Chapter 11

Great Australian Bight Trawl Sector

A Moore and A Koduah

FIGURE 11.1 Relative fishing intensity in the Great Australian Bight Trawl Sector, 2016–17 fishing season

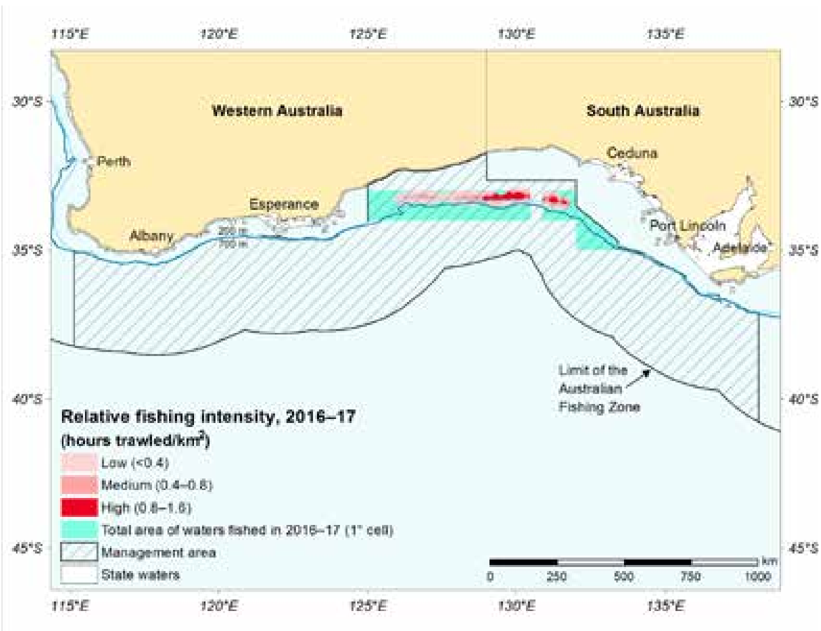


TABLE 11.1 Status of the Great Australian Bight Trawl Sector

Status	2015		2016		Comments
Biological status	**Fishing mortality**	**Biomass**	**Fishing mortality**	**Biomass**	
Bight redfish (*Centroberyx gerrardi*)					Catch is below RBC. Estimate of current biomass is above the target.
Deepwater flathead (*Platycephalus conatus*)					Catch is below RBC. Estimate of current biomass is near the target.
Ocean jacket (*Nelusetta ayraud*)					Catch has been stable in recent years. No formal assessment. Fishery-independent survey data indicate stock is not overfished.
Orange roughy (*Hoplostethus atlanticus*)					No commercial catch. No formal assessment of biomass, and impact of historical catches is uncertain.
Economic status	NER are likely to have increased slightly in 2015–16. The positive effects of lower effort and the ongoing fall in the price of fuel are likely to have more than offset the negative effect on NER of a lower gross value of production.				

Notes: **NER** Net economic returns. **RBC** Recommended biological catch.

Fishing mortality	Not subject to overfishing	Subject to overfishing	Uncertain
Biomass	Not overfished	Overfished	Uncertain

Trawl catch
SETFIA

11.1 Description of the fishery

Area fished

The former Great Australian Bight Trawl Fishery was amalgamated with the Southern and Eastern Scalefish and Shark Fishery (SESSF) in 2003 to become the Great Australian Bight Trawl Sector (GABTS; Figure 11.1) of the SESSF.

The GABTS can be divided into a continental-shelf fishery (at depths of less than 200 m), an upper continental-slope fishery (at depths of about 200–700 m) and a deepwater fishery (on the mid- to lower slope, depth 700–1,000 m).

Fishing methods and key species

The fishing methods used in the GABTS are otter trawl and Danish-seine; pair trawling has been trialled in the past. In shelf waters, trawling is usually at depths of 120–200 m, targeting mainly deepwater flathead (*Platycephalus conatus*) and bight redfish (*Centroberyx gerrardi*). The shelf fishery operates year round. For upper continental-slope trawling, target species include blue grenadier (*Macruronus novaezelandiae*), western gemfish (*Rexea solandri*) and pink ling (*Genypterus blacodes*). Ocean jacket (*Nelusetta ayraud*) is an important byproduct species, with 228 t landed in 2016–17. Other byproduct species include angel shark (*Squatina* spp.), yellow-spotted boarfish (*Paristiopterus gallipavo*), latchet (*Pterygotrigla polyommata*) and jackass morwong (*Nemadactylus macropterus*). Danish-seine targets deepwater flathead on the continental shelf.

Management methods

The Commonwealth Fisheries Harvest Strategy Policy (HSP; DAFF 2007) and the SESSF Harvest Strategy Framework (AFMA 2009) both apply to the key species in the GABTS (see Chapter 8). Under the framework, recommended biological catches (RBCs) are usually based on achieving a default target reference point of 48 per cent of the unfished biomass ($0.48B_0$), as a proxy for the biomass producing maximum economic yield (B_{MEY}). However, a bio-economic model (Kompas et al. 2012) estimated B_{MEY} target reference points of $0.43B_0$ for deepwater flathead and $0.41B_0$ for bight redfish in the GABTS. These estimated B_{MEY} targets were used by the Australian Fisheries Management Authority (AFMA) Commission to set the total allowable catch (TAC) for bight redfish and deepwater flathead for the 2016–17 fishing season.

Fishing effort

Total trawl fishing effort across all depths in 2016–17 was 12,480 trawl hours, down from the 2004–05 peak of 30,866 trawl hours. The continental shelf continues to be the focus of fishing effort, with 11,888 trawl hours in 2016–17 (Figure 11.2), compared with 591 trawl hours on the continental slope (Figure 11.3).

The deepwater fishery historically targeted orange roughy (*Hoplostethus atlanticus*). However, since 2007, when most of the historical orange roughy fishing grounds were closed under the Orange Roughy Conservation Programme (AFMA 2006), little effort has occurred at these depths.

The fishery has 10 boat statutory fishing rights that allow a boat to fish in the fishery, and separate quota statutory fishing rights that allow quota species to be landed. Four trawl vessels and one Danish-seine vessel operated in the fishery in 2016–17.

Catch

Reduced effort in the fishery has led to reduced catches of key target species over time. Deepwater flathead continues to dominate catches, with 636 t landed in the 2016–17 fishing season, which was 55 per cent of the TAC. Bight redfish landings in 2016–17 were 274 t, which was 23 per cent of the TAC.

FIGURE 11.2 Catch and effort on the GABTS shelf, 1988–89 to 2016–17

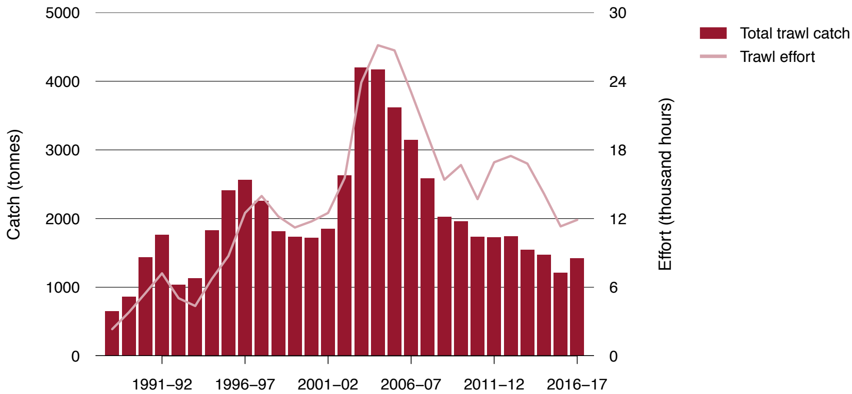


FIGURE 11.3 Catch and effort on the GABTS slope, 1988–89 to 2016–17

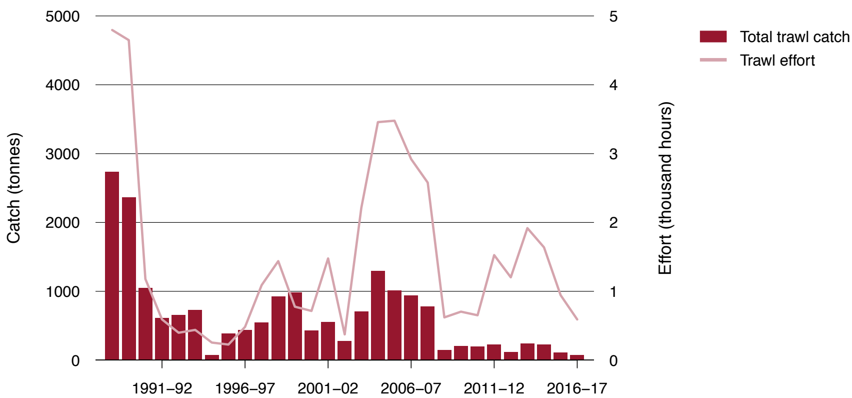


TABLE 11.2 Main features and statistics for the GABTS

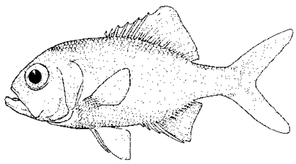
Fishery statistics a	2015–16 fishing season			2016–17 fishing season		
Stock	**TAC (t)**	**Catch (t)**	**Real value (2015–16)**	**TAC (t)**	**Catch (t)**	**Real value (2016–17)**
Bight redfish	2,358	191	$940,000	1,179	274	na
Deepwater flathead	1,150	631	$4.38 million	1,150	636	na
Ocean jacket	–	216	$366,000	–	228	na
Orange roughy **b**	0 (200, 50)	0 (0, 0)	0	0 (200, 50)	0 (0, 0)	na
Total	**3,508 (250) c**	**1,038**	**$7.69 million**	**2,329 (250) c**	**1,138**	**na**
Fishery-level statistics						
Effort	13,509 trawl hours; 511 seine shots			12,480 trawl hours; 442 seine shots		
Fishing permits (SFRs)	10			10		
Active vessels	3 trawl; 1 seine			4 trawl; 1 seine		
Observer coverage	182 trawl hours (1.35%)			366 trawl hours (2.93%)		
Fishing methods	Trawl, Danish-seine					
Primary landing ports	Adelaide, Port Lincoln, Thevenard (South Australia)					
Management methods	Input controls: limited entry, area closures, gear restrictions Output controls: ITQs, TACs, trigger limits					
Primary markets	Domestic: Melbourne, Perth, Sydney					
Management plan	*Southern and Eastern Scalefish and Shark Fishery Management Plan 2003*					

a Fishery statistics are provided by fishing season, unless otherwise indicated. Fishing season is 1 May to 30 April. Real-value statistics are by financial year and were not available for the 2016–17 financial year at time of publication. **b** A 200 t research quota and a 50 t bycatch TAC in the Albany and Esperance zones are not included in the total catch. **c** Research allowance.
Notes: **ITQ** Individual transferable quota. **na** Not available. **SFR** Statutory fishing rights. **TAC** Total allowable catch. – Not applicable.

Bight redfish
AFMA

11.2 Biological status

Bight redfish (*Centroberyx gerrardi*)



Line drawing: FAO

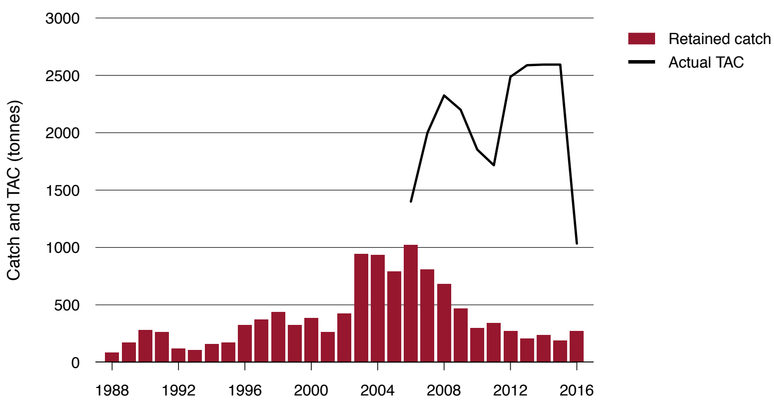
Stock structure

The biological stock structure of bight redfish is unknown. It is considered to be a single biological stock in the GABTS for assessment and management purposes.

Catch history

Catch of bight redfish in the GABTS increased to 572 t in 2003–04, before almost doubling in association with the temporary introduction of a freezer trawler to the fishery. Catch reached a peak of 1,407 t in 2007–08. The freezer trawler departed in 2008, and effort decreased to around half of peak levels. Landed catch in the 2016–17 fishing season was 274 t (Figure 11.4).

FIGURE 11.4 Bight redfish annual catches and fishing season TACs in the GABTS, 1988 to 2016



Note: **TAC** Total allowable catch.

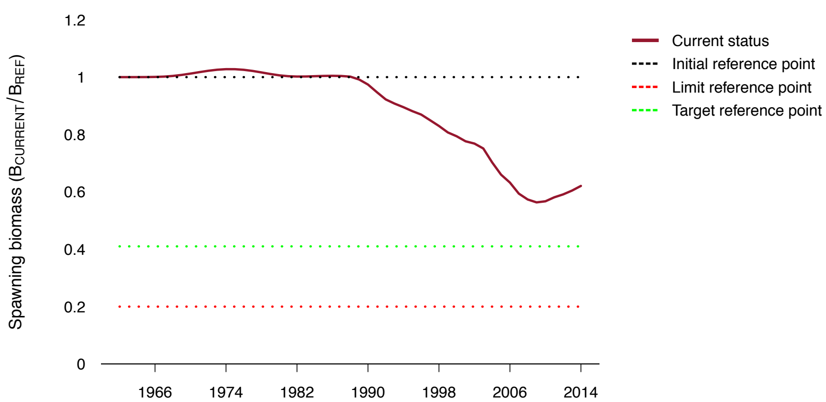
Stock assessment

The target reference point for bight redfish of 41 per cent of the unfished spawning stock biomass ($0.41SB_0$; Kompas et al. 2012) was accepted by the Great Australian Bight Resource Assessment Group (GABRAG) in 2011 (AFMA 2011). The 2011 tier 1 stock assessment for bight redfish (Klaer 2011) was updated in 2015 (Haddon 2015). The base-case assessment predicted the female spawning biomass at the start of 2015–16 to be 63 per cent of unexploited female spawning stock biomass, above the target reference point of $0.41SB_0$. The unexploited female spawning biomass was estimated to be 5,451 t. The large reduction in the estimate of female spawning biomass from the 2011 assessment (26,210 t) reflects that the data now available for the updated assessment are more informative about the unfished biomass and the effects of fishing (Figure 11.5).

Fishery-independent trawl surveys were undertaken each year between 2006 and 2011 (except for 2010), and estimated relative abundance of the main target and byproduct species on the shelf (Knuckey & Hudson 2007; Knuckey et al. 2008, 2009, 2011). A 2015 fishery-independent trawl survey estimated that the relative biomass of bight redfish (2,573 t; coefficient of variation [CV] 0.28) had decreased 80 per cent from the previous 2011 estimate (13,189 t; CV 0.13). The GABTS industry has noted a decrease in available bight redfish in recent seasons. Length-frequency data suggest a truncation of larger bight redfish between 2011 and 2013. Ageing data also indicate a reduction in the abundance of older redfish in recent years.

The updated stock assessment (Haddon 2015) produced an RBC under the 20:35:41 harvest control rule of 862 t for the 2016–17 fishing season, or three- or five-year RBCs of 828 t and 797 t, respectively. Application of the large change–limiting rule limited the reduction in the 2016–17 fishing season TAC to 1,179 t.

FIGURE 11.5 Estimated spawning biomass of bight redfish in the GABTS, 1962 to 2014

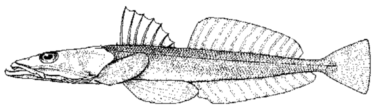


Source: Haddon 2015

Stock status determination

The 2015 stock assessment predicted female spawning biomass to be 63 per cent of unfished levels and above the target reference point of $0.41B_0$. Catch in recent seasons continues to be well below RBCs. On this basis, bight redfish is classified as **not overfished** and **not subject to overfishing**.

Deepwater flathead (*Platycephalus conatus*)



Line drawing: Karina Hansen

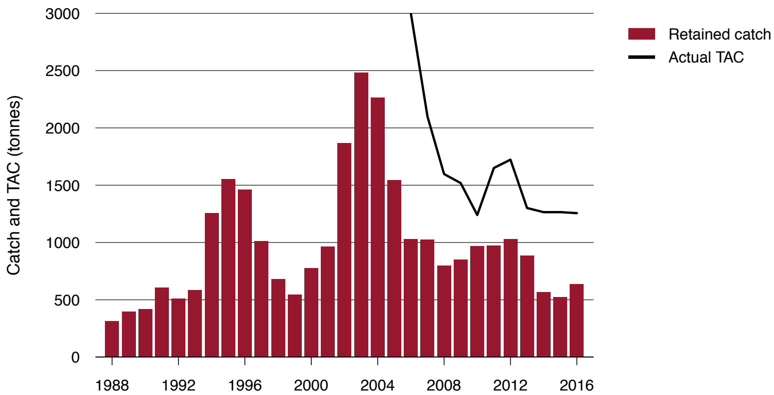
Stock structure

The biological stock structure of deepwater flathead is unknown. The stock is considered to be a single biological stock in the GABTS for assessment and management purposes.

Catch history

Catch of deepwater flathead peaked in 2003–04 at just under 2,500 t, and has been relatively stable at under 1,000 t since 2008–09. Landed catch in the 2016–17 fishing season was 636 t (Figure 11.6).

FIGURE 11.6 Deepwater flathead annual catch and fishing season TACs in the GABTS, 1988 to 2016



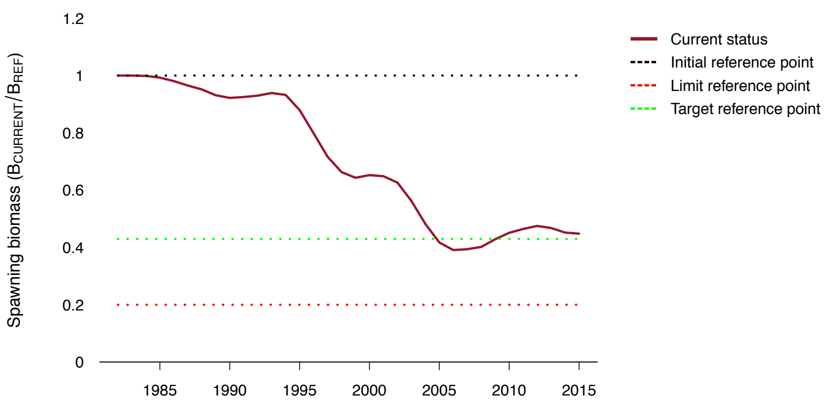
Note: **TAC** Total allowable catch.

Stock assessment

The target reference point for deepwater flathead of 43 per cent of the unfished spawning stock biomass ($0.43SB_0$; Kompas et al. 2012) was accepted by GABRAG in 2011 (AFMA 2011). The 2013 tier 1 stock assessment for bight redfish (Klaer 2013) was updated in 2016 (Haddon 2016). The 2016 base-case assessment predicted the female spawning biomass at the start of 2016–17 to be 45 per cent of unexploited female spawning stock biomass, above the target reference point of $0.43B_0$. This depletion level is consistent with the 2013 assessment. The unexploited female spawning biomass was estimated to be 4,993 t. Application of the 20:35:43 harvest control rule produced an RBC for 2014–15 of 1,146 t. The multiyear TAC of 1,150 t was retained for the 2016–17 fishing season.

The results of the 2015 fishery-independent trawl survey (Knuckey et al. 2015) suggested that estimated relative biomass of deepwater flathead had decreased to 5,065 t (CV 0.09), compared with 9,227 t in the 2011 survey (CV 0.05)—this is a 45 per cent reduction (Knuckey et al. 2009, 2011, 2015). The updated stock assessment suggested no change in depletion level between 2013 and 2016, although the estimate of unexploited female spawning stock biomass had decreased from 9,320 t to 4,993 t. The GABTS industry has noted a decrease in available deepwater flathead in recent seasons, which correlates with decreasing catch. There is no evidence of a truncation in size or age structure of deepwater flathead (Haddon 2016).

FIGURE 11.7 Estimated spawning biomass of deepwater flathead in the GABTS, 1982 to 2015

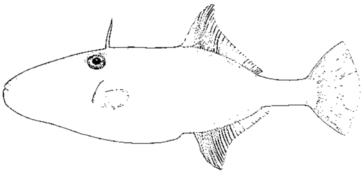


Source: Haddon 2016

Stock status determination

The 2016 stock assessment predicted spawning biomass in 2016–17 to be near the target reference point and above the limit reference point from the HSP ($0.2SB_0$). Catch continues to be below the RBC. On this basis, deepwater flathead is classified as **not overfished** and **not subject to overfishing**.

Ocean jacket (*Nelusetta ayraud*)



Line drawing: FAO

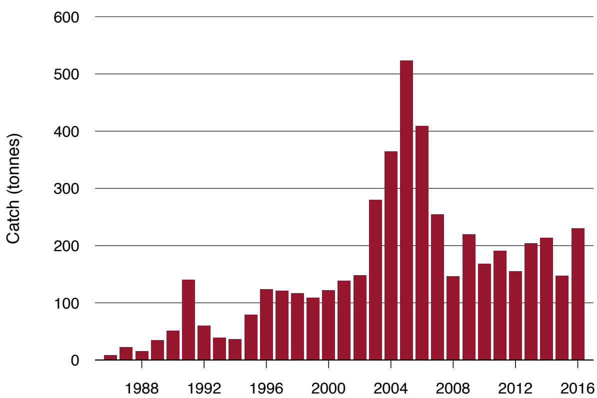
Stock structure

The biological stock structure of ocean jacket is unknown. In the GABTS, it is assessed as a separate stock from the stock in the Commonwealth Trawl and Scalefish Hook sectors.

Catch history

Landed catch of ocean jacket peaked in 2005 at 527 t, but then decreased, and has been less than 250 t since 2008–09 (Figure 11.8). Landed catch in the 2016–17 fishing season was 228 t.

FIGURE 11.8 Ocean jacket catch in the GABTS, 1986 to 2016



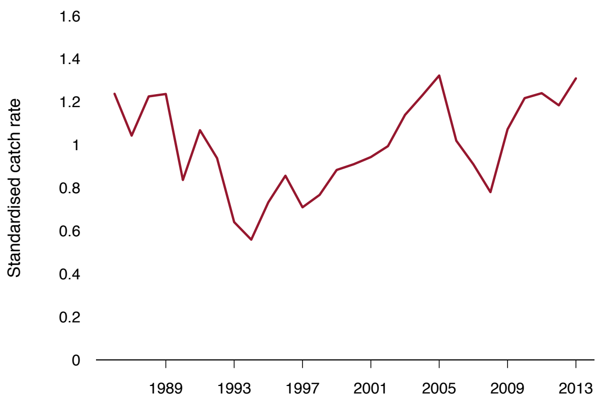
Stock assessment

Formal stock assessments are not conducted for ocean jacket in the GABTS. Standardised catch rates have been variable; the most recent catch rates were similar to those at the start of the series (1986) (Sporcic & Haddon 2015; Figure 11.9).

Ocean jacket represented 16–35 per cent of survey catch by weight in the 2006, 2008, 2009 and 2011 fishery-independent trawl surveys, with an increase in relative abundance between 2009 and 2011 (Knuckey & Hudson 2007; Knuckey et al. 2008, 2009, 2011). Ocean jacket represented 7 per cent of the catch in the 2015 fishery-independent trawl survey, with an estimated relative biomass of 3,702 t (CV 0.19) (Knuckey et al. 2015) compared with 27,712 t (CV 0.20) in 2011. A bycatch survey of the GABTS in 2002 indicated that ocean jacket is often discarded (Knuckey & Brown 2002), potentially limiting the use of commercial catch-per-unit-effort as an index of abundance for this species.

Ocean jacket is a relatively short-lived species (approximately six years), reaching maturity within 2–3 years. Large cyclical changes in abundance appear to have occurred off eastern Australia (Miller & Stewart 2009). Historical catch data suggest that ocean jacket was fished down off the east coast of Australia in the 1920s and 1950s (Klaer 2001). There are no age data for ocean jacket from the GABTS, and the available historical length-frequency data are too old to be used as an index of abundance.

FIGURE 11.9 Standardised catch rate for ocean jacket in the GABTS, 1986 to 2013

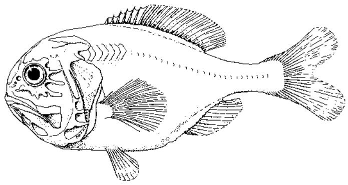


Source: Sporcic & Haddon 2015

Stock status determination

No formal stock assessment for ocean jacket in the GABTS has been done. However, its catch histories and life history characteristics suggest that it is unlikely that the stock is overfished. The level of catch in 2016–17 is unlikely to constitute overfishing. On this basis, ocean jacket in the GABTS is classified as **not overfished** and **not subject to overfishing**.

Orange roughy (*Hoplostethus altanticus*)



Line drawing: Rosalind Murray

Stock structure

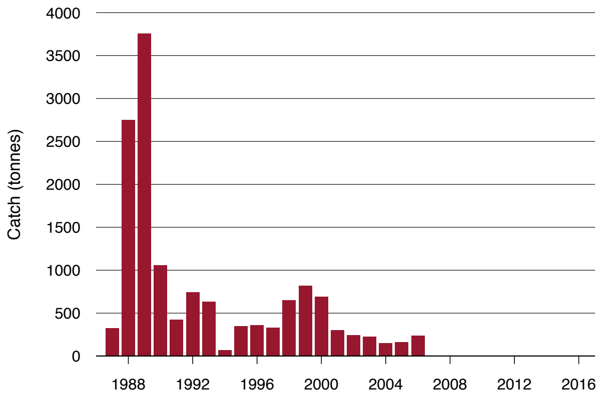
The stock structure of orange roughy in the Australian Fishing Zone (AFZ) is unresolved. Based on the existing data and fishery dynamics, multiple regional stocks of orange roughy are assumed, and the fishery is managed and assessed as a number of discrete regional management units, shown in Figure 9.34 (Chapter 9).

Gonçalves da Silva et al. (2012) examined variation in a large number of loci using genetic techniques that have the power to detect low levels of genetic differentiation. The study concluded that orange roughy in the AFZ form a single genetic stock, but identified some differentiation between Albany/Esperance, Hamburger Hill (in the Great Australian Bight) and south-eastern Australia. It was noted that the amount of genetic exchange needed to maintain genetic homogeneity is much less than the amount needed for demographic homogeneity, and that residency or slow migration may result in separate demographic units, despite genetic similarity (Morison et al. 2013).

Catch history

Catch of orange roughy in the GABTS peaked at 3,757 t in 1988–89 and then declined (Figure 11.10). Since 1990, most of the GABTS catch has come from grounds off Albany and Esperance in the western part of the fishery. Early fishery-independent trawl surveys on the continental slope in the Great Australian Bight reported that orange roughy had the highest maximum catch rate (1,820 kg/hour) of any slope species at that time (Newton & Klaer 1991). The highest catch rates came from the locations of the original aggregations off Kangaroo Island and Port Lincoln, although the surveys found no large aggregations comparable with the historical aggregations. It seems likely that orange roughy across the Great Australian Bight has been depleted, with no large aggregation being seen since 1990. However, the actual level of depletion is unknown. Catch was zero between 2008–09 and 2011–12, and negligible thereafter. No catch was reported in the 2016–17 fishing season.

FIGURE 11.10 Orange roughy catch in the GABTS, 1987 to 2016



Stock assessment

No quantitative stock assessment has been conducted for orange roughy in the GABTS 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 t to 3,784 t (Newton 1989). Aggregations have not been found in the same locations since then (Wayte 2004). A spawning aggregation was discovered in 1990 on a ridge 30 nautical miles from the Port Lincoln grounds (Newton & Tuner 1990). This aggregation, which has not been seen since, initially supported trawl catches of around 40 t/shot, typical of lightly exploited orange roughy fisheries, but only yielded a total catch of 800 t before being depleted.

Orange roughy was listed as conservation dependent under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in 2006. A deepwater management strategy was implemented to address the requirements of the Orange Roughy Conservation Programme (AFMA 2006), under which commercial fishing was closed in several orange roughy zones across the Great Australian Bight, particularly the areas deeper than 700 m. More than 96 per cent of the historical catch (1988 to 2005) and more than 99 per cent of the more recent catch (2001 to 2005) was taken in these closed zones. Until sustainable harvest levels can be determined, fishing will be allowed in these zones only under a research program that has been approved by AFMA. The allocated research quota for 2015–16 was 200 t, but no catch was taken under a research permit during this season. The orange roughy incidental catch allowance remained at 50 t for the 2015–16 fishing season, with zero reported catch. The Orange Roughy Conservation Programme 2006 has been replaced by the Orange Roughy Rebuilding Strategy 2014 (AFMA 2014). Existing arrangements in the GABTS fishery have been maintained under the updated rebuilding strategy.

Stock status determination

There have been no recent surveys or representative catch-trend data to determine the abundance of orange roughy in the Great Australian Bight. As a result, this stock is classified as **uncertain** with regard to the level of biomass. Given that zero or negligible orange roughy catch has been reported in recent years, and that areas where more than 96 per cent of historical catches were taken are now closed, orange roughy is classified as **not subject to overfishing**.

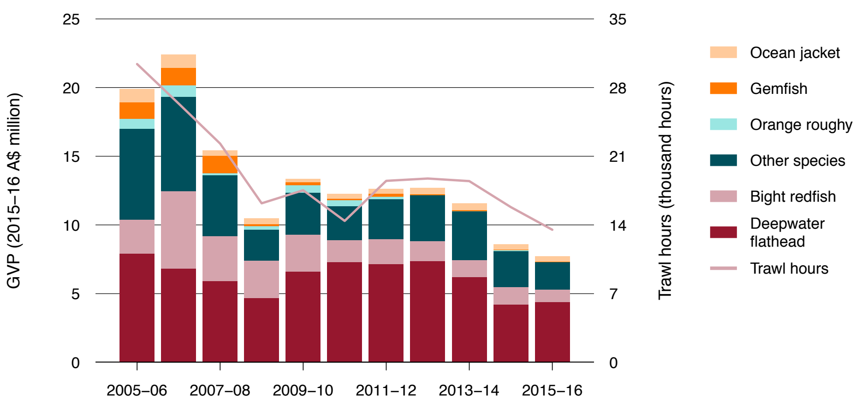
11.3 Economic status

Key economic trends

Estimates of net economic returns (NER) for the GABTS are not available. The real gross value of production (GVP) for the fishery increased from $19.90 million in 2005–06 to a peak of $22.42 million in 2006–07 (in 2015–16 dollars; Figure 11.11). Reductions in the GABTS catch resulted in real GVP declining substantially in the next two years, falling to $10.50 million in 2008–09; GVP then increased in 2009–10 to $13.36 million. Following this, real GVP for the fishery remained steady at around $12.00 million until 2013–14. An average of around $8.00 million was generated over the following two years. GVP in 2015–16 was $7.69 million. In 2015–16, deepwater flathead contributed $4.38 million (57 per cent of total GVP), and bight redfish contributed $940,000 (12 per cent).

Recent declines in catch are consistent with reductions in effort, which would have reduced sector costs. Changes in hours trawled have been closely correlated with changes in GVP over the examined period (Figure 11.11). Hours trawled decreased from 30,399 hours in 2005–06 to 15,820 hours in 2014–15. Hours trawled declined by a further 15 per cent in 2015–16 to 13,509 hours. The decline in effort in 2015–16 coincided with a 23 per cent fall in the price of fuel. Although GVP declined for the second consecutive year (by 33 per cent compared with 2013–14), the decline in effort and unit fuel price suggests that costs in the fishery fell faster than revenue in 2015–16, suggesting an increase in profitability.

FIGURE 11.11 Real GVP for the GABTS by key species and trawl hours, 2005–06 to 2015–16

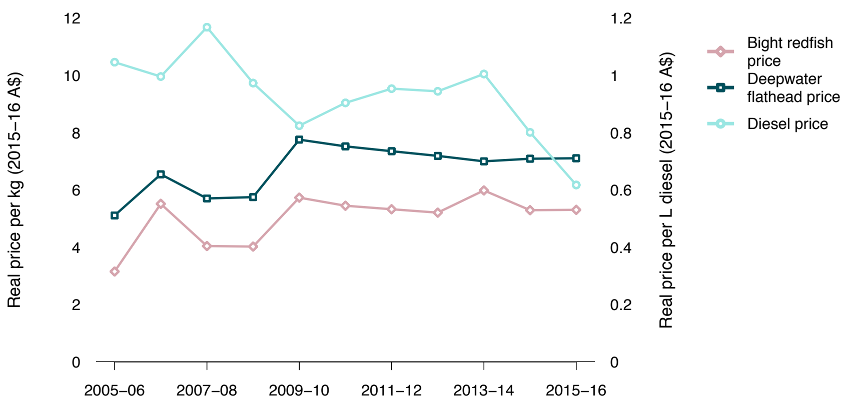


Notes: **GVP** Gross value of production. Trawl hours do not include Danish-seine effort. One Danish-seine vessel was active from 2012–13 to 2016–17.

Although lower catches have driven the decrease in GVP in recent years, this has been partially offset by increasing prices received for key species caught in the sector (Figure 11.12). Higher prices in 2009–10, which are considered to partially reflect improvements in product quality (GABMAC 2009, 2010), drove the increase in GVP between 2008–09 and 2010–11. Average prices in 2015–16 were $7.11 per kilogram for deepwater flathead and $5.31 per kilogram for bight redfish, up from $5.11 per kilogram for deepwater flathead and $3.16 per kilogram for bight redfish (2015–16 dollars) in 2005–06.

Trawling—the main method used in the sector—is typically fuel intensive. Fluctuations in the price of fuel are therefore likely to be a key driver of sector profitability. The Australian average off-road diesel price followed a decreasing trend over the period examined (Figure 11.12). It peaked in 2007–08 at $1.17 per litre, before declining to $0.82 per litre in 2009–10, and falling sharply in 2015–16 to $0.62 per litre (all expressed in 2015–16 dollars). A high price of fuel can negatively affect profitability, but increases in fish prices since 2003–04 and the significant fall in the price of fuel in 2014–15 have reduced this impact.

FIGURE 11.12 Annual average prices for deepwater flathead and bight redfish, and annual average off-road diesel price, 2005–06 to 2015–16



Note: The off-road diesel price is the price per litre paid by farmers (excludes goods and services tax).

Management arrangements

Like other SESSF sectors, the GABTS is a limited-entry fishery managed under TACs for target species, allocated as individual transferable quotas. During the 2016–17 fishing season, 636 t of deepwater flathead was caught (55 per cent of the 1,150 t TAC), and 274 t of bight redfish was caught (23 per cent of the 1,179 t TAC). Market prices for bight redfish are sensitive to supply (Kompas et al. 2012), so the high level of latency may be partly explained by fishers not wanting to land large volumes of bight redfish that could drive down the market price. For this reason, the industry has voluntary trip limits in place for bight redfish.

The GABTS began a trial of fishery co-management in July 2009 (AFMA 2012a). This has seen the Great Australian Bight Fishing Industry Association take a greater role in management decisions, including making direct operational recommendations to AFMA, improving fisheries data collection, developing a chain-of-custody process to improve product traceability and developing a boat operating procedures manual. Such an approach should be associated with improvements in the cost, efficiency and adaptability of management (FRDC 2008). The trial of co-management arrangements received positive feedback from those operating in the GABTS (GABMAC 2010), and these arrangements have been maintained in the fishery.

Performance against economic objective

The most recent stock assessments for bight redfish projected biomass levels at the start of 2014–15 to be above the target (Haddon 2015), potentially allowing increased profits from the species as it is fished down to its maximum economic yield (MEY) target reference point. Similarly, the latest assessment for deepwater flathead indicates that the stock is at, or slightly above, the MEY target (Haddon 2016). Hence, it is unlikely that fishery profitability is constrained by stock size.

Estimates of specific bio-economic target reference points for the two key species have improved the ability to manage stocks at levels that maximise NER. However,as noted by Kompas et al. (2012), the accuracy of the target for each species could potentially be improved with information on how prices for each species are influenced by catch levels. Taking these factors into account in the setting of target reference points for each species would allow an improved assessment of economic performance.

11.4 Environmental status

The GABTS ecological risk management report (AFMA 2008; updated 2012b, 2015) indicated that two byproduct invertebrate species groups—cuttlefish (various species) and octopods (various species)—were at high risk in this fishery (level 2 Residual Risk Assessment). However, this risk determination primarily reflected uncertainty resulting from a lack of data. The level 3 Sustainability Assessment for Fishing Effects (SAFE) excluded invertebrates and indicated that fishing mortality did not exceed the reference point for any of the 204 vertebrate species assessed (Zhou et al. 2007). Impacts on bycatch species have been further reduced by a decrease in effort and closures in the fishery.

As part of their boat-specific seabird management plans, vessels are required to use effective seabird mitigation devices. In late 2014, AFMA completed a trial, using observers, to test the effect of seabird mitigation devices on seabird interactions with otter trawlers. The trial showed that the use of warp deflectors (large floats attached in front of trawl warps to scare birds away—often called 'pinkies') reduced heavy contact between actively feeding seabirds and warp wires by around 75 per cent (Pierre et al. 2014). Based on the outcomes of the trial, AFMA mandated a minimum requirement in seabird management plans of 600 mm pinkies. The South East Trawl Fishing Industry Association (SETFIA) has also introduced a code of conduct and a training program to improve seabird avoidance measures, and trialled alternative seabird mitigation devices, including water sprayers and bird bafflers. The trial was completed in June 2016, but the report is not yet publicly available. SETFIA has reported that water sprayers and bird bafflers used in the trial reduced interactions between seabirds and the warp by 90 per cent and 96 per cent, respectively. Following the success of this trial, AFMA announced that from 1 May 2017 all vessels in the Commonwealth Trawl Sector and GABTS fisheries must use one of the following mitigation devices: sprayers, bird bafflers or pinkies with zero discharge of fish waste.

AFMA publishes quarterly reports of logbook interactions with protected species on its website. Two interactions with species protected under the EPBC Act were reported in the GABTS in 2016. One interaction was reported with a seahorse or pipefish, which was reported to be dead.

11.5 References

AFMA 2006, *Orange Roughy Conservation Programme*, Australian Fisheries Management Authority, Canberra.

—— 2008, *Residual Risk Assessment of the level 2 ecological risk assessment species results: report for the Great Australian Bight trawl sub-fishery of the Southern and Eastern Scalefish and Shark Fishery*, AFMA, Canberra.

—— 2009, *Harvest strategy framework for the Southern and Eastern Scalefish and Shark Fishery*, version 1.2, September 2009, AFMA, Canberra.

—— 2011, 'Southern and Eastern Scalefish and Shark Fishery—Great Australian Bight Resource Assessment Group (GABRAG) meeting, 27–28 October 2011', AFMA, Adelaide.

—— 2012a, *Great Australian Bight Trawl Fishery co-management trial*, AFMA, Canberra.

—— 2012b, *Residual risk assessment of the level 2 Productivity Susceptibility Analysis: report for the otter board trawl method of the Great Australian Bight Trawl Sector*, AFMA, Canberra.

—— 2014, *Orange roughy (*Hoplostethus atlanticus*) stock rebuilding strategy 2014*, AFMA, Canberra.

—— 2015, *Ecological risk management strategy for the Southern and Eastern Scalefish and Shark Fishery,* AFMA, Canberra

DAFF 2007, *Commonwealth Fisheries Harvest Strategy: policy and guidelines*, Australian Government Department of Agriculture, Fisheries and Forestry, Canberra.

FRDC 2008, *Co-management: managing Australia's fisheries through partnership and delegation*, report of the FRDC's national working group on the fisheries co-management initiative, project 2006/068, Fisheries Research and Development Corporation, Canberra.

GABMAC 2009, 'Southern and Eastern Scalefish and Shark Fishery—Great Australian Bight Management Advisory Committee (GABMAC) meeting, 28 May 2009, Canberra', final minutes, AFMA, Canberra.

—— 2010, 'Southern and Eastern Scalefish and Shark Fishery—Great Australian Bight Management Advisory Committee (GABMAC) meeting', AFMA, Canberra.

Gonçalves da Silva, A, Appleyard, S & Upston J 2012, *Orange roughy (*Hoplostethus atlanticus*) population genetic structure in Tasmania, Australia: testing assumptions about eastern zone orange roughy stock structure*, CSIRO Marine and Atmospheric Research, Hobart.

Haddon, M 2015, *Bight redfish (*Centroberyx gerrardi*) stock assessment using data to 2014/2015*, draft report, CSIRO Oceans and Atmosphere, Hobart.

—— 2016, *Deepwater flathead* (Platycephalus conatus) *stock assessment using data to 2015/16*, draft report, CSIRO Oceans and Atmosphere, Hobart.

Klaer, N 2001, 'Steam trawl catches from southeastern Australia from 1918 to 1957: trends in catch rates and species composition', *Marine and Freshwater Research*, vol. 52, pp. 399–410.

—— 2011, 'Bight redfish (*Centroberyx gerrardi*) stock assessment based on data up to 2010/11', in GN Tuck (ed.), *Stock assessment for the Southern and Eastern Scalefish and Shark Fishery 2012*, part 1, AFMA & CSIRO Marine and Atmospheric Research, Hobart.

—— 2013, 'Deepwater flathead (*Neoplatycephalus conatus*) stock assessment based on data up to 2012/13', in GN Tuck (ed.), *Stock assessment for the Southern and Eastern Scalefish and Shark Fishery 2013*, part 1, AFMA & CSIRO Marine and Atmospheric Research, Hobart.

Knuckey, IA & Brown, LP 2002, *Assessment of bycatch in the Great Australian Bight Trawl Fishery*, final report to FRDC, report 2000/169, FRDC, Canberra.

—— & Hudson, R 2007, *Resource survey of the Great Australian Bight Trawl Fishery 2006*, report to AFMA, Canberra.

——, Hudson, R & Koopman, M 2008, *Resource survey of the Great Australian Bight Trawl Fishery 2008*, report to AFMA, Canberra.

——, Koopman, M & Hudson, R 2009, *Resource survey of the Great Australian Bight Trawl Fishery 2009*, report to AFMA, Canberra.

——, Hudson, R & Nemec, J 2010, *Monitoring orange roughy in the Great Australian Bight 2010*, report to AFMA, Canberra.

——, Koopman, M & Hudson, R 2011, *Resource survey of the Great Australian Bight Trawl Sector 2011*, report to AFMA, Canberra.

——, Koopman, M & Hudson, R 2015, *Resource survey of the Great Australian BightTrawl Sector 2015*, report to AFMA, Canberra.

Kompas, T, Che, N, Chu, L & Klaer, N 2012, *Transition to MEY goals for the Great Australian Bight Trawl Fishery*, report to FRDC, Australian Centre for Biosecurity and Environmental Economics, Crawford School of Public Policy, Australian National University, Canberra.

Miller, M & Stewart, J 2009, 'The commercial fishery for ocean leatherjackets (*Nelusetta ayraudi,* Monacanthidae) in New South Wales, Australia', *Asian Fisheries Science*, vol. 22, no. 1, pp. 257–64.

Morison, AK, Knuckey, IA, Simpfendorfer, CA & Buckworth, RC 2013, *South East Scalefish and Shark Fishery: draft 2012 stock assessment summaries for species assessed by GABRAG, ShelfRAG & Slope/DeepRAG*, report to AFMA, Canberra.

Newton, G 1989, 'The orange roughy fishery of the Great Australian Bight', Australian Society for Fish Biology conference, 1989.

—— & Tuner, D 1990, 'Spawning roughy in the GAB—a new find', *Australian Fisheries*, October, 1990.

—— & Klaer, N 1991, 'Deep-sea demersal fisheries of the Great Australian Bight: a multivessel trawl survey', *Bureau of Rural Resources Bulletin*, no. 10, Australian Government Publishing Service, Canberra.

Pierre, J, Gerner, M & Penrose, L 2014, *Asessing the effectiveness of seabird mitigation devices in the trawl sectors of the Southern and Eastern Scalefish and Shark Fishery in Australia*, AFMA, Canberra.

Sporcic, M & Haddon, M 2015, *Catch rate standardizations for selected SESSF species (data to 2013)*, CSIRO Oceans and Atmosphere Flagship, Hobart.

Wayte, S 2004, *Analysis of orange roughy catch data from the Great Australian Bight*, report to AFMA, Canberra.

Zhou, S, Smith, T & Fuller, M 2007, *Rapid quantitative risk assessment for fish species in major Commonwealth fisheries*, report to AFMA, Canberra.