units for the purpose of stock assessment: Lord Howe Rise; NW Challenger; SW Challenger; West Norfolk Ridge; South Tasman Rise, and North, Central, and South Louisville (Figure 3).

Orange roughy on the South Tasman Rise are regarded as a straddling stock with fish inside the AFZ. Those on the Westpac Bank on the SW Challenger Plateau are regarded as a straddling stock with fish inside New Zealand's EEZ and the ORH 7A stock.

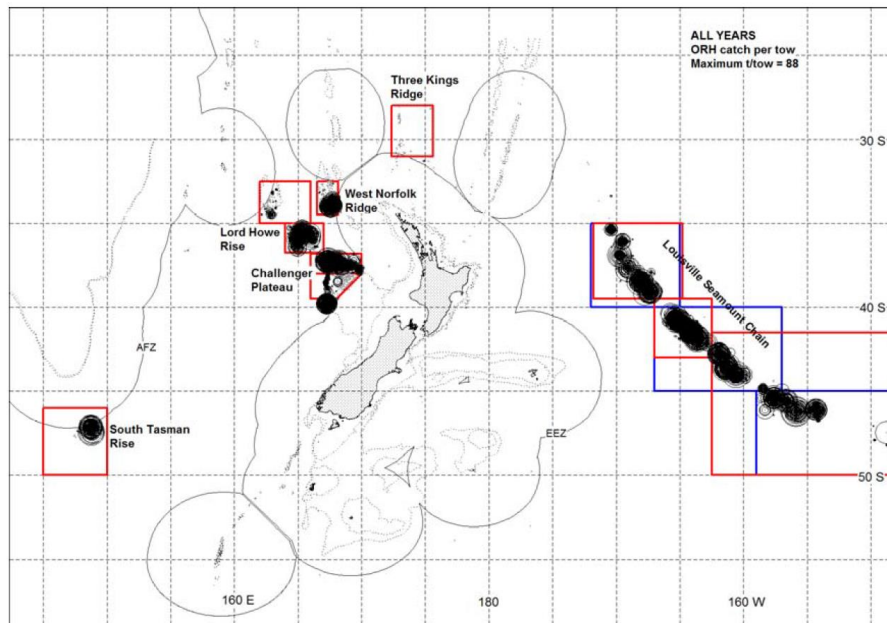


Figure 3: Comparison of new areas assumed for stock assessment purposes (in red) and previous areas (in blue) overlaid on the total distribution of catch rates for orange roughy. Where both areas are coincident, red boxes overlay blue boxes. See Clark et al 2016 for details.

3. STOCK ASSESSMENT

Several low-information stock assessments were presented to the SPRFMO Scientific Committee in 2015 and 2016 but these were not used by the committee to frame advice to the SPRFMO Commission until the 2017 meeting. The following is an extract from the report of the Scientific Committee's meeting in August 2017.

98. *Noting the urgent need to collect information to support robust assessments of orange roughy in the SPRFMO Area for sound management advice, the Scientific Committee considered the three approaches to assess SPRFMO orange roughy stocks as detailed in SC5-DW11 to DW14, SC5-INF03, and the Report of the 2nd Deepwater Workshop of the Scientific Committee (Annex 5). Although none of the methods is ideal for the assessment of SPRFMO orange roughy stocks, the SC considered them to be collectively indicative of stock status and potential yields. The development of advice on catch limits for individual stocks was considered but, because of the level of uncertainty in estimates of status and yield by stock, it was considered better to group the stocks for the development of advice.*
99. *The SC used the lower 95% CIs of estimated stock status to inform the level of precaution that might be appropriate. The group of stocks to the west of New Zealand (in the Tasman Sea) have a greater potential for low stock status than those to the east (Louisville Ridge) and a more precautionary approach was considered appropriate there.*

Papers adopted and cited by the Scientific Committee in framing this advice were as follows:

- Roux et al (2017), FAR 2017/01, tabled as paper SC5-DW11: Low information stock assessment of orange roughy in the SPRFMO Area. Available at: <http://www.sprfmo.int/assets/SC5-2017/SC5-DW11-NZFAR-2017-01-Orange-roughy-SPRFMO-area.pdf>
- Edwards & Roux (2017), tabled as paper SC5-DW12: A simple delay-difference model for assessment of data-poor orange roughy stocks. Available at: <http://www.sprfmo.int/assets/SC5-2017/SC5-DW12-Edwards-Roux-Delay-difference-ORY-model.pdf>
- Roux & Edwards (2017), tabled as paper SC5-DW13: A data limited approach for assessing small scale fisheries for orange roughy in the SPRFMO Area. Available at: <http://www.sprfmo.int/assets/SC5-2017/SC5-DW13-rev1-Roux-Edwards-BDM-method-ORY.pdf>

- Cordue (2017a), tabled as paper SC5-DW14: Catch-history based stock assessments of seven SPRFMO orange roughy stocks. Available at: <http://www.sprfmo.int/assets/SC5-2017/SC5-DW14-Cordue-catch-history-method-ORY.pdf>
- Cordue (2017b), tabled as paper SC5-INF03: A CPUE based stock assessment of the Louisville Central orange roughy stock. Available at: <http://www.sprfmo.int/assets/SC5-2017/SC5-INF03-LouisCentralAssess.pdf>
- Galvez et al (2017), tabled as paper SC5-Doc08: Report from the Deepwater Workshop in Hobart, May 2017. Available at: <http://www.sprfmo.int/assets/SC5-2017/SC5-Doc08-rev1-DWG-Workshop-Report-Final27Sep17.pdf>

4. STATUS OF THE STOCKS

The status of the stocks in the SPRFMO Convention Area is poorly known. The SPRFMO Scientific Committee based its precautionary advice to the Commission in 2017 on the papers cited in Section 3, using the lower limit of 95% confidence or credible intervals of the estimated status from a range of low-information methods. These were tabulated by Cryer et al (2017) (Table 4).

It is not known if recent catch levels are sustainable, or whether they will allow the stocks to move towards a size that will support the *MSY*.

Table 4: Summary results from biomass dynamic modelling using a spatially disaggregated CPUE index (BDM) and catch-history age-structured assessment (CAS) for seven putative stocks of orange roughy. The lower 95% credible limits of depletion are from Roux & Edwards 2017 (BDM) and Cordue 2017a (CAS) and potential yield is here estimated as $B_{curr} \times HR_{MSY}$ (BDM) and the lower limit of Cordue's illustrative range of percentiles from the posterior distribution of long-term yield (CAS).

Management unit	Lower 95% CI from BDM	Potential Yield from BDM (t)	Lower 95% CI from CAS	Potential Yield from CAS (t)
Louisville North	0.35	207	0.32	270
Louisville Central*	0.14	148	0.24	400
Louisville South	0.39	510	0.18	270
West Norfolk Ridge	0.26	60	0.19	110
Lord Howe Rise**	0.49	N/A	0.07	87
Northwest Challenger	N/A	N/A	0.13	170
South Tasman Rise	N/A	N/A	0.42	N/A

* An age-structured CPUE model for Louisville Central (Cordue 2017b) gave estimates of the lower 95% limits for depletion and yield intermediate between those of BDM and CAS models.

** The BDM fit for Lord Howe Rise included an implausibly high estimate of r_{max} for orange roughy and the model was not considered useful.

5. FOR FURTHER INFORMATION

- Anderson, O F (2006) A summary of biological information on the New Zealand fisheries for orange roughy (*Hoplostethus atlanticus*) for the 2003–04 fishing year. *New Zealand Fisheries Assessment Report 2006/16*. 25 p.
- Clark, M R (2003) Estimation of orange roughy biomass on the Louisville Ridge: application of “Seamount Meta-analysis” results. Final Research Report to the Ministry of Fisheries for ORH2002/03. (Unpublished report held by Fisheries New Zealand, Wellington.)
- Clark, M R (2004) Descriptive analysis of orange roughy fisheries in the New Zealand region outside the EEZ: Lord Howe Rise, Northwest Challenger Plateau, West Norfolk Ridge, South Tasman Rise, and Louisville Ridge to the end of the 2002–03 fishing year. *New Zealand Fisheries Assessment Report 2004/51* 36 p.
- Clark, M R (2006a) Descriptive analysis of orange roughy fisheries in the New Zealand region outside the EEZ: Lord Howe Rise, Northwest Challenger Plateau, West Norfolk Ridge, South Tasman Rise, and Louisville Ridge to the end of the 2003–04 fishing year. *New Zealand Fisheries Assessment Report 2006/25*. 37 p.
- Clark, M R (2006b) Descriptive analysis of orange roughy fisheries in the New Zealand region outside the EEZ: Lord Howe Rise, Northwest Challenger Plateau, West Norfolk Ridge, South Tasman Rise, and Louisville Ridge to the end of the 2004–05 fishing year. *New Zealand Fisheries Assessment Report 2006/56*. 38 p.
- Clark, M R (2008) Descriptive analysis of orange roughy fisheries in the New Zealand region outside the EEZ: Lord Howe Rise, Northwest Challenger Plateau, West Norfolk Ridge, South Tasman Rise, and Louisville Ridge to the end of the 2005–06 fishing year. *New Zealand Fisheries Assessment Report 2008/12*. 45 p.
- Clark, M R; Anderson, O F (2001) The Louisville Ridge orange roughy fishery: an update of commercial catch-effort data and CPUE analysis of the fishery to the end of the 1999–2000 fishing year. *New Zealand Fisheries Assessment Report 2001/74*. 31 p.
- Clark, M R; Anderson, O F (2003) The Louisville Ridge orange roughy fishery: an analysis of commercial catch-effort data and stock assessment of the fishery to the end of the 2000–01 fishing year. *New Zealand Fisheries Assessment Report 2003/3*. 26 p.
- Clark, M R; O'Driscoll, R L (2002) Descriptive analysis of orange roughy fisheries in the Tasman Sea outside the New Zealand EEZ: Lord Howe Rise, Northwest Challenger Plateau, and South Tasman Rise from 1986–87 to the end of the 2000–01 fishing year. *New Zealand Fisheries Assessment Report 2002/59*. 26 p.
- Clark, M R; McMillan, P J; Anderson, O F; Roux, M-J (2016) Stock management areas for orange roughy (*Hoplostethus atlanticus*) in the Tasman Sea and western South Pacific Ocean. *New Zealand Fisheries Assessment Report 2016/19*. 27 p.

ORANGE ROUGHY (ORH ET)

- Clark, M; Tilzey, R (1996) A summary of stock assessment information for orange roughy fisheries on the Lord Howe Rise: 1996. Bureau of Resource Sciences, Canberra. 23 p. (Available from BRS, P.O. Box E11, Canberra, Australia).
- Clark, M; Tilzey, R (2001) A summary of commercial catch and effort information for the orange roughy (*Hoplostethus atlanticus*) fishery on the South Tasman Rise from 1987 to 1999. *New Zealand Fisheries Assessment Report 2001/3*. 16 p.
- Cordue, P L (2017a) Catch-history based stock assessments of seven SPRFMO orange roughy stocks. Paper SC05-DW14 for the Scientific Committee of the South Pacific Regional Fisheries Management Organisation, Shanghai, 23–28 August 2017.
- Cordue, P L (2017b) A CPUE based stock assessment of the Louisville Central orange roughy stock. Paper SC05-INF03 for the Scientific Committee of the South Pacific Regional Fisheries Management Organisation, Shanghai, 23–28 August 2017.
- Cryer, M; Bock, T; Nicol, S (2017) Potential scientific advice for Orange roughy stocks / management units within the Western SPRFMO Area. Paper SC05-DW15 for the Scientific Committee of the South Pacific Regional Fisheries Management Organisation, Shanghai, 23–28 August 2017.
- Edwards, C T T; Roux, M-J (2017) A simple delay-difference model for assessment of data-poor orange roughy stocks. Paper SC05-DW12 for the Scientific Committee of the South Pacific Regional Fisheries Management Organisation, Shanghai, 23–28 August 2017.
- Galvez, M; Cryer, M; Nicol, S; Loveridge, C (2017) Report of the SPRFMO Deep Water Working Group Workshop. Paper SC05-Doc08 for the Scientific Committee of the South Pacific Regional Fisheries Management Organisation, Shanghai, 23–28 August 2017.
- O'Driscoll, R L (2001) CPUE analysis of orange roughy fisheries outside the New Zealand EEZ: Lord Howe Rise and Northwest Challenger Plateau, to the end of the 1999–2000 fishing year. *New Zealand Fisheries Assessment Report 2001/36*. 26 p.
- O'Driscoll, R L (2003) Catch-per-unit-effort analysis of orange roughy fisheries outside the New Zealand EEZ: Lord Howe Rise and Northwest Challenger Plateau to the end of the 2001–02 fishing year. *New Zealand Fisheries Assessment Report 2003/36*. 38 p.
- Roux, M-J; Doonan, I; Edwards, C T T; Clark, M R (2017) Low information stock assessment of orange roughy *Hoplostethus atlanticus* in the South Pacific Regional Fisheries Management Organisation Convention area. *New Zealand Fisheries Assessment Report 2017/01*.
- Roux, M-J; Edwards, C T T (2017) A data-limited approach for assessing small-scale fisheries for orange roughy *Hoplostethus atlanticus* in the South Pacific Regional Fisheries Management Organisation Convention Area (SPRFMO). Paper SC05-DW13 for the Scientific Committee of the South Pacific Regional Fisheries Management Organisation, Shanghai, 23–28 August 2017.
- Smith, P J; Robertson, S; Horn, P; Bull, B; Anderson, O; Stanton, B R; Oke, C S (2002) Multiple techniques for determining stock relationships between orange roughy *Hoplostethus atlanticus* fisheries in the eastern Tasman Sea. *Fisheries Research* 58: 119–140.
- Tilzey, R (2000) South Tasman Rise trawl fishery. In: Caton, A., McLoughlin, K. (eds) Fishery status reports 1999: resource assessments of Australian Commonwealth fisheries. BRS, Canberra.
- Wayte, S; Bax, N; Clark, M; Tilzey, R (2003) Analysis of orange roughy catches on the South Tasman Rise, 1997–2002. Report provided to the Orange Roughy Assessment Group. 14 p. (Unpublished report held by CSIRO, Hobart.)