Orange Roughy (2023)

Hoplostethus atlanticus

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STOCK STATUS OVERVIEW

Jurisdiction	Stock	Stock status	Indicators
Commonwealth	Cascade Plateau	Sustainable	Historical spawning stock biomass, fishing mortality
Commonwealth	Eastern Zone	Sustainable	Spawning stock biomass, fishing mortality
Commonwealth	Great Australian Bight	Undefined	Fishing mortality
Commonwealth	South Tasman Rise	Depleted	CPUE, fishing mortality
Commonwealth	Southern Zone	Depleted	Historical spawning stock biomass, fishing mortality
Commonwealth	Western Zone	Depleted	Historical spawning stock biomass, fishing mortality

STOCK STRUCTURE

Orange Roughy is assumed to consist of multiple regional stocks. The species is managed and assessed as a number of discrete regional management units and/or biological stocks, six of which are presented here.

Orange Roughy within the Australian Fishing Zone form a single genetic stock [Gonçalves da Silva et al. 2012]; however, separate demographic units exist despite genetic similarity. Orange Roughy on the Cascade Plateau has distinct morphometrics, parasite populations, size and age

composition, and spawning time, and is considered to be a separate management unit within the Southern Remote Zone [AFMA 2013]. The Orange Roughy stock in the South Tasman Rise is considered to be a discrete population. Research indicates that there is more genetic structure in global Orange Roughy populations than has previously been detected, although Australian and New Zealand stocks could not be differentiated [Varela et al. 2013].

Here, assessment of stock status is presented at the management unit level—Eastern Zone, Southern Zone, Western Zone and Great Australian Bight; and at the biological stock level—Cascade Plateau and South Tasman Rise.

STOCK STATUS

Cascade Plateau

Orange Roughy (Cascade Plateau) in Commonwealth fisheries is managed as a Tier 1 stock under the Southern and Eastern Scalefish and Shark Fishery (SESSF) Harvest Strategy Framework [AFMA 2021a]. In 2006, the species was listed as conservation dependent under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The most recent Tier 1 assessment (2006) used acoustic survey abundance indices to assess spawning aggregations on the Cascade Plateau [Wayte and Bax 2007]. This assessment was then updated in 2009 [Wayte 2009] with an alternative acoustic biomass estimate for 2005 and the addition of landed catch from 2007 to 2009. The updated Tier 1 assessment estimated that the spawning stock biomass would be 64% of the unfished level in 2011 if the recommended biological catch (RBC) of 315 t was taken, or 63% in 2011 if the total allowable catch (TAC) of 500 t was fully caught in 2010 [Wayte 2009].

A recent study by Scoulding and Kloser [2020] indicated that acoustic target strength for large orange roughy, such as those found on the Cascade Plateau, could have overestimated biomass by 58%. This was considered unlikely to have any material impact on the status of the stock since the 2009 assessment [CSIRO 2021, pers. comm.]. The South East Resource Assessment Group (SERAG) accepted this advice from CSIRO but agreed to recommend a TAC of 397 t for the 2021–22 fishing season, based on the long-term RBC from the 2009 stock assessment [AFMA 2021b].

The above evidence indicates that the biomass of this stock is unlikely to be depleted and that recruitment is unlikely to be impaired.

Commonwealth landed catch in the trawl sector of the SESSF was 266 t in the 2021–22 fishing season [Emery et al. 2022]. Estimates of discards by Commonwealth fisheries and state catches are unavailable, however, discards are considered to be negligible and state catches to be zero [Emery et al. 2022]. Since the most recent stock assessment, catches have remained below the long-term RBC of 397 t and been 0 t for several years.

The above evidence indicates that the current level of fishing mortality is unlikely to cause the stock to become recruitment impaired.

On the basis of the evidence provided above, the Cascade Plateau biological stock is classified as a **sustainable stock.**

Eastern Zone

Orange Roughy (Eastern Zone) in Commonwealth fisheries is managed as a Tier 1 stock under the SESSF Harvest Strategy Framework [AFMA 2021a]. In 2006,

the species was listed as conservation dependent under the *Environment Protection and Biodiversity Conservation Act 1999*(EPBC Act).

While the 2017 Tier 1 stock assessment [Haddon 2017a] informed the management of the stock for the 2021–22 fishing season, a new assessment was undertaken in 2021 [Burch et al. 2021]. The assumed stock structure is a combination of eastern zone (primarily St Helens Hill and St Patricks Head) and Pedra Branca from the southern zone. This is based on the hypothesis that a proportion of Orange Roughy (Southern Zone) migrate to the main spawning grounds in the Eastern Zone (St Helens Hill or St Patricks Head) to spawn in winter [Upston et al. 2014].

The 2017 Tier 1 stock assessment [Haddon 2017a] estimated that the spawning stock biomass (SSB) at the start of 2017 was 34% of the unfished level, which is above the limit reference point (LRP) of 20% of the unfished level. This led to a 3-year average RBC of 1,345 t [Haddon 2017a].

The 2021 Tier 1 stock assessment [Burch et al. 2021] estimated spawning stock biomass to be 30% (95% CI 23–40%) of the unfished level at the start of 2021, and projected spawning stock biomass in 2022 to be 30% of the unfished level (assuming that catches in 2021 were the same as in 2020) [Burch et al. 2021]. This resulted in a 3-year average RBC of 737 t [Burch et al. 2021].

The stock is therefore unlikely to be depleted and recruitment is unlikely to be impaired.

Commonwealth landed catch in the trawl sector of the SESSF was 1,450.7 t in the 2021–22 fishing season, which was higher than the agreed TAC set (1,277 t) but less than the actual TAC (1,569 t) set due to the addition of undercatch from the 2020–21 fishing season [Emery et al. 2022]. Discards have been estimated to be 10.7 t based on the weighted average of the previous four fishing seasons (2017 to 2020) [Althaus et al. 2021]. CSIRO undertook maximum posterior density (MPD)-based analyses to test the likely stock response to the fishing mortality in 2021–22, and specifically whether the landed catch in the 2021–22 fishing season exceeded a level that could result in the stock breaching its LRP. The results indicated that the 95% asymptotic confidence intervals do not drop below the LRP at any time during the projection (100 years) and that the stock exceeds the target reference point of 48% of the unfished spawning stock biomass after around 80 years [Emery et al. 2022].

The above evidence indicates that the current level of fishing mortality is unlikely to cause the stock to become recruitment impaired.

Based on the evidence provided above, the Eastern Zone management unit is classified as a **sustainable stock**.

Great Australian Bight

OOrange Roughy (Great Australian Bight) in Commonwealth fisheries is currently managed under a rebuilding strategy [AFMA 2022]. In 2006, the species was listed as conservation dependent under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

No quantitative stock assessment has been conducted for Orange Roughy (Great Australian Bight) because the available data are sporadic and spatially scattered [Knuckey et al. 2010].

Early catches were reported as coming from temporary feeding aggregations associated with cold-water upwelling off Kangaroo Island and Port Lincoln.

Catches from these aggregations ranged from 2,500–3,784 t [Newton 1989]. Aggregations were not found in these locations between the late 1980s and 2004 [Wayte 2004], when the most recent data were available. A spawning aggregation was discovered in 1990 on a ridge 30 nautical miles from the Port Lincoln grounds [Newton and Turner 1990]. This aggregation, which has not been seen since, initially supported high trawl catches of around 40 t per shot, typical of lightly exploited Orange Roughy fisheries, but only yielded a total catch of 800 t before catch rates declined.

More than 96% of the historical catch (1988–2005) and more than 99% of the more recent catch (2000–05) was taken in areas that have since been closed [AFMA 2014]. Until sustainable harvest levels can be determined, fishing will be allowed in these zones only under the Great Australian Bight Trawl Sector (GABTS) Orange Roughy Research Plan that has been approved by AFMA [AFMA 2014].

No commercial catch of Orange Roughy was landed in 2021–22, however, 29 t of research quota was landed as part of the GABTS Orange Roughy Research Plan [GABIA 2020]. As there have been no recent surveys and there is no representative catch-trend data to determine the abundance of Orange Roughy (Great Australian Bight), the stock biomass is uncertain [Moore et al. 2022]. There is insufficient information available to confidently classify the status of this stock.

On the basis of the evidence provided above, the Great Australian Bight management unit is classified as an **undefined stock**.

South Tasman Rise

Orange Roughy (South Tasman Rise) in Commonwealth fisheries is currently managed under a rebuilding strategy [AFMA 2022]. In 2006, the species was listed as conservation dependent under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The only assessment of the Orange Roughy (South Tasman Rise) used catches and catch rates in a standardised catch per tow analysis, as well as examining acoustic data collected during the winter spawning seasons of 1998–2002 [Wayte et al. 2003]. The standardised catch per tow analysis indicated that catch rates declined by 92% between 1997–98 and 2002–03 [Wayte et al. 2003].

Anecdotal information suggests that illegal catches in 1999 may have been substantially higher than documented. These illegal catches may have contributed to reduction of the initial (and likely relatively small) stock biomass, producing the reduced catches and catch rates recorded in 2002–03 [Wayte et al. 2003]. No recovery was evident after this and estimated relative abundance in 2002–03 was only 8% of abundance in 1997–98 [Wayte et al. 2003]. No significant acoustic marks, indicative of spawning aggregations, were apparent during industry surveys in 2000, 2001 or 2002. The assessment concluded that there was little doubt that the stock size, or the availability of fish to the fishery, had decreased dramatically after the first couple of years of the fishery and had shown no signs of recovery.

The fishery has not been surveyed since 2002 and has been closed to fishing since 2007–08. This absence of fishing mortality is expected to allow the stock to recover from its recruitment impaired state, however, detection of increases in biomass has not been attempted.

On the basis of the evidence provided above, the South Tasman Rise biological stock is classified as a **depleted stock**.

Southern Zone

Orange Roughy (Southern Zone) in Commonwealth fisheries is currently managed under a rebuilding strategy [AFMA 2022]. In 2006, the species was listed as conservation dependent under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The most recent accepted assessment of Orange Roughy (Southern Zone) was in 2000. The assessment used standardised catch-per-shot abundance indices from vessels that had regularly fished this zone. This assessment estimated abundance in 2001 to be 7% of the unfished level and below the LRP of 20% of the unfished biomass [Wayte and Bax 2002a].

Noting recovery of the Orange Roughy (Eastern Zone) stock, and a long period of low TACs in the southern zone, SERAG has discussed the possibility that this stock may also be experiencing some level of recovery [AFMA 2019]. Under the rebuilding strategy [AFMA 2022] targeted fishing is not permitted, and SERAG continues to advise an RBC of zero. The above evidence indicates that the biomass of this stock is likely depleted, and that recruitment is likely to be impaired.

Orange Roughy (Southern Zone) is limited to incidental catch allowances, to allow for unavoidable catches while targeting other species. Consequently, AFMA set an incidental catch allowance of 31 t for the 2021–22 fishing season, with an additional 96 t allocated for the Pedra Branca area (assessed as part of Orange Roughy (Eastern Zone).

Commonwealth landed catch in the trawl sector of the SESSF was 119.8 t in the 2021–22 fishing season [Emery et al. 2022]. Estimates of discards by Commonwealth fisheries and state catches are unavailable, however, discards are considered to be negligible and state catches to be zero [Emery et al. 2022]. There are no reliable indicators to determine if this level of fishing mortality will allow the stock to rebuild.

On the basis of the evidence provided above, the Southern Zone management unit is classified as a **depleted stock**.

Western Zone

Orange Roughy (Western Zone) in Commonwealth fisheries is currently managed under a rebuilding strategy [AFMA 2022]. In 2006, the species was listed as conservation dependent under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The most recent accepted assessment of Orange Roughy (Western Zone) was in 2002. It projected that there was a greater than 90% probability that the 2004 biomass would be less than 30% of the 1985 biomass [Wayte & Bax 2002b]. A comparison of the age composition in 1994 to 1996 with that in 2004 showed a marked reduction in the modal age, indicating a heavily fished stock, although it is uncertain whether all the otolith samples were from the same stock.

In 2017, a preliminary analysis of CPUE between 1989 and 2006 was undertaken [Haddon 2017b] to investigate trends in standardised CPUE between 2003 (the last year of data used in previous CPUE analysis) and 2006 (before introduction of deepwater closures). This analysis indicated a potential recovery in the stock between 2002 and 2006, through a 3-fold increase in standardised CPUE.

However, the low number of observations caused a high level of uncertainty [Haddon 2017b]. Although this work was not recommended for use in management, results suggested that further sampling and exploration of the condition of the stock were warranted. Consequently, a Western Orange Roughy Research Program (WORRP) was approved by AFMA in 2020. The WORRP provides a 200 t research catch allowance to support adequate data collection to inform a future stock assessment and to determine whether rebuilding has occurred.

Noting recovery of the Orange Roughy (Eastern Zone) stock, and a long period of low TACs in the western zone, SERAG has discussed the possibility that this stock may also be experiencing some level of recovery [AFMA 2019]. Under the rebuilding strategy [AFMA 2022] targeted fishing is not permitted, and SERAG continues to advise an RBC of zero. The above evidence indicates that the stock is depleted, and that recruitment is likely to have been impaired.

Commonwealth landed catch in the trawl sector of the SESSF was 10.4 t in the 2021–22 fishing season (with an additional 118 t taken under the approved WORRP) [Emery et al. 2022]. Estimates of discards by Commonwealth fisheries and state catches are unavailable, however, discards are considered to be negligible and state catches to be zero [Emery et al. 2022]. There are no reliable indicators to determine if this level of fishing mortality will allow the stock to rebuild.

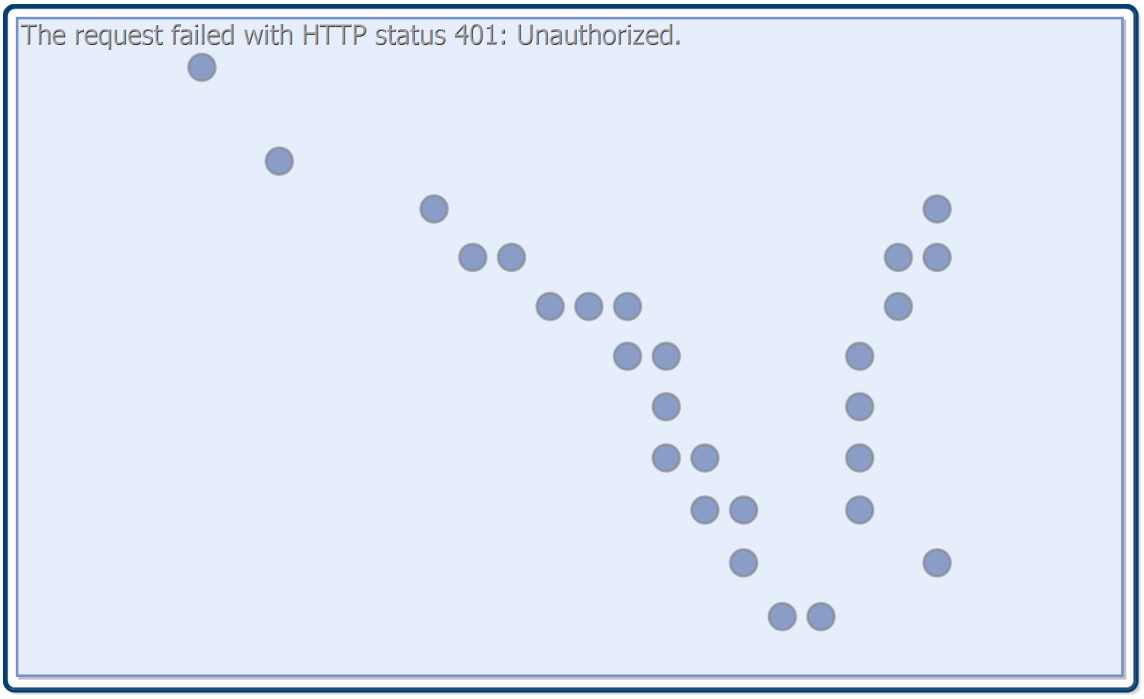
On the basis of the evidence provided above, the Southern Zone management unit is classified as a **depleted stock**.

BIOLOGY

Orange Roughy biology [Fenton et al. 1991;Thomsen 1998; Kloser et al. 2015; Froese and Paul 2016]

Species	Longevity / Maximum Size	Maturity (50 per cent)
Orange Roughy	149 years, 750 mm TL	27–32 years, 350–370 mm TL

DISTRIBUTION



Distribution of reported commercial catch of Orange Roughy

TABLES

Fishing methods	
	Commonwealth
Commercial	
Otter Trawl	✓
Unspecified	✓

Management Methods	
	Commonwealth
Commercial	
Gear restrictions	✓
Limited entry	✓
Marine park closures	✓
Quota	✓
Spatial closures	✓

Total allowable catch	✓
Total allowable catch (incidental)	✓

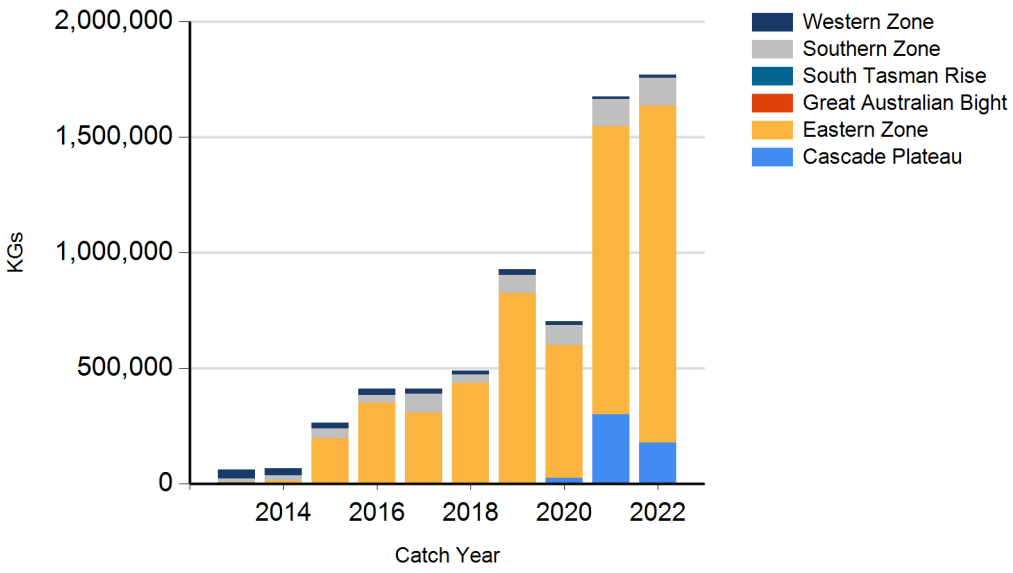
Catch	
	Commonwealth
Commercial	1769.11 t

Commonwealth – Commercial (Management Methods/Catch). Data provided for the Commonwealth align with the Commonwealth Southern and Eastern Scalefish and Shark Fishery for the 2021–22 financial year.

Commonwealth – Recreational. The Australian government does not manage recreational fishing in Commonwealth waters. Recreational fishing in Commonwealth waters is managed by the state or territory immediately adjacent to those waters, under its management regulations.

Commonwealth – Indigenous. The Australian government does not manage non-commercial Indigenous fishing in Commonwealth waters, with the exception of Torres Strait. In general, non-commercial Indigenous fishing in Commonwealth waters is managed by the state or territory immediately adjacent to those waters.

CATCH CHART



Commercial catch of Orange Roughy - note confidential catch not shown

References

AFMA 2013	AFMA 2013, Species summaries for the Southern and Eastern Scalefish and Shark Fishery: for stock assessments completed in 2013 in preparation for the 2014–15 fishing season, Australian Fisheries Management Authority, Canberra.
Varela et al. 2013	Varela, AI, Ritchie, PA and Smith, PJ 2013, Global genetic population structure in the commercially exploited deep-sea teleost orange roughy (Hoplostethus atlanticus) based on microsatellite DNA analyses, Fisheries Research, 140: 83–90.
Gonçalves da Silva et al. 2012	Gonçalves da Silva, A, Appleyard, S and Upston, J 2012, Establishing the evolutionary compatibility of potential sources of colonizers for overfished stocks: a population genomics approach, Molecular Ecology, 24(3): 564–579.
Upston et al. 2014	Upston, J, Punt, AE, Wayte, S, Ryan, T, Day, J and Sporcic, M 2014, Orange Roughy (Hoplostethus atlanticus) Eastern Zone stock assessment incorporating data up to 2014, produced by CSIRO Oceans and Atmosphere, Hobart for AFMA, Canberra.
Kloser et al. 2015	Kloser, R, Sutton, C, Krusic-Golub, K and Ryan, T 2015, Indicators of recovery for orange roughy (Hoplostethus atlanticus) in eastern Australian waters fished from 1987, Fisheries Research, 167: 2225–235.
Wayte and Bax 2002a	Wayte, S and Bax, N 2002a, Southern zone orange roughy stock assessment, report to Orange Roughy Stock Assessment Group CSIRO Marine and Atmospheric Research, Hobart.
Wayte and Bax 2002b	Wayte, S and Bax, N 2002b, Western zone orange roughy stock assessment, report to Orange Roughy Stock Assessment Group CSIRO Marine and Atmospheric Research, Hobart.
Wayte and Bax 2007	Wayte, SE and Bax, N 2007, Stock assessment of the Cascade Plateau orange roughy 2006, CSIRO, Hobart.
Knuckey et al. 2010	Knuckey, IA, Hudson, R and Nemec, J 2010, Monitoring orange roughy in the Great Australian Bight Trawl Fishery 2008, report to AFMA, Canberra.
Wayte et al. 2003	Wayte, SE, Bax, N, Clark, M and Tilzey, R 2003, Analysis of orange roughy catches on the South Tasman Rise 1997-2002, paper for the Orange Roughy Assessment Group, CSIRO, Hobart.
Wayte 2004	Wayte, SE 2004, Analysis of orange roughy catch data from the Great Australian Bight, report to the Australian Fisheries Management Authority, Canberra.
Newton 1989	Newton, G 1989, The orange roughy fishery of the Great Australian Bight, Australian Society for Fish Biology conference, 1989.
Newton and Turner 1990	Newton, G and Turner, D 1990, Spawning roughy in the GAB - a new find, Australian Fisheries, October 1990.
AFMA 2014	AFMA 2014, Orange roughy (Hoplostethus atlanticus) stock rebuilding strategy, Australian Fisheries Management Authority, Canberra.
AFMA 2022	AFMA 2022, Orange roughy (Hoplostethus atlanticus) stock rebuilding strategy 2022, Australian Fisheries Management Authority, Canberra.
Fenton et al. 1991	Fenton, GE, Short, SA and Ritz, DA 1991, Age determination of orange roughy Hoplostethus atlanticus (Pisces: Trachichthyidae) using 210 Pb/226Ra disequilibria, Marine Biology, 109: 197–202.
Thomsen 1998	Thomsen, B 1998, Faroese quest of orange roughy in the North Atlantic, International Council for the Exploration of the Sea Copenhagen (Denmark), theme session on deepwater fish and fisheries, 16–19 September 1998, ICES, Copenhagen, Denmark.
Froese and Pauly 2016	Froese, R and Pauly, D (eds) 2016, FishBase, World Wide Web electronic publication, www.fishbase.org, version (06/2016).
Haddon 2017a	Haddon, M 2017a, DRAFT Orange Roughy East (Hoplostethus atlanticus) stock assessment using data to 2016, CSIRO Oceans and Atmosphere, for discussion by SERAG, November 2017.
AFMA 2021a	AFMA 2021a, Harvest strategy framework for the Southern and Eastern Scalefish and Shark Fishery: amended (2021), Australian Fisheries Management Authority, Canberra.
Burch et al. 2021	Burch, P, Curin Osorio, S and Bessell-Browne, P 2021, Eastern zone orange roughy (Hoplostethus atlanticus) stock assessment based on data up to 2020 – draft, CSIRO Oceans and Atmosphere, Hobart.
Wayte 2009	Cascade orange roughy stock assessment update, CSIRO Oceans and Atmospheric Research, Hobart

Emery et al. 2022	Emery, T, Wright, D, Davis, K, Keller, K, Woodhams, J and Curtotti, R 2022, Commonwealth Trawl and Scalefish Hook sectors, in Patterson, H, Bromhead, D, Galeano, D, Larcombe, J, Timmiss, T, Woodhams, J and Curtotti, R (eds), Fishery status reports 2022, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra.
AFMA 2021b	AFMA 2021b, Southern and Eastern Scalefish and Shark Fishery South East Resource Assessment Group (SERAG) meeting 3, minutes, 29 November – 1 December 2021, Australian Fisheries Management Authority, Canberra.
Clark 2001	Clark, M 2001, Are deepwater fisheries sustainable? – the example of orange roughy (Hoplostethus atlanticus) in New Zealand, Fisheries Research, 51: 123–35.
Moore et al. 2022	Moore, A, Keller, K and Tuynman, H 2022, Great Australian Bight Trawl Sector, in Patterson, H, Bromhead, D, Galeano, D, Larcombe, J, Timmiss, T, Woodhams, J and Curtotti, R (eds), Fishery status reports 2022, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra.
GABIA 2020	GABIA 2020, Orange roughy research plan for the GABTF 2020–2024, Great Australian Bight Industry Association, Adelaide.
AFMA 2019	AFMA 2019, Southern and Eastern Scalefish and Shark Fishery South East Resource Assessment Group (SERAG) meeting, minutes, 3–4 December 2019, Australian Fisheries Management Authority, Canberra.
Haddon 2017b	Haddon, M 2017b, Statistical CPUE standardisations for western zone orange roughy (1989–2006), CSIRO Oceans and Atmosphere, Hobart.
Althaus et al. 2021	Althaus, F, Thomson, R and Sutton, C 2021, Southern and Eastern Scalefish and Shark Fishery catches and discards for TAC purposes using data until 2020, CSIRO Oceans and Atmosphere, Hobart.
Scoulding and Koloser 2020	Scoulding, B and Koloser, R 2020, Industry-collected target strength of high seas orange roughy in the Indian Ocean, ICES Journal of Marine Science, 78: 2120–31.