



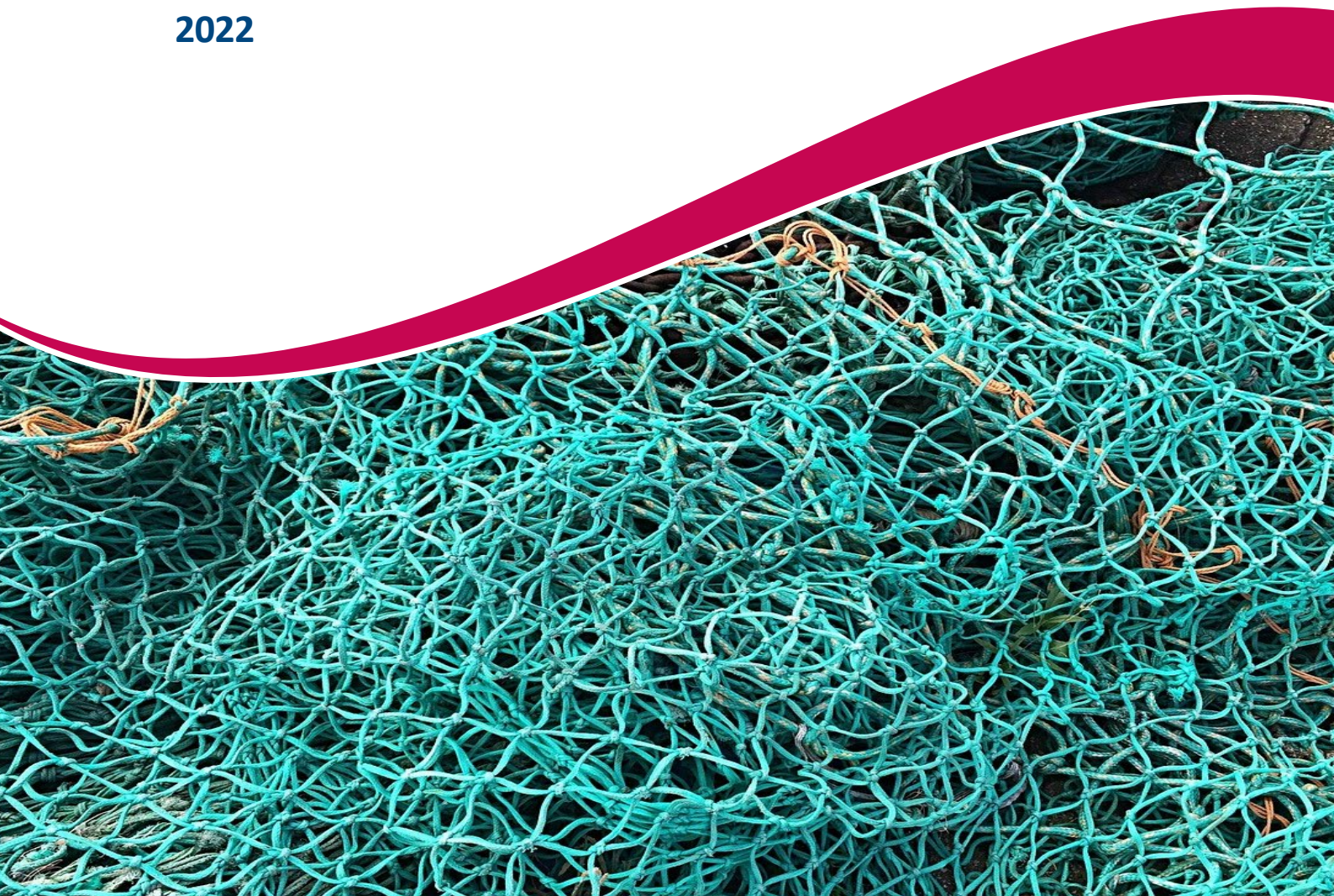
Australian Government

Australian Fisheries Management Authority

Orange Roughy (*Hoplostethus atlanticus*)

Stock Rebuilding Strategy

2022



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Executive summary

This *Orange Roughy Rebuilding Strategy 2022* (the Strategy) replaces the *Orange Roughy Rebuilding Strategy* (the 2014 Strategy) and maintains the objectives of the Orange Roughy Conservation Program (ORCP) to conserve orange roughy to ensure its long-term survival in nature and recover the species to ecologically sustainable levels.

Recognising progress made under the 2014 Strategy, including the recovery of the Eastern orange roughy stock to above the limit reference point, the primary objective of the Strategy continues to be to return all orange roughy stocks to levels where they can be harvested in an ecologically sustainable manner consistent with the objectives of the [Commonwealth Fisheries Harvest Strategy Policy 2018](#) (HSP) and [Guidelines for the Implementation of the Commonwealth Fisheries Harvest Strategy Policy](#) (HSP Guidelines), and ultimately to maximise the economic returns to the Australian community.

In line with, and guided by the HSP and HSP Guidelines, management actions set out in the Strategy maintain low fishing mortality to support rebuilding of stocks assessed as overfished, while continuing to monitor and assess the stocks. This will be done through:

- deep water closures within the Southern and Eastern Scalefish and Shark Fishery (SESSF) to protect orange roughy while providing access and flexibility to industry for stocks that are commercially sustainable;
- allowing targeted fishing for orange roughy stocks that are assessed as being above the limit reference point of 20 per cent of the unfished spawning biomass;
- research and monitoring to support stock assessments and to support the Strategy to meet its objectives.

The South East Resource Assessment Group (SERAG) and Great Australian Bight RAG (GABRAG) annually review data for relevant orange roughy stocks and recommend biologically appropriate catches based on the most recent stock assessment (where available) and fishing mortality information. The South East Management Advisory Committee (SEMAC) and Great Australian Bight Management Advisory Committee (GABMAC) consider the outcomes of the annual review, including any recommended changes to the Strategy, and recommend sustainable catch limits for the coming SESSF fishing season.

The management arrangements contained in the Strategy may be amended as required in response to changes in stock status or in response to the ongoing monitoring by the relevant RAG and MAC.

AFMA will undertake a formal review of the Strategy after five years.

Introduction

Under the HSP, rebuilding strategies must be developed for all species which are assessed as being below their biomass limit reference point. For orange roughy stocks, the proxy of 20 per cent of the unfished spawning biomass is used as the limit reference point. Stocks that have been assessed to be above the limit reference point (i.e. orange roughy eastern and Cascade Plateau stocks) are managed according to the HSP as targeted fisheries.

This *Orange Roughy Rebuilding Strategy 2022* (the Strategy) replaces the 2014 Strategy and maintains the objectives of the ORCP which was implemented in 2006 when orange roughy was listed as 'Conservation Dependent' under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). A listing in this category requires that a fish species is 'the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long-term survival in nature are maximised'.

Accordingly, in line with the EPBC Act, the objective of the ORCP was to conserve orange roughy to ensure its long-term survival in nature and recover the species to ecological sustainable levels. Recognising the progress made under the 2014 Strategy and the ORCP, the primary objective of the Strategy continues to be to return all orange roughy stocks to levels where they can be harvested in an ecologically sustainable manner consistent with the objectives of the HSP.

In 2019, AFMA conducted a five-year review of the 2014 Strategy and then obtained expert advice and feedback from SERAG, GABRAG, SEMAC and GABMAC in 2020. Outcomes of the review are available on the [AFMA website](#). A four-week public consultation process was undertaken in January 2021 and then final drafts incorporating feedback and recommendations were returned to GABMAC in February 2021 and to SEMAC in March 2021, for review and endorsement.

The Strategy continues to focus on methods to reduce the overall fishing mortality of overfished stocks, primarily through deepwater closures, while implementing ongoing monitoring and assessment programs to improve the understanding of stock status, including for stocks assessed as being above the biological limit reference point.

Objectives

The primary objective of the Strategy is to rebuild orange roughy stocks to levels where they can be harvested in an ecologically sustainable manner consistent with the HSP and to ultimately maximise the economic returns to the Australian community.

Specific objectives of the Strategy¹ are:

1. to rebuild orange roughy stocks* in the area of the SESSF to the biomass limit reference point (B_{LIM}) of 20 per cent of the unfished spawning biomass within a biologically reasonable time frame; being one mean generation time (56 years) plus 10 years (66 years) from the start of the ORCP. That is, to reach B_{LIM} by no later than 2072;

¹ The limit and target reference points for managing orange roughy stocks were recommended by SlopeRAG on 30 October 2014. The reference points are consistent with the default reference points in the *Commonwealth Fisheries Harvest Strategy Policy 2018*.

2. having reached B_{LIM} , rebuild these stocks to the maximum sustainable yield biomass level of 40 per cent of the unfished spawning biomass (B_{MSY}) using the harvest control rules outlined in the SESSF Harvest Strategy Framework. These harvest control rules provide for a Total Allowable Catch (TAC) to allow fishing at a level that allows the stock to rebuild from B_{LIM} to B_{MSY} ; and
3. once B_{MSY} is reached, pursue the proxy maximum economic yield biomass level of 48 per cent of unfished spawning biomass (B_{MEY}).

* The Eastern Zone and Cascade Plateau stocks are assessed to be rebuilt.

Rebuilding timeframes

The [HSP Guidelines](#) recognise that there are alternative timelines to rebuild a stock and that in determining the appropriate time to rebuild a stock, consideration should be given to the loss in profits in the short term and the speed at which the stock should be rebuilt to the limit reference point (B_{LIM}).

The HSP Guidelines typically require that recovery times are set by default as the shortest of:

- the mean generation time plus 10 years; or
- three times the mean generation time.

Recognising the biology of orange roughy, Management Strategy Evaluation (MSE) of harvest control rules implemented under the SESSF Harvest Strategy Framework (Wayte, 2009b) and the timeframe required for management measures to take effect, the Strategy has adopted the rebuilding timeframe to B_{LIM} of one mean generation time plus 10 years. With a mean generation time of 56 years, the objective of the Strategy is to rebuild all stocks to B_{LIM} within 66 years from the commencement of management measures under the ORCP (Australian Fisheries Management Authority, 2006), that is, by or before 2072.

Additionally, AFMA can make annual updates to the strategy as the research progresses and management responses evolve.

Biology and stock structure

Life history

Orange roughy is a deep water fish that occurs in southern Australian waters, often associated with steep topographical features such as seamounts. The species underwent significant decline during the early to mid-1990s as a result of heavy fishing pressure by demersal trawl operators.

Orange roughy are slow growing to a maximum size of ~ 50 cm (Gomon, et al., 2008) slow to mature (~30 years), have a mean generation time of about 56 years (J. Upston, pers. comm.) and long lived (>100 years) (Kailola, et al., 2003). They are synchronous spawners (Pankhurst, et al., 1987) with spawning events occurring annually although individuals may not spawn every year (Bell, et al., 1992). Males appear to spawn over a one to two week period and females spawn for up to one week producing between 10,000 and 90,000 large (2.0 – 2.5 mm diameter) eggs (Pankhurst, et al., 1987).

Orange roughy aggregate to spawn in some areas, and such aggregations are targeted by fishers. Orange roughy exhibit an avoidance reaction to trawls and other towed objects and fishing may therefore disrupt spawning behaviour and reduce future recruitment to an extent that is underestimated by the reduction in biomass. The stock-recruitment relationship for orange roughy (like most species) is poorly known. Steepness (how the stock-recruitment relationship is defined in a stock assessment) is assumed to be 0.75 but if this is higher than the true value, recruitment would have been reduced by more than the amount predicted in assessments.

These traits, combined with the predictability of spawning events in both space and time, make this species particularly vulnerable to overfishing.

Stock structure

Orange roughy is widely distributed in southern Australian waters from New South Wales, south around Tasmania and west to southern Western Australia. The species also occurs off New Zealand, southern Africa and in the Atlantic Ocean and Mediterranean Sea.

Orange roughy mainly occur between the depths of 700-1400 metres where the water temperature is cold. They form dense spawning and feeding aggregations over rugged topographic features such as the edge of the continental shelf and seamounts. They can also disperse more widely over smooth and rough bottom. The species is benthopelagic, generally occurring on the bottom but at times rising 50-100 metres off the bottom to feed or spawn (Branch, 2001; Kailola, et al., 2003; Gomon, et al., 2008).

The stock structure of orange roughy in Australian waters is uncertain. Goncalves da Silva *et al.* (2012) found low but statistically significant genetic differences between stocks from the North Atlantic, western Africa, Chile and Australia/New Zealand. However, within Australian waters only low levels of genetic differentiation were found suggesting that Australian orange roughy form a single genetic stock. However, loci were found to have signatures of natural selection suggesting three separate areas: Albany/Esperance; Hamburger Hill (in the Great Australian Bight); and south-eastern Australia. There were no meaningful divisions found within the south east Australian stock.

However, the authors point out that genetics is not the sole determinant of stock structure and the results do not resolve the question of whether the locations in question are demographically isolated. It was noted that the amount of genetic exchange needed to maintain genetic homogeneity is much less than the amount needed to have demographic homogeneity, and that residency or slow migration may result in separate demographic units despite genetic similarity (Morison, et al., 2013). The available evidence suggests that fish from the eastern and western coasts of Tasmania appear to be distinct from each other, and from those on the Cascade Plateau and South Tasman Rise (Hordyk, 2009).

Genetically similar stocks can still be demographically separate and may require separate management (Prince & Hordyk, 2009; Goncalves d Silva, et al., 2012; SlopeRAG/DeepRAG, 2013). Accordingly, within the SESSF, orange roughy are managed in nine zones (Maps at [Appendix A](#)):

1. Eastern Zone (Commonwealth Trawl Sector (CTS))
2. Cascade Plateau (CTS)
3. Southern Zone (CTS)
4. Western Zone (CTS)
5. Southern Remote Zone (CTS)

6. North-eastern Remote Zone (CTS)
7. South Tasman Rise (CTS)
8. East Coast Deepwater Trawl Zone (CTS)
9. Great Australian Bight Trawl (GABT): far west, west, central west, central east, east.

Key threats to recovery

A key threat to the recovery of orange roughy stocks in Australian waters is commercial trawl fishing in the SESSF.

Orange roughy is primarily caught in the SESSF by the otter trawl method between 700 metres and 1200 metres. Most fishing occurs on winter spawning grounds (mid-July to late August), but fishing can also occur during the summer months when orange roughy disperse more widely across flat bottom and mix with deep water sharks and oreo species.

The first substantial quantities of orange roughy were taken in the late 1980s with the discovery of large aggregations off western Tasmania and western Victoria. Catches increased significantly in 1989 with the discovery of a large spawning aggregation at St Helen's Hill, a seamount off eastern Tasmania, and other non-spawning aggregations in waters adjacent to Maatsuyker and Pedra Branca Islands off southern Tasmania. The reported catch of orange roughy peaked in 1990 at around 50,000 tonnes with large quantities estimated to have been unreported (Hordyk, 2009).

In the early 1990s, catch limits and individual transferable quotas were implemented followed by a formal harvest strategy in 1994. The intent of the harvest strategy was to maintain the biomass above 30 per cent of pre-1988 levels. If the stock fell below 30 per cent it was to be rebuilt to this level by 2004. Despite the TAC being sequentially reduced to rebuild stocks, operators could not catch the TAC and the TAC reductions failed to halt the decline in biomass.

In 2006, with the implementation of the ORCP, the SESSF was closed to targeted orange roughy fishing except on the Cascade Plateau where the stock remained above the Cascade Plateau target biomass of 60 per cent of unfished levels.

Orange roughy has also been caught in the Commonwealth-managed Western Deepwater Trawl Fishery off the coast of Western Australia. However, apart from what appears to be a one-off large catch of 150 tonnes in 2001, annual catches are generally less than 4 tonnes with no catch reported since 2005. An annual catch limit of 100 tonnes currently applies.

Stock status

Recovery of the stock may be impacted by changes in the proportion of fish spawning annually and by changes in their reproductive potential. Orange roughy do not mature until approximately 28 years of age so recruitment would have remained at pre-fishery levels for many years after fishing commenced. Current recruitment is from the orange roughy stock prior to commercial fishing commencing in the late 1980s and is the main factor in the relatively rapid rebuilding of the Eastern Zone stock.

This same factor should have helped other Australian stocks to rebuild. However, due to the relatively short history of orange roughy fisheries it is unclear what the effects of commercial fishing will be on future recruitment to the fishery. The expected 'slowing' of recovery is expanded on further below for the eastern zone stock.

Orange roughy are very-long lived and so their populations will naturally be resilient to long periods of low recruitment. Conversely, the great longevity and low natural mortality of orange roughy indicate that even relatively low levels of fishing pressure are likely to lead to stock declines, which will affect future recruitment. Surveys have shown an increase in reproductive capability following declines in the stock size (Koslow, et al., 1995; Pitman, et al., 2013) and there may also be changes to growth rates and age at maturity that act to rebuild stocks faster than would otherwise be predicted.

Eastern zone

The most recent assessment (Burch, 2022) indicated that the stock biomass had continued to increase and estimated the female spawning biomass had rebuilt to be 30 per cent of unfished biomass ($30\%B_0$) at the beginning of 2022. Since 2006, seven acoustic surveys have been undertaken on the St Helen's Hill and St Patrick's Head, herein referred to as the Eastern Orange Roughy Management Area (ORMA), the most recent in 2019. The acoustic survey abundance estimates support the model predicted increase in spawning biomass.

In the 2009 MSE (Wayte, 2009b), recovery of the Eastern Zone stock to B_{LIM} was predicted to occur before 2030, while recovery to the target reference point (B_{TARG}) took almost 70 years. The MSE suggested recovery would slow for a period after 2030 – attributed to an expected reduction in spawning biomass due to heavy fishing and subsequently lowered recruitment up to 1990, and the MSE assumption of the age at which 50 per cent of fish mature of 38 years. This 'slowing' of the recovery is demonstrated in the predicted female spawning biomass in Figure 1 (Burch, 2022).

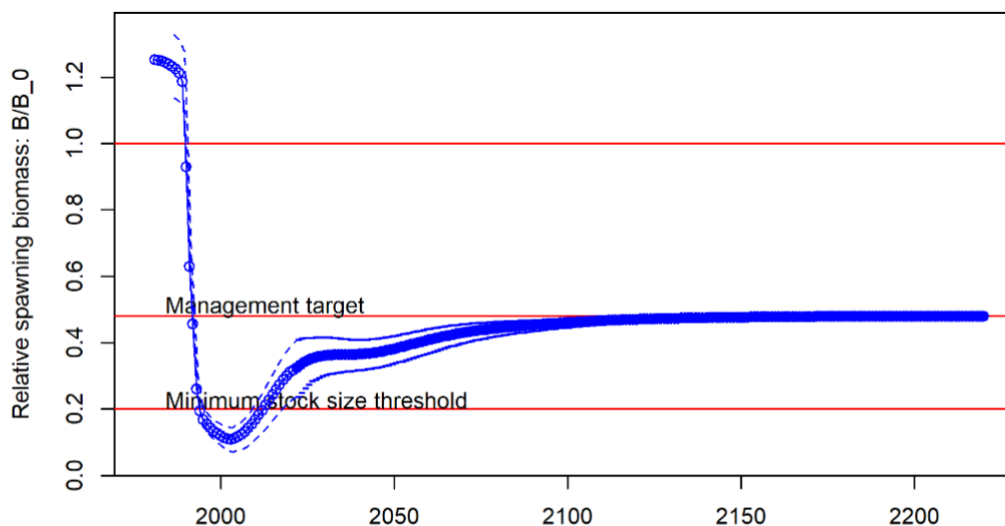


Figure 1 From (Burch, 2022) The MPD (point estimate) time-series of relative spawning biomass forecast 200 years into the future with catches set using the SSSF 20:35:48 harvest control rule for the 2021 base-case model. The dashed line indicates approximate 95% confidence intervals.

Cascade Plateau

The Cascade Plateau is managed as a separate zone. It was previously suggested that there may be some mixing between the Cascade and south-east populations during larval and juvenile stages and that the Cascade Plateau may have played a role in the recovery of depleted populations. For this reason, a target reference point of 60 per cent of unfished biomass was adopted for this stock under the ORCP.

The last stock assessment for orange roughy on the Cascade Plateau was in 2009 (Wayte, 2009a), and was an update to the 2006 (Wayte & Bax, 2006) stock assessment (see [Stock Assessments](#)). Based on this assessment the biomass of orange roughy in 2010 was estimated to be at 64 per cent of unfished biomass levels.

[SlopeRAG² \(2014\)](#) considered differences in size, growth rates, length and general morphology compared to the eastern and southern stocks and agreed there was no scientific evidence to link the Cascade Plateau stock with the other stocks. The RAG agreed there was no justification for maintaining the stock at a targeted reference point of 60 per cent of unfished biomass and recommended using a target of 48 per cent of unfished biomass, consistent with the objectives of the *Commonwealth Harvest Strategy Policy 2007* (Department of Agriculture, Fisheries and Forestry, 2007); now the 2018 HSP.

Southern zone

The component of the Southern Zone stock that resides in the Pedra Branca seamounts area is assessed as a part of the eastern zone stock assessment due to assumptions about stock structure (Bax, 2000). Further information is provided under [Monitoring and Data Collection](#).

The stock status in the remainder of the Southern Zone is uncertain but the most recent advice indicates it is likely to be less than the limit reference point. The most recent accepted assessment (Bax, 2000) estimated the biomass to be around 7 per cent of 1989 levels. A 2004 and 2006 review of fishery indicators

² SlopeRAG and ShelfRAG were amalgamated into SERAG in 2016.

and observations of possible spawning aggregations (from acoustic surveys) indicated that rebuilding may be occurring.

Substantial portions of the two main historical catching areas in the Southern Zone are now within Commonwealth Marine Reserves. Future research and monitoring needs in the Southern Zone is likely to be informed by work on the stock structure of the Eastern Zone.

Western zone

The most recent stock assessment for the Western Zone (Wayte & Bax, 2002) estimated the biomass had a 50 per cent chance of being less than 30 per cent of the biomass that existed in 1985.

A [Western Orange Roughy Research Plan](#) (WORRP) was implemented in 2020 with the aim to collect catch and effort data, as well as biological information on the age and size structure of the western orange roughy stock, to ultimately support a future stock assessment. Further detail is provided under [Monitoring and Data Collection](#).

Southern remote zone

There are no known spawning aggregations in the Southern Remote Zone. Catches have been historically low and there is no stock assessment for orange roughy in this area.

North east remote zone

There are no known spawning aggregations in the North East Remote Zone. Catches are very low, with the highest recorded catch since 1998 being 78 tonnes in 2003. There is no stock assessment for orange roughy in this area.

South Tasman Rise

The South Tasman Rise (STR) is an undersea ridge that extends south of Tasmania and into the Southern Ocean, straddling the Australian Fishing Zone (AFZ) and the high seas. In 2000, Australia established a Memorandum of Understanding (MOU) with New Zealand to manage the STR cooperatively. This MOU expired in 2007 and the STR is current closed to fishing both within the Australian Fishing Zone and on the high seas.

The STR orange roughy fishery began in 1997. It has been anecdotally reported that very large catches were taken by Illegal, Unreported and Unregulated (IUU) vessels in 1999 but very little catch was taken in subsequent years. An assessment in 2003 (Prince & Diver, 2002) of the STR fishery indicated the original stock was not large and had been reduced dramatically since 1997, although no biomass estimates are available. There have been no updates to the assessment since the fishery was closed in 2007 and the current biomass and population trends are unknown.

East Coast Deepwater Trawl Sector

Limited fishing has occurred in the East Coast Deepwater Trawl (ECDWT) sector of the SESSF, with 150 kg reported in the 2003-04 fishing year and no catch since then. There is no stock assessment for orange roughy in this area.

Great Australian Bight

There is no formal stock assessment for orange roughy in the Great Australian Bight (GAB) because catches are low and data collection has been sporadic and spatially scattered. Since 1990, catches have primarily come from the Albany/Esperance area with catches peaking in 1993 at 425 tonnes off Albany, and in 1999 at 650 tonnes off Esperance. No large aggregations have been reported since 1990 and the species is believed to have declined in the GAB as it had in other parts of the SESSF (Woodhams *et al.* 2013).

The [GAB Orange Roughy Research Plan](#) (the GAB Research Plan), was developed by the Great Australian Bight Industry Association (GABIA) in 2007 to meet the requirements of the ORCP (Australian Fisheries Management Authority, 2006) and now the Strategy. Further detail is provided under [Monitoring and Data Collection](#).

Management approaches

Management arrangements for the current fishing season across the SESSF can be accessed in the 'SESSF management arrangements booklet' which is distributed to all concession holders prior to the commencement of each fishing season. The SESSF fishing season commences on 1 May each year. A copy of the booklet is available from: <https://www.afma.gov.au/fisheries/southern-and-eastern-scalefish-and-shark-fishery>.

Management arrangements implemented under the Strategy fit into four broad categories.

Catch limits

Targeted fishing for orange roughy is permitted in the Eastern Zone, the Cascade Plateau and the Pedra Branca area of the Southern Zone, where stock assessments have estimated with confidence that the biomass is above the limit reference point. For all other zones, an incidental bycatch TAC is determined each year to allow for incidental catch of orange roughy when fishing for other deepwater species.

Consistent with the HSP, targeted fishing will not re-commence for a stock until there is evidence that the stock has recovered, or is likely to have recovered, to above the limit reference point.

Information regarding annual TACs and updated monthly catches for all SESSF quota species, including orange roughy, can be accessed through AFMA's monthly 'catchwatch' reports at: <https://www.afma.gov.au/fisheries-services/catchwatch-reports>.

Closures

Spatial closures have been implemented in deep water areas within the SESSF, except where targeted orange roughy fishing is allowed or specific management arrangements are in place to target other deep water species. The 'South East Trawl Deep Water Closure' was first implemented in 2007 and excludes trawling generally beyond a 700 m depth contour across the CTS (see [Appendix B](#), Schedule 13).

In the GABT, a deepwater management strategy was implemented to address the requirements of ORCP. Rather than a broad deepwater closure, the Orange Roughy Research Zones ([Appendix B](#)) were

implemented and were designed to capture more than 95 per cent of the total orange roughy catches taken in the GABT. Access to these areas is only permitted under scientific permits as part of the GABT Orange Roughy Research Plan (see [Data Collection](#)).

AFMA's fisheries management approach aligns with the principles of ecologically sustainable development and the precautionary principle and there are Australian Marine Parks within the Commonwealth waters of the SESSF. The marine parks of relevance to SESSF fishers are located within the Temperate East, South-east and South-west Networks.

These spatial management measures help support management of the impacts of fishing activities on non-target species and the long-term sustainability of the marine environment. Further information can be found on the Parks Australia website at <https://parksaustralia.gov.au/marine/parks/>.

Reporting and monitoring

AFMA implements a broad range of reporting and monitoring requirements to ensure data on catches of all species are accurate and the impact of fishing on individual species can be measured. The primary mechanism by which AFMA collects information on catch is through daily fishing logbooks. AFMA also uses Vessel Monitoring Systems (VMS) to monitor and verify fishing effort and deploys scientific observers on boats to collect biological information and independently verify catch and effort reporting. These programs are expanded on further below under [Monitoring and Data Collection](#).

Limited entry

Under the *Southern and Eastern Scalefish and Shark Fishery Management Plan 2003*, fishing access to the SESSF is limited to the number of concessions that currently exist. New operators can access the fishery only by purchasing or leasing an existing concession. This assists with restricting any future expansion of incidental catch and managing stocks within their TAC limit.

In 2006, a structural adjustment package resulted in the removal of 59 boat Statutory Fishing Rights (reduction of approximately 50 per cent) and 32 boats from the CTS of the SESSF. This structural adjustment led to an immediate and significant reduction of total shots and effort (trawl hours) across in the CTS.

Monitoring and data collection

Stock assessments

Stock assessments monitor stock status and the recovery of orange roughy. However, not all areas are assessed because of limited fishing effort and catch data and costs of assessment. For example, a monitoring method known as the [net-attached acoustic optical system \(AOS\)](#) are acoustic surveys that measure the sound reflectance or 'target strength' of fish at multiple frequencies. The AOS provides an index of abundance for orange roughy and are a key source of data for stock assessments in the Eastern Zone and Cascade Plateau. However, to be effective, the surveys require information on spawning aggregations collected by fishermen. Therefore, their use is limited to areas where aggregations are reasonably well known.

Eastern Zone

The 2021 stock assessment (Burch, 2022) estimated that the stock is above the limit reference point, and was estimated to be at 30 per cent of unfished biomass at the beginning of 2022. Acoustic surveys undertaken at St. Helen's Hill and St. Patrick's Head (1999, 2006, 2010, 2012, 2013, 2016 and 2019) have estimated an increase in abundance, which supports the estimated increase in abundance from the Tier 1 stock assessments from 17 per cent of unfished biomass in 2011 and 26 per cent in 2014.

An acoustic survey is also planned for 2023 to support the next stock assessment in 2025.

Pedra Branca

The component of the Southern Zone stock that resides in the Pedra Branca seamounts area is assessed as a part of the eastern zone stock assessment due to the stock structure assumptions.

To distribute the Recommended Biological Catch (RBC) from the eastern orange roughy stock assessment between the eastern and southern zones, the total catch that came from the eastern zone and the Pedra Branca area between 1996 (when VMS was introduced) and 2005 (when the ORCP was implemented) is used giving an RBC of 93 per cent for the eastern zone and 7 per cent for the southern zone.

Cascade Plateau

The first quantitative stock assessment of the Cascade Plateau orange roughy population was produced in 2004 (Wayte, 2004). The 2004 assessment used catch records, biological data collected over the previous six years, and the 2003 acoustic biomass estimate. The 2004 stock assessment estimated the orange roughy biomass at Cascade Plateau to be between 7,000 and 18,700 t and the long term sustainable catch to be 300-400 t.

In 2006 (Wayte & Bax, 2006), the assessment was again updated, using the acoustic biomass estimate from the 2005 winter spawning aggregation which was about three times larger than previous estimates. The 2006 assessment estimated the stock to be about 20,000 t and the current biomass as 72-73 per cent of the unfished biomass.

The 2006 stock assessment was re-run in 2009 (Wayte, 2009a) using a revised 2005 acoustic biomass estimate due to concerns about the acoustic signal strength and likely over estimate of biomass from that survey. Using the updated estimate of biomass from the 2005 acoustic survey, the 2010 biomass was estimated to be 64 per cent of unfished biomass.

Hull-mounted acoustic surveys were completed in 2021 and 2022, and the scheduling of future stock assessments will be dependent on fishing effort and data availability.

Data collection

Integrated Scientific Monitoring Program

The ISMP is a data collection program which places AFMA observers on commercial fishing boats to collect independent information on fishing operations, the retained and discarded catch composition and protected species interactions. Data is collected either on-board or via port sampling.

This data stream is critical because it provides fisheries managers, research organisations, environmental agencies, the fishing industry and the wider community with independent, reliable, verified and accurate information on the fishing catch, effort and practice of Commonwealth boats. The program has provided information on the quantity, size and age composition of quota species, including orange roughy, caught in sectors of the SESSF since 1994.

The ISMP is used to:

- verify logbook information;
- determine levels of interaction with Threatened, Endangered and Protected (TEP) species;
- quantify levels of bycatch and status of discards (mortality rates);
- collect biological data for stock assessments and research projects on-board or at port (e.g. collection of otoliths – fish ear bones – to age fish, and collect sex and length data of fish);
- record environmental observations;
- collect anecdotal information (qualitative data) for research;
- quantify level of depredation (if high coverage);
- educate fishers (e.g. data collection, species identification, handling TEP species, tag recovery, compliance regulations).

AFMA specifies minimum observer coverage requirements for the Eastern and Southern ORMAs for the period 1 June to 31 August each year to ensure biological samples are collected to support the Tier 1 stock assessment. Currently, an observer must be carried for the first three trips in the ORMA and then every second trip thereafter. Once a master (skipper) has had three consecutive trips with observers on board in the previous season without records of discards exceeding 500 kg in any shot, coverage will be reduced to the first trip and every second trip thereafter.

These requirements and the ISMP sampling regime targets are reviewed annually to ensure sampling remains representative of fishing effort and to ensure optimal data collection. Requirements are updated in the SESSF Management Arrangements Booklet available at: <https://www.afma.gov.au/fisheries/southern-and-eastern-scalefish-and-shark-fishery>.

Acoustic surveys

Acoustic surveys have provided an index of abundance for the Eastern Zone and Cascade Plateau spawning aggregations since 1999. In addition to an acoustic biomass estimate, biological data is collected to support analyses of age, length, sex, and weight as key inputs to the Tier 1 stock assessment.

Since 1999, seven acoustic surveys have been completed in the Eastern Zone and are typically scheduled every three years. The most recent survey was in 2019 and was included as an index of abundance in the 2021 Tier 1 stock assessment.

There have also been seven acoustic surveys of the Cascade Plateau spawning aggregation since 1999, with the 2003, 2004 and 2005 survey indices used in the 2006 stock assessment. The stock assessment was updated in 2009 to incorporate a revision to 2005 acoustic survey index, however, low catches and reduced fishing effort between 2006 and 2019 limited the information flow from this part of the fishery. Fishing effort has increased since 2020 and hull-mounted acoustic surveys were completed in 2021 and 2022.

Research programs

Research programs have been implemented in the GAB and Western orange roughy zones to collect catch and effort data, as well as biological information on the age and size structure of orange roughy in each area, which will ultimately support a future assessment of the stock's status.

The GAB Orange Roughy Research Plan was developed by GABIA in 2007 to meet the requirements of the ORCP and now the Strategy. The Western Orange Roughy Research Plan was developed by AFMA and the South East Trawl Fishing Industry Association (SETFIA) and successfully implemented in 2020.

To fish for orange roughy under the research plans, proponents must submit a scientific permit application including the proposed sampling design/survey plans. If approved, the permit allows operators to enter orange roughy closures and target orange roughy using a Research Catch Allowance (RCA); provided they meet the data collection requirements described in the conditions of their scientific permit.

The research plans are reviewed annually by the relevant RAG and MAC, including recommendations for RCA and any changes required to the sampling design. Further information is available for the [GAB Orange Roughy Research Plan](#) and [Western Orange Roughy Research Plan](#).

Evaluation and reporting

Reviewing the strategy

SERAG and GABRAG have primary responsibility for monitoring the status of orange roughy stocks to determine if rebuilding is occurring. The Eastern Zone and Cascade Plateau stocks are not subject to the same management arrangements as other orange roughy stocks, and the annual review focuses on catch and effort data from targeted fishing, as well as any available indicators of stock status, including recent assessments.

Unlike other species managed under rebuilding strategies in the SESSF, orange roughy are not typically caught when fishing for other species. As such, the annual review of the rebuilding strategy does not consider targeting behaviour, rather, it focuses on data collection and catches against incidental bycatch TACs.

As a minimum, the annual review will focus on the following key considerations:

- Indications of how stock status is tracking against the Strategy objectives using available assessments, data, intelligence or fishery indicators;
- Analysis of current management measures implemented;
- Review of catch and effort data, heat maps and other data collected including consideration of potential data gaps and needs;
- Review of catches against incidental catch limits;
- Consideration of potential changes to management measures or data collection approaches.

Outcomes of the annual review are considered by SEMAC and GABMAC when recommending RCAs to support the research programs, and to set unavoidable bycatch TACs for zones which are not subject to targeted fishing. The management arrangements contained in the Strategy may be amended as required in response to changes in stock status or in response to the outcomes of the annual review.

AFMA will undertake a formal review of the Strategy after five years.

Reporting and consultation

AFMA reports annually on the stock status of orange roughy and performance against the goals of the Strategy to the *Department of Agriculture, Fisheries and Forestry* (DAFF) to meet reporting requirements under the SESSF Wildlife Trade Operation (WTO) accreditation.

During the development of the Strategy, AFMA has consulted with:

- DAFF;
- Southern and Eastern Scalefish and Shark Fishery Resource Assessment Group (SESSFRAG), SERAG, GABRAG, SEMAC and GABMAC;
- GABIA, SETFIA and individual operators, particularly those in the CTS and GABT; and
- Key stakeholders including environmental non-government organisations, through formal public consultation – a call for public comments on AFMA’s website.

Economic impacts

Economic impacts associated with the recovery orange roughy include the costs of monitoring, research and the stock assessment processes. Management costs are apportioned between industry and the Australian Government under AFMA’s Cost Recovery Impact Statement (CRIS) which reflects the Australian Government’s Cost Recovery Guidelines.

There is an additional impact on the fishing industry where targeted fishing is not permitted, however, some of these costs may be offset in the longer term, subject to overfished stock rebuilding and commercial fishing re-commencing.

Future Focus

Recognising progress made under the 2014 Strategy and consistent with the objectives of the *Fisheries Management Act 1991* and the HSP, this revised strategy’s primary objective is to continue achieving progress in returning all orange roughy stocks to levels where they can be harvested in an ecologically sustainable manner. In this context, the existing rebuilding objectives are maintained – primarily to rebuild the stocks to the biomass limit reference point (20 per cent of unfished biomass, or B_{LM}) by or before 2072.

The management arrangements outlined in this strategy follow on from the 2014 Strategy and focus on maintaining the overall low fishing mortality levels to promote stock recovery and obtaining more data so stock status and recovery can be better monitored.

Based on advice from SERAG, GABRAG, GABMAC and SEMAC, in the period of this rebuilding strategy, AFMA will focus on the following:

Research Plans

AFMA will continue to support the GAB and Western research plans during the life of this Strategy including ongoing consultation with industry. Operation of the research plans and data collected are

reviewed annually by the relevant RAG and MAC, including recommendations for RCAs and whether any changes are required to the sampling design.

Acoustic Surveys

Acoustic surveys are a key input to the Eastern Zone and Cascade Plateau stock assessments. A survey was completed on the Cascade Plateau in 2021 and 2022, and a survey is planned for 2023 on the Eastern Zone seamounts. The timing and frequency of future acoustic surveys, including for other zones, will be dependent on the need to support future stock assessments.

ISMP Program

AFMA notes the importance of onboard AFMA observers for data collection particularly for biological sample collection and discard estimates; and will continue to prioritise ISMP sampling targets for this species.

Variability and climate change

AFMA is committed to sustainable fisheries management, and better understanding how Commonwealth fisheries can adapt to the effects of climate change is an important priority. AFMA has noted concerns about ecosystem shifts over time that may lead to non-recovery of some stocks and that there has been a declining trend in commercial catch per unit of effort (CPUE) for many SESSF quota stocks, despite a decrease in effort over time.

AFMA is exploring this issue and the potential impacts on rebuilding species to provide a better understanding of the threats to recovery. AFMA will maintain this focus with expert advice from the relevant RAGs and MACs and by supporting research proposals in this emerging field, noting current projects underway that are:

- investigating changing biological parameters in relation to climate variability,
- collecting periodic data on environmental parameters and species' distributions, and
- considering options for implementing dynamic reference points in future harvest strategies to account for environmentally driven trends in productivity and recruitment.

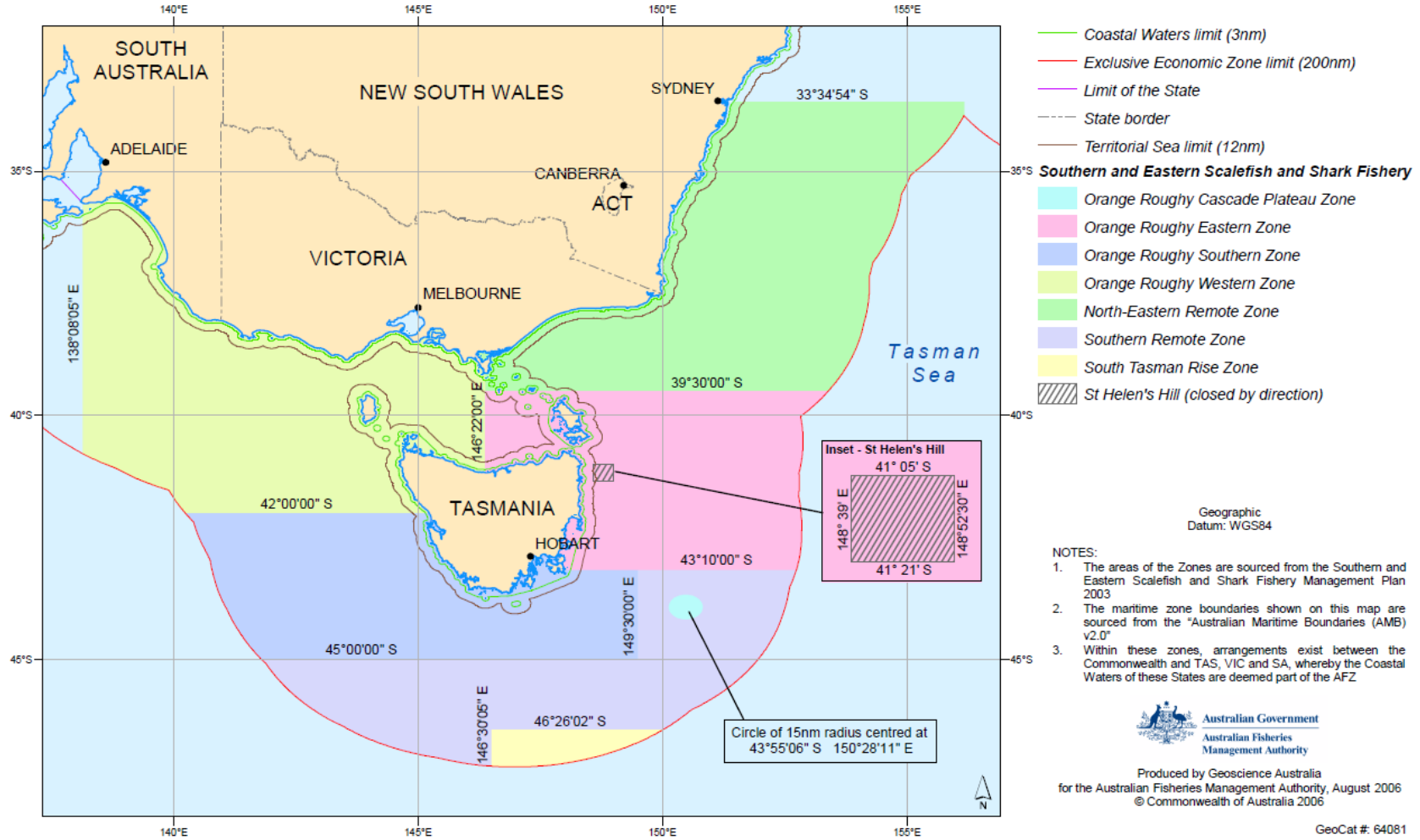
Electronic monitoring

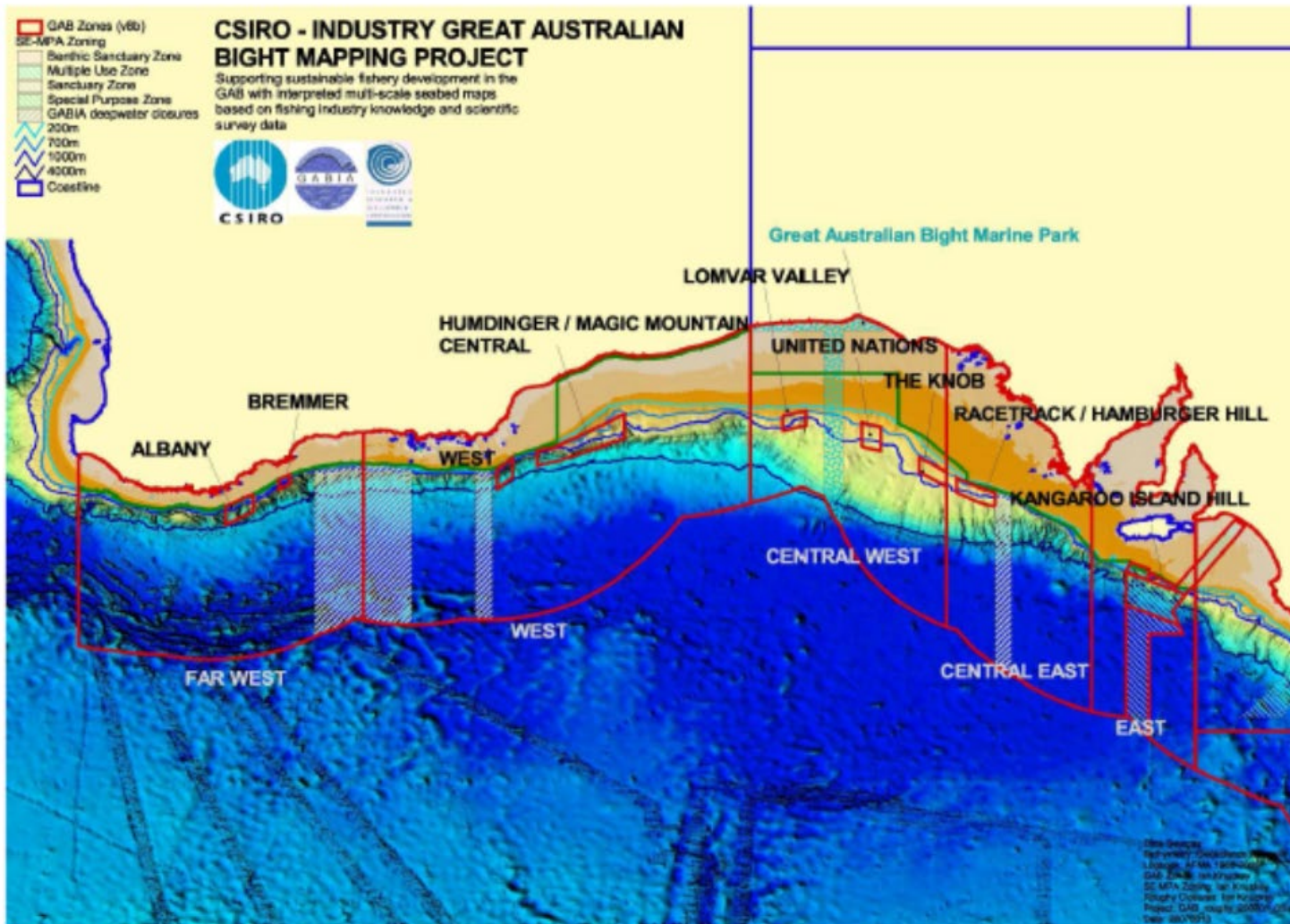
AFMA is investigating the capability of electronic monitoring systems for deployment in Commonwealth trawl fisheries as a supplement to the ISMP. Noting the challenges associated with discerning species composition on trawl boats, there is also work underway to determine whether the systems (through artificial intelligence) can provide estimated size and species composition of catch automatically as the catch is brought on board for various gear types.

AFMA will maintain a strong focus on research priorities and considering how changes in ecosystem shifts and climate variability impacts on rebuilding progress. As research emerges and based on expert advice, AFMA may review and update management and monitoring approaches. The annual review of the strategy will incorporate updates and in response, this strategy may be updated.

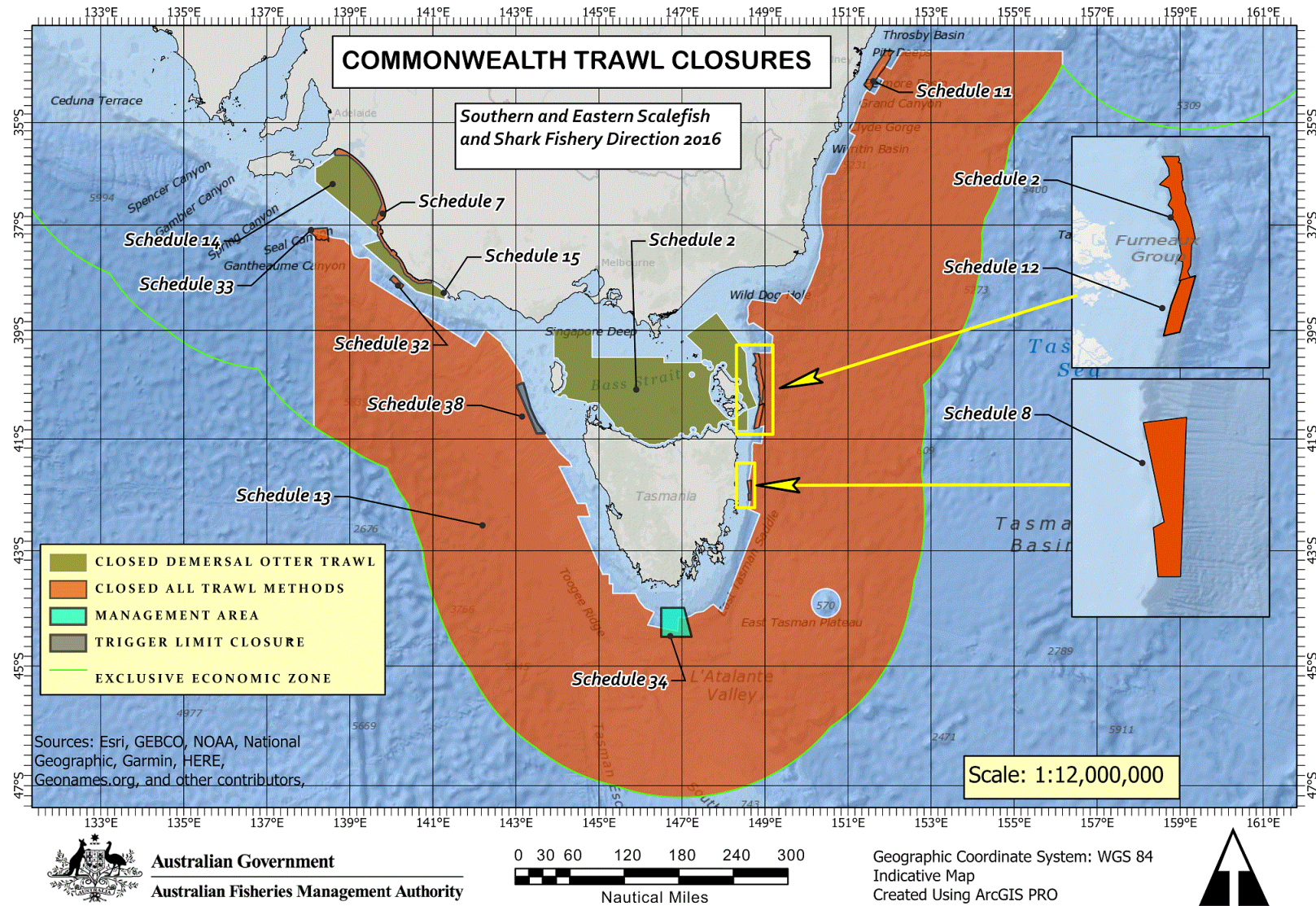
Appendix A – Orange roughy zones

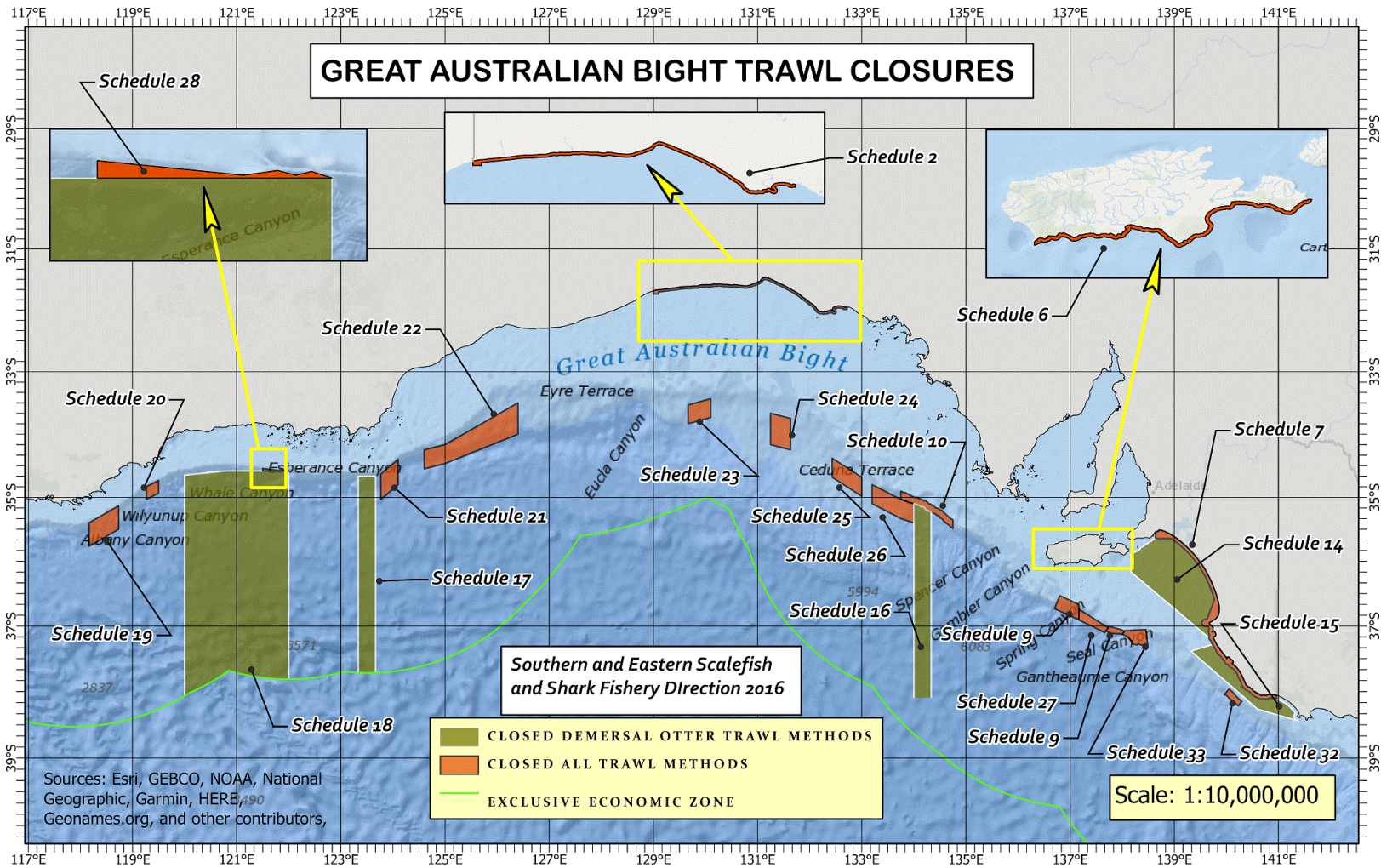
Southern and Eastern Scalefish and Shark Fishery Area of the Orange Roughy Zones



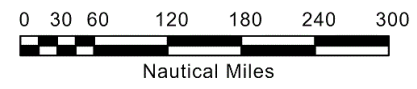


Appendix B – Orange roughy closure maps





Australian Government
Australian Fisheries Management Authority



Geographic Coordinate System: WGS 84
 Indicative Map
 Created Using ArcGIS PRO



Useful links and references

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