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**Octopus resource of Western
Australia harvest strategy
2018 – 2022**

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Important disclaimer

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LIST OF ACRONYMS

ARMA	Aquatic Resources Management Act
B _{MSY}	Stock biomass that can support the Maximum Sustainable Yield
CAES	Catch and Effort Statistics
CDR	Catch Disposal Record
CEO	Chief Executive Officer of DPIRD
CSLPMF	Cockburn Sound Line & Pot Managed Fishery
DOF	Developmental Octopus Fishery
DPIRD	Department of Primary Industries and Regional Development
EBFM	Ecosystem Based Fisheries Management
ESD	Ecological Sustainable Development
EPBC	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
ETP	Endangered, Threatened and Protected
FRDC	Fisheries Research and Development Corporation
FRMA	Fish Resources Management Act 1994
FRMR	Fish Resources Management Regulations 1995
GLM	Generalised Linear Model
HCR	Harvest Control Rules
MSC	Marine Stewardship Council
OIMF	Octopus Interim Managed Fishery
OCF	Operational Compliance Plan
SCPUE	Standardised Commercial Catch Rate
SLA	Service Level Agreement
WA	Western Australia
WAFIC	Western Australia Fishing Industry Council
WCRLMF	West Coast Rock Lobster Managed Fishery

1 INTRODUCTION

Harvest strategies for aquatic resources managed by the Western Australian (WA) Department of Primary Industries and Regional Development (DPIRD) are formal documents that are prepared based on a formal policy (Department of Fisheries 2015) to support the decision-making processes and ensure consistency with the principles of Ecologically Sustainable Development (ESD; Fletcher 2002) and Ecosystem Based Fisheries Management (EBFM; Fletcher et al. 2010). The objectives of ESD are reflected in the objects of the *Fish Resources Management Act 1994* (FRMA), Section 3, and the *Aquatic Resources Management Act* (ARMA) 2016, Clause 9, which will replace the FRMA once enacted.

The publication of harvest strategies is intended to make the decision-making considerations and processes for the management of specified aquatic resources publicly transparent and provide a basis for informed dialogue on management actions with resource users and other stakeholders (Department of Fisheries 2015).

These strategies provide guidance for decision-makers, but do not derogate from or limit the exercise of discretion required for independent decision-making under the FRMA by either the Minister for Fisheries, the Chief Executive Officer (CEO) of DPIRD or other delegated decision-makers in order to meet the objects of the FRMA.

Harvest strategies make explicit the objectives, performance indicators, reference levels, and harvest control rules for each defined ecological asset taken into consideration by DPIRD when preparing advice for the Minister for Fisheries (Department of Fisheries 2015). They also indicate the scope of management actions required in relation to the status of each resource in order to meet the specific long- and short-term management objectives and the broader goals of ESD and EBFM. Finally, they specifically outline the expected performance of the fisheries that access each resource.

1.1 Review Process

The WA harvest strategy policy (Department of Fisheries 2015) recognises that fisheries change over time and that a review period should be built into each harvest strategy to ensure that it remains relevant. This harvest strategy will remain in place for a period of five years, after which time it will be fully reviewed; however, given that this is the first harvest strategy for this resource, this document may be subject to review and amended as appropriate within this five-year period.

2 SCOPE

This harvest strategy has been developed for the Octopus Resource of Western Australia (WA) and considers all activities that capture octopus. The resource essentially comprises a single species, *Octopus cf. tetricus*, which is primarily captured using traps by the Octopus Interim Managed Fishery (OIMF) in state waters south of 26°30'S to the South Australian border (129°E) (Figure 2.1).

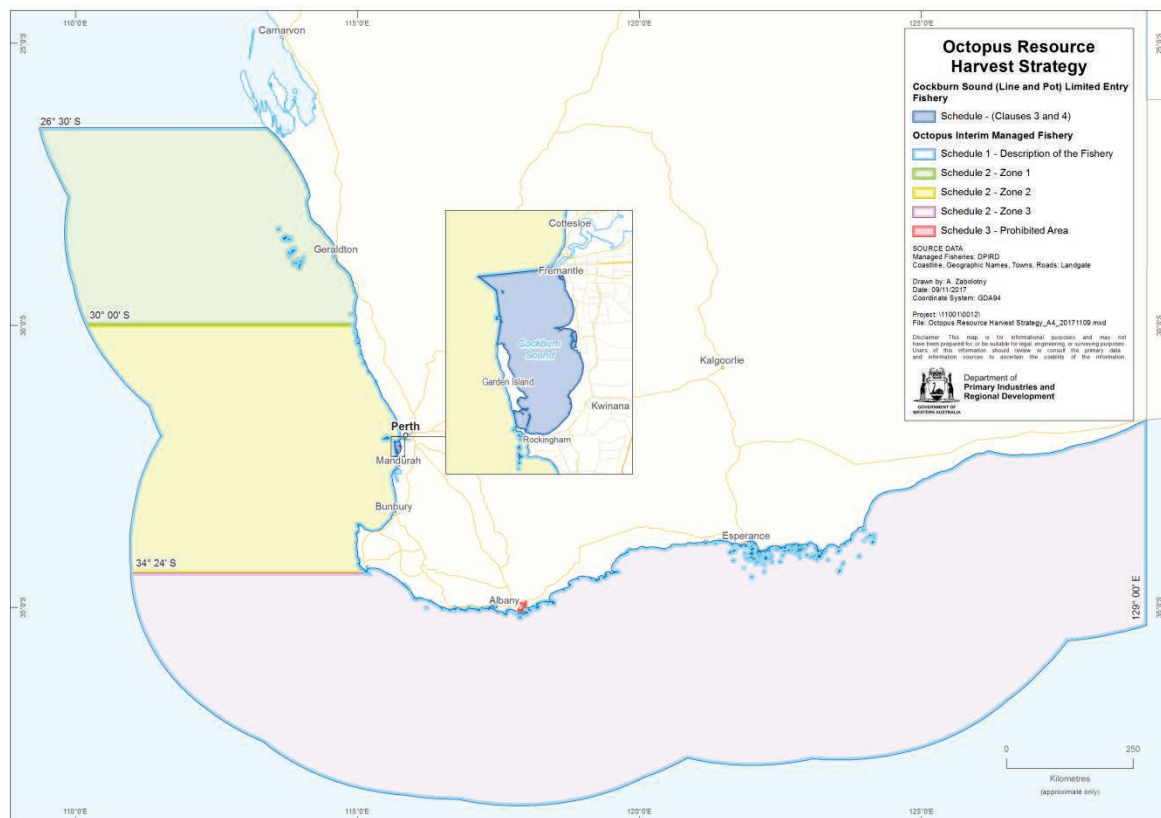


Figure 2.1. Boundaries of the Octopus Interim Managed Fishery and Cockburn Sound (Line and Pot) Managed Fishery, the two main commercial fisheries that target the Octopus Resource

Octopus is also captured in small but significant quantities in the Cockburn Sound Line and Pot Managed Fishery (CSLPMF) and the West Coast Rock Lobster Managed Fishery (WCRLMF). Recreational fishing for octopus occurs but the catch is negligible compared to commercial quantities. A small number of other commercial fisheries also catch negligible quantities of octopus.

This harvest strategy has been developed in line with DPIRD’s over-arching *Harvest Strategy Policy for Aquatic Resources* (Department of Fisheries 2015) which is consistent with relevant national policies / strategies (ESD Steering Committee 1992), guidelines (e.g. Sloan et al. 2014) and international best practice (Fletcher et al. 2016).

This document has been developed via a consultative process with commercial and recreational fishing peak bodies and has been approved by the CEO of DPIRD and the Minister for Fisheries.

2.1 Environmental Context

The Octopus Resource predominantly occurs within the West and South Coast Bioregions which extend from near Shark Bay (26°30’ S) to the South Australia border (129° E). Both bioregions have a Mediterranean climate, with most rainfall occurring during the winter months. Coastal water temperatures range from approximately 18° C to 24° C off the west

coast and 15° C to 21° C off the south coast. Biological communities are mainly comprised of temperate species that mix with tropical species in the northern regions of the West Coast Bioregion. The Leeuwin Current is considered to be a main oceanographic influence on biological communities within the Bioregions because of its extent and its significant impact on biological productivity (Commonwealth of Australia 2008).

The West Coast Bioregion is characterised by exposed sandy beaches and a limestone reef system that creates surface reef lines, often about five kilometres off the coast. Further offshore the continental shelf habitats are typically composed of coarse sand interspersed with low limestone reef associated with old shorelines (Fletcher and Santoro 2015).

The South Coast Bioregion is a high energy environment, heavily influenced by large swells generated in the Southern Ocean. The marine habitats are similar to the coastline, having fine, clear sand seafloors interspersed with occasional granite outcrops and limestone shoreline platforms and sub-surface reefs.

2.2 Target Species – *Octopus cf. tetricus*

The primary target of octopus fishing activities in WA is *Octopus cf. tetricus*, which is one of a number of species that fall under the cosmopolitan *Octopus vulgaris* species complex (Amor et al. 2017). Historically *O. cf. tetricus* was considered synonymous with the Common Sydney Octopus, *Octopus tetricus*, that is similar in appearance and occurs in similar habitats on the east coast of Australia. Although yet to be formally described, taxonomic studies indicate that *O. cf. tetricus*, which has a geographically distinct population from Shark Bay to Esperance, is likely to be a separate species (Amor et al. 2014).

Octopus cf. tetricus occurs in depths of 5 to 70 m and inhabits rocky reefs, seagrass meadows, and sandy substrates (Edgar 1997, Norman and Reid 2000). Males reach sexual maturity around 8 months and females 12 months. The maximum age for both sexes is around 18 months (Leporati et al. 2015). Size and sex composition data from fisheries suggest that *O. cf. tetricus* migrates from inshore to offshore waters with increasing age (Leporati et al. 2015).

Females are highly fecund laying ~ 100 000 eggs that take ~ 30 days to hatch (Joll 1976). Hatchlings spend ~ 50 days as paralarvae in the water column before settlement (Hart et al. 2016). *Octopus cf. tetricus* is semelparous and death occurs shortly after egg laying for females and the onset of senility for males (Joll 1983). Major predators include grey nurse sharks, wobbegong, Western Australian dhufish, mullocky, queen snapper, groupers (subfamily Epinephelinae) and also Australian sea lions.

Incidences of other octopus species being caught in the OIMF are highly irregular, with occasional reports of *Octopus cyanea* in northern waters and *Macroctopus maorum* off the south coast (Hart et al. 2016).

2.3 Fishing Activities

2.3.1 Governance

Octopus in Western Australia is targeted by the commercial and recreational fishing sectors and is managed by DPIRD under the following legislation:

- *Fish Resources Management Act 1994* (will be replaced by the Aquatic Resources Management Act 2016 once enacted);
- *Fish Resources Management Regulations 1995* (FRMR); and
- FRMA Part 6 — *Octopus Interim Managed Fishery Management Plan 2015*, *Cockburn Sound (Line and Pot) Management Plan 1995*, and *West Coast Rock Lobster Managed Fishery Management Plan 2012*.

Licence holders and fishers must also comply with the requirements of the:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC);
- *Western Australian Marine Act 1982*;
- *Western Australian Wildlife Conservation Act 1950*;
- *Western Australian Conservation and Land Management Act 1984*;
- *Western Australian Environmental Protection Act 1986*; and
- Any other legislation governing the use of the marine environment in which activities occur.

2.3.2 Commercial Fishing

The estimated total annual value for 2016, from all sectors, was \$2.1 million based on the total catch of 252 t (commercial) and an average product price of \$8.29 kg live weight. There is also a substantial processing and value-added component to the octopus catch with factories in Fremantle and Geraldton.

2.3.2.1 *Octopus Interim Managed Fishery*

The potential of an octopus fishery was first investigated by Japanese researchers from 1979 to 1981 in response to high levels of octopus predation and bycatch in the WCRLMF. A developmental strategy for octopus fishing was implemented in the late 1990s and the Developmental Octopus Fishery (DOF) was established as a limited entry fishery in 2001 under exemptions from the FRMA. The permitted gear for the fishery was the shelter pot, an open-ended and unbaited fishing gear that provided a refuge for octopus. Shelter pots were set on demersal longlines of approximately 500 pots per line that required a soak-time of 15 to 25 days and, due to their design, could only be set in shallow (< 20 m), protected waters.

From 2007 to 2009 fishers in the DOF developed and tested a new gear type known as trigger traps. Trigger traps are a rectangular trap typically set in cradles of three, either as single-lines or on longlines. Traps are baited with an artificial crab which, when grasped by the octopus, triggers a trap door mechanism. This active fishing gear greatly reduced soak time to an average of 11 days, increased catch rates, and enabled fishing in previously inaccessible habitats.

The development of trigger traps provided the impetus to draft an adaptive management strategy for the DOF during 2011/12 new management arrangements came into place that gave all fishers the opportunity to use the new gear type. The spatial management framework of the fishery was also modified to align with the northern and southern zones of the WCRLMF.

The DOF transitioned from an exemption fishery to more formal management arrangements in November 2015 with the introduction of the *Octopus Interim Managed Fishery Management Plan* (OIMF Plan). The OIMF Plan will transition from FRMA to ARMA on its commencement.. There are currently seven permits in the OIMF; two have entitlement in Zones 1 and 2, one has entitlement in Zone 1 only, two have entitlement in Zone 2 only, and two have entitlement in Zone 3 only (Figure 2.1).

Catch in the OIMF grew slowly between 2001 and 2008 and during this period it represented between 3.8% and 19% of the statewide commercial octopus catch. Since 2009 the fishery has continued to grow rapidly and the 2016 catch of 208 t now represents over 80% of the statewide commercial octopus catch.

Both trigger traps and shelter pots are highly selective gear types and negligible amounts of species other than octopus are captured by the fishery. Interactions with endangered, threatened and protected (ETP) species are low and restricted to entanglements of whales with ropes. Fishers have adopted gear changes to mitigate entanglements, which includes setting pots on longlines, and using weighted ropes that hang vertically in the water column. No entanglements were reported in 2016.

In 2016 there were 17 vessels and nominated operators active in the OIMF, each employing 2 to 4 people.

2.3.2.2 Cockburn Sound Line and Pot Managed Fishery

The CSLPMF is one of five commercial fisheries established in Cockburn Sound in 1994 and is managed under the *Cockburn Sound (Line and Pot) Management Plan 1995*. The fishery operates using shelter pots and is currently the second largest octopus fishery in WA with a total catch of 24 t in 2016. Squid and fish are also able to be taken by line.

In May 2015 the octopus component of the CSLPMF was transitioned from a fishery where effort was primarily limited by vessel size restrictions to an octopus pot scheme of entitlement. Under this new scheme, 11 licensees currently have entitlement to fish for octopus. Four vessels were active in 2016.

2.3.2.3 West Coast Rock Lobster Managed Fishery

The current day OIMF has evolved from the WCRLMF and remains closely connected to this fishery. Historically the majority of octopus caught in WA was as bycatch from rock lobster fishing. The octopus catch from this fishery has been < 40 t since 2009, well below the historical peak of 139 t in 2002, and was 16 t in 2016. There are no catch or size restrictions on the octopus in the WCRLMF, however recent effort reductions and the shift to an Individual Transferable Quota management system with a conservative total allowable commercial catch will ensure the octopus catch remains a low percentage of the overall catch.

2.3.2.4 Other commercial fisheries

Numerous trap and trawl fisheries in WA catch and retain octopus, however their combined catch has never exceeded 10 tonnes. Any impact from such fishing is assumed to be negligible.

2.3.3 Recreational Fishing

Recreational Octopus fishing is permitted throughout WA and consists of bycatch from recreational lobster pots and targeted octopus fishing, by SCUBA divers and using shelter pots. Management of octopus catch is predominantly through the use of a combined daily bag limit with squid and cuttlefish that is currently 15 per day for individuals and 30 per boat¹.

In 2015 a two-year trial was initiated that allows Recreational Fishing from Boat Licence Holders to use a modified version of the commercial octopus trigger trap to target octopus from boats. Recreational fishers are subject to a range of conditions and are permitted to use a maximum of six trigger traps. In March 2017 the exemption was extended until 2020.

An estimate of the 2015/16 annual recreational catch by boat-based fisheries was 1379 individuals of which 1159 were retained (Ryan et al. 2017). More than 80% of the catch was taken in the West Coast Bioregion.

2.3.4 Customary Fishing

Octopus is not a primary target of Indigenous Australians in WA. There is no quantitative information available on catch, which is likely to be negligible relative to commercial levels.

3 HARVEST STRATEGY

This harvest strategy is structured to describe, hierarchically:

- 1) the high-level, long-term objectives of management (Section 3.1);
- 2) the short-term, operational objectives (Section 3.2); and
- 3) how these translate into the management approach used for this fishery (Section 3.3).

¹ http://www.fish.wa.gov.au/Documents/recreational_fishing/rec_fishing_guide/rules_guide_statewide.pdf

This is followed by a more detailed description of:

- 4) the harvest strategy procedures (Section 3.4);
- 5) the processes for managing stock status (Section 3.5);
- 6) fishery performance (Section 3.6); and
- 7) the specific monitoring and assessment procedures used to ascertain if objectives are being met (Section 3.7).

3.1 Long-Term Objectives

In addition to ensuring the biological sustainability of all captured aquatic resources, this harvest strategy includes broader ecological objectives for each ecosystem component relevant to octopus fishing, as well as social and economic objectives for each fishing sector. It is important to note that the social and economic objectives are applied within the context of ESD.

3.1.1 Ecological Sustainability

- 1) To maintain spawning stock biomass of each retained species above B_{MSY} to maintain high productivity and ensure the main factor affecting recruitment is the environment;
- 2) To ensure fishing impacts do not result in serious or irreversible harm² to bycatch species populations;
- 3) To ensure fishing impacts do not result in serious or irreversible harm to endangered, threatened and protected species populations;
- 4) To ensure the effects of fishing do not result in serious or irreversible harm to habitat structure and function; and
- 5) To ensure the effects of fishing do not result in serious or irreversible harm to ecosystem structure and function.

3.1.2 Economic and Social Benefits

- 6) To provide flexible opportunities to ensure fishers can maintain or enhance their livelihood, within the constraints of ecological sustainability; and
- 7) To provide fishing participants with reasonable opportunities to maximise cultural, recreational and lifestyle benefits of fishing, within the constraints of ecological sustainability.

3.2 Operational Objectives

Long-term management objectives are typically operationalised as short-term (e.g. annual), fishery-specific objectives through one or more performance indicators that can be measured and assessed against pre-defined reference levels so as to ascertain actual performance. Thus,

² Serious or irreversible harm relates to a change caused by the fishery that fundamentally alters the capacity of the component to maintain its function or to recover from the impact.

within the context of the long-term objectives provided above, the octopus fishery has operational objectives to maintain each resource / component above the Threshold level (and, where relevant, close to the Target level), or rebuild the resource if it has fallen below the Threshold or Limit levels.

3.3 Overview of Management Approach

The harvest strategy for the Octopus Resource of WA is a *constant exploitation approach*, where the annual catch varies in proportion to variations in stock abundance. To implement this strategy, fisheries capturing octopus are managed using a range of input controls. These include limited entry, gear restrictions with limits on pot allocations, and spatial regulations that restrict fishers to specific zones (Table 3).

3.4 Overview of Harvest Strategy Procedures

The procedures used within this harvest strategy involve two interrelated decision-making processes (see Figure 3.1 and Figure 3.2). The first is the formal, resource-level review process that assesses the current status of the relevant stocks against defined (Target, Threshold and Limit) reference levels to determine the risks associated with each operational objective (Figure 3.1). If the status falls outside the Target reference level/range, Harvest Control Rules (HCRs) are triggered and management adjustments/measures implemented to return the resource status back to the target range. This process currently occurs annually.

The second process involves an annual, fishery-level review (Figure 3.2). This determines whether the current catch/effort by each of the relevant sectors is consistent with the levels defined (or expected) by the current HCRs and the status of the resource (i.e. the resource-level review process). If the annual catch, effort and/or catch rate for one or more species/sectors falls outside of an annual tolerance range and cannot be adequately explained the performance is termed 'Unacceptable'. This result would generate a review that may lead to management adjustments, or the need for a re-assessment of the resource status and determine whether the current HCRs and their associated management arrangements are still appropriate. These are described in detail in the following sections.

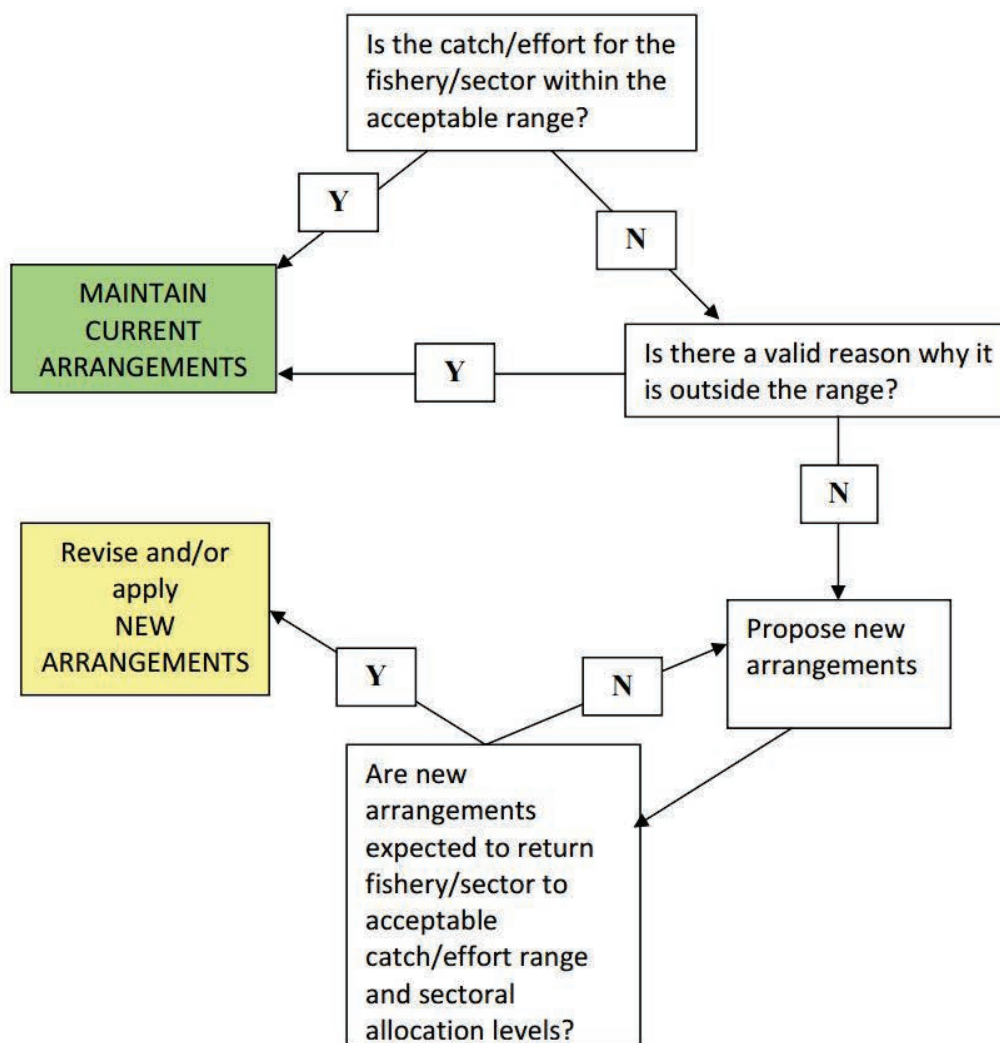


Figure 3.2. Decision tree for regular review of fishery status based on allowable catch/effort tolerance levels and any sectoral allocation decisions (Source: Department of Fisheries 2015)

3.5 Performance Indicators, Reference Levels and Control Rules

Suitable indicators have been selected to describe the status of the Octopus Resource and performance in relation to each management objective, with a set of reference levels established to separate acceptable from unacceptable performance. Where relevant, these levels include:

- A Target level or range (i.e. where you want the indicator to be);
- A Threshold level at B_{MSY} (i.e. where you review your position); and
- A Limit level (i.e. where you do not want the indicator to be and below which there is a significantly increased risk of recruitment impairment).

Based on where the indicators sit in relation to each of their reference levels, harvest control rules define what specific management actions should occur.

3.5.1 Identifying Performance Indicators & References Levels

3.5.1.1 *Octopus cf. tetricus*

The OIMF is currently in a phase of controlled expansion, with fishing practices changing continuously as fishers adapt to the introduction of trigger traps and seek to optimize fishing operations within the constraints of the current management arrangements. During the development of the fishery, and in the absence of a population model, stock status has been monitored using commercial catch rates. Catch rates are assumed to be an index of abundance and used as a proxy for spawning biomass. The preliminary performance indicator for the Octopus Resource is the standardised commercial catch rate (SCPUE) of octopus caught using trigger traps in Zones 1 and 2 of the OIMF, expressed in landed weight (Appendix Figure A 1).

The SCPUE performance indicator is compared annually against reference levels that have nominally been set at 40, 30, and 20% of initial catch rates, $SCPUE_0$ (Table 1). These levels are intended to be consistent with current internationally accepted benchmarks (Mace 1994; Caddy and Mahon 1995; Gabriel and Mace 1999; Wise et al. 2007). The initial year for setting reference levels was 2010, when the first substantial (> 100 t) catches occurred in the OIMF (Appendix Figure A 1).

The SCPUE performance indicator is based on data solely from the OIMF which are considered to be the best measure of the status of the wider *O. cf. tetricus* stock. This single performance indicator applies to all sectors exploiting the Octopus Resource. This is considered appropriate given the population connectivity of *O. cf. tetricus*, which is thought to be high due to its extended paralarval phase, year-round recruitment, capacity to move as adults, and broad area of contiguous habitat occupied in WA waters.

This overall approach is expected to be sufficiently risk-averse noting the high productivity of *O. cf. tetricus*, coupled with initial surveys that have shown substantial octopus biomass and only moderate levels of catchability with the current allowable gear (Hart et al. 2016). The current catch rate based performance measures will be further refined as additional data becomes available or until there is a sufficiently long time series of data available to construct a population model.

Table 1. Interim, catch rate based performance indicator used as a proxy for spawning biomass for the Octopus Resource. The 2017 catch rate standardisation model calculated $SCPUE_0$ to be 1.2 kg per potlift (landed weight).

Performance Indicator	Reference levels		
	Target	Threshold	Limit
Spawning biomass (B)	B_{40}	B_{30}	B_{20}
SCPUE Proxy (kg per potlift)	$0.4 \times SCPUE_0$	$0.3 \times SCPUE_0$	$0.2 \times SCPUE_0$

3.5.1.2 Risk Assessments

Other ecological assets incorporated in this harvest strategy include bycatch, ETP species, habitats and ecosystem structure and function. Reference levels used to monitor performance against management objectives relating to these assets have been set to differentiate acceptable fishery impacts from unacceptable fishery impacts according to the risk levels defined in Fletcher et al. (2012) and Fletcher (2015).

3.5.1.3 Economic and Social Benefits

In line with the principles of ESD, this harvest strategy also includes objectives for the economic and social benefits of fishing for the commercial and recreational fishing sectors. These objectives relate to the provision of opportunities to ensure (1) commercial fishers can maintain / enhance their livelihood and (2) that all fishers can maximise cultural, recreational and /or lifestyle benefits of fishing. It is important to note that management actions relating to these objectives are applied within the constraints of ecological sustainability.

The economic and social objectives for the commercial and recreational octopus fishery do not currently have explicit performance measures within the harvest strategy. Rather, it is through formal consultation processes that regulatory impediments to maintaining or enhancing economic return, and maximising social benefits of fishing, are discussed. Where possible, and in due consideration of ecological sustainability, fisheries management arrangements can be adjusted or reformed to help meet these objectives.

Once suitable and measurable indicators for monitoring performance against the economic and social objectives have been identified, these will be included in future revisions of this harvest strategy.

3.5.2 Application of Harvest Control Rules

For each performance indicator and reference level an accompanying HCR guides the management decisions and actions that will occur (Table 2). HCRs are the key part of the harvest strategy for directing what management decisions are needed to meet sustainability objectives. Due to the inherent complexities of fisheries management, HCRs need to strike an appropriate balance. They cannot be overly explicit as this could hinder effective management and resource utilisation. They also cannot be overly vague or there is a risk of compromising the decision making process and ecological sustainability. Examples of potential management responses for a commercial fishery include setting a new, lower, capacity of the fishery, restricting effort spatially or temporally (such as a seasonal closure), or additional gear restrictions. The ability to implement specific changes depends on the legal instrument under which the management measure occurs. The timeline for completing a management review in response to a breach of a reference level is three months for the Threshold and one month for the Limit. Further information on the management measures in place for this fishery is provided in Section 4.

Table 2. Harvest strategy objectives, performance indicators, references levels, and control rules for the Octopus Resource and associated assets that may be impacted by fishing activities. Note that reference levels prescribe the operational objective which is to maintain each resource above the Threshold level and near the Target level.

Component	Management objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
Ecological					
Target Species	To maintain spawning stock biomass of each retained species above B_{MSY} to maintain high productivity and ensure the main factor affecting recruitment is the environment	<i>Octopus cf. tetricus</i>	Annual standardised commercial catch rate (SCPUE) of octopus caught in trigger traps within Zones 1 and 2	<p>Target: 0.48 kg per potlift</p> <p>Threshold: 0.36 kg per potlift</p> <p>Limit: 0.24 kg per potlift</p>	<p>No management action required</p> <p>If the Threshold is breached³, a management review will be completed within 3 months to develop a management response.</p> <p>If sustainability is considered to be at risk, appropriate management action will be taken as soon as is practicable to reduce the total catch by up to 50%.</p> <p>If the Limit is breached³, a management review will be initiated immediately and completed within 1 month to develop a management response.</p> <p>Appropriate management action will be taken as soon as is practicable to reduce total catch by 50 to 100 %.</p> <p>If a severe risk is identified then fishing will cease immediately while the initial review process is undertaken.</p>

³ A reference level is considered to be breached when there is a greater than 20 % probability that it has been exceeded. That is, if the 20th percentile of a distribution of the estimated SCPUE (i.e. the lower bound of a 60% confidence interval) falls below the Threshold or Limit

Component	Management objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
Bycatch (non-Endangered, threatened and protected species) species	To ensure fishing impacts do not result in serious or irreversible harm to bycatch species populations	All (non ETP) bycatch species	Periodic risk assessments incorporating current management arrangements, catch levels, species information and available research.	<p>Target: Fishing impacts expected to generate an acceptable level of risk to all bycatch species' populations, i.e. moderate risk or lower.</p> <p>Threshold: Fishing impacts are considered to generate an undesirable level of risk to any bycatch species' populations, i.e. high risk.</p> <p>Limit: Fishing impacts are considered to generate an unacceptable level of risk to any bycatch species' populations, i.e. severe risk.</p>	<p>Continue management aimed at achieving ecological objectives.</p> <p>A review is completed within three months to investigate the reasons for the variation and options to reduce the risk. Appropriate management action will be taken as soon as is practicable to reduce the risk to an acceptable level.</p> <p>A review is completed within one month to investigate the options to reduce the risk. Appropriate management action will be taken to reduce the risk to an acceptable level as soon as is practicable.</p>
Endangered, threatened and protected (ETP) species	To ensure fishing impacts do not result in serious or irreversible harm to ETP species populations	All ETP species	Periodic risk assessments incorporating current management arrangements, number of reported interactions, species information and available research.	<p>Target: Fishing impacts expected to generate an acceptable level of risk to ETP species populations and stocks, i.e. moderate risk or lower.</p> <p>Threshold: Fishing impacts are considered to generate an undesirable level of risk to any ETP species' populations and stocks, i.e. high risk.</p>	<p>Continue management aimed at achieving ecological objectives.</p> <p>A review is completed within three months to investigate the reasons for the variation and options to reduce the risk. Appropriate management action will be taken to reduce the risk to an acceptable level.</p>

Component	Management objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
				<p>Limit: Fishing impacts are considered to generate an unacceptable level of risk to any ETP species' populations and stocks, i.e. severe risk.</p>	<p>A review is completed within one month to investigate the options to reduce the risk. Appropriate management action will be taken to reduce the risk to an acceptable level as soon as is practicable.</p>
Habitats	To ensure the effects of fishing do not result in serious or irreversible harm to habitat structure and function.	Benthic habitats	Periodic risk assessments incorporating current management arrangements, extent of fishing activities, habitat distribution and available research.	<p>Target: Fishing impacts are considered to generate an acceptable level of risk to habitat structure and function, i.e. moderate risk or lower.</p> <p>Threshold: Fishing impacts are considered to generate an undesirable level of risk to habitat structure and function, i.e. high risk.</p> <p>Limit: Fishing impacts are considered to generate an unacceptable level of risk to habitat structure and function, i.e. severe risk.</p>	<p>Continue management aimed at achieving ecological objectives.</p> <p>A review is completed within three months to investigate the reasons for the variation and options to reduce the risk. Appropriate management action will be taken to reduce the risk to an acceptable level.</p> <p>A review is completed within one month to investigate the options to reduce the risk. Appropriate management action will be taken to reduce the risk to an acceptable level as soon as is practicable.</p>
Ecosystem	To ensure the effects of fishing do not result in serious or irreversible harm to ecosystem structure and function	Southwest Bioregions continental shelf ecosystems	Periodic risk assessments incorporating current management arrangements, extent of fishing activities, ecosystem information and available research.	<p>Target: Fishing impacts are considered to generate an acceptable level of risk to ecosystem structure and function, i.e. moderate risk or lower.</p>	<p>Continue management aimed at achieving ecological objectives.</p>

Component	Management objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
				<p>Threshold: Fishing impacts are considered to generate an undesirable level of risk to ecosystem structure and function, i.e. high risk.</p> <p>Limit: Fishing impacts are considered to generate an unacceptable level of risk to ecosystem structure and function, i.e. severe risk.</p>	<p>A review is completed within three months to investigate the reasons for the variation and options to reduce the risk. Appropriate management action will be taken to reduce the risk to an acceptable level.</p> <p>A review is completed within one month to investigate the options to reduce the risk. Appropriate management action will be taken to reduce the risk to an acceptable level as soon as is practicable.</p>

3.6 Annual Fishery Performance & Tolerance Levels

Defining annual tolerance levels provides a formal but efficient basis to annually evaluate the effectiveness of current management arrangements in delivering the levels of catch (or effort for quota-managed fisheries) specified by HCRs and where relevant, any sectoral allocation decisions (Fletcher et al. 2016). If the annual catch and effort remains within the ‘tolerance range’ (based on historical variations in recruitment and/or fishing operations) the fishery is considered to be operating ‘acceptably’ with no need to review the management settings. Where the annual catch or effort falls outside of this range and this cannot be adequately explained (e.g. documented evidence of, for example, environmental or market induced impacts), this will result in a review of the cause which may lead to a re-assessment of the resource status. This would necessitate reassessing the status against the performance indicators and HCRs which could potentially lead to a change in management settings and therefore a revision of the tolerance levels.

A combined catch tolerance range of 200 to 500 tonnes is currently in place for all fisheries within the Octopus Resource. This broad acceptable catch range has been set with the expectation of catches further increasing in the OIMF as the fishery continues to develop.

The catch tolerance levels are reviewed annually and published in the State of Fisheries and Aquatic Resource Report and in DPIRD’s Annual Report to the WA parliament.

3.7 Monitoring and Assessment Procedures

3.7.1 Information and Monitoring

3.7.1.1 Fishery-Dependent Information

All commercial fishers in WA are required to provide statutory Catch and Effort Statistics (CAES). For both the OIMF and CSLPMF operators are required to fill out vessel-specific daily logbooks for each line of shelter pots or cradles of trigger traps hauled during a single day’s fishing. Information recorded in logbooks includes GPS locations for the start and end of each line, number of cradles or pots hauled, days soaked, depth, and number and weight of octopus caught. Since the move to a quota management system in 2010, fishers in the WCRLMF have been required to return trip-specific returns and Catch Disposal Records (CDR) that report catch in 10 minute by 10 minute location blocks. Information on the boat-based recreational catch of octopus is collected periodically through a state-wide survey implemented in 2011 (Ryan et al. 2017).

Additional fishery-dependent monitoring includes a biological program in the OIMF and CSLPMF that is used to measure the size, weight, reproductive scheduling, and age of harvested animals. The rate of octopus predation on rock lobsters in the WCRLMF has also been documented through a commercial monitoring program since the 1980s and provides additional information on octopus abundance.

3.7.1.2 Fishery-Independent Information

While no routine fishery-independent monitoring occurs of *O. cf. tetricus* a substantial amount of information was collected as part of Fisheries Research and Development Corporation (FRDC) Project 2010/200 (Hart et al. 2016). This information forms the basis for the ongoing development of the Octopus Resource. Research conducted during this project included development of ageing methodology and age validation, detailed investigation of life history, depletion experiments, and analysis of data to determine gear efficiency and catchability. Data collected from this study were used to estimate biomass, conduct per recruit modelling and estimate sustainable catch and harvest levels for *O. cf. tetricus*.

3.7.2 Assessment Procedures

3.7.2.1 *Octopus cf. tetricus*

Assessment of *O. cf. tetricus* is undertaken annually based on an analysis of commercial catch rates in the OIMF. Daily logbook data on the whole weight of octopus catch are analysed using a Generalised Linear Model (GLM) that estimates the average annual weight of octopus caught per potlift, standardised for the effects of month, latitude, water depth, differences in individual fishing vessels, and the number of days pots were left fishing for. This analysis captures the major seasonal and spatial effects that influence octopus catch rates and is applied only to trigger traps in Zones 1 and 2 of the OIMF, where the majority of fishing is occurring. Note that final catch rates are divided by 1.3 and presented in landed weight (head removed), a more economically relevant term.

The rationale for the current development and expansion of the OIMF is outlined in the final report for FRDC Project 2010/200 (Hart et al. 2016). A key part of this study was a depletion experiment conducted during 2013 that was used to estimate the biomass of octopus in two sites near Mandurah, and the catchability of octopus to trigger traps. Using information on the area of suitable habitat, this enabled a conservative calculation of total biomass of octopus for the wider OIMF. Coupled with per recruit modelling it provided the initial guidance on what level of catch is likely to be sustainable in the fishery.

3.7.2.2 Risk Assessments

DPIRD uses a risk-based EBFM framework to assess the impacts of fishing on all parts of the marine environment, including target species, bycatch, ETP species, habitats and the ecosystem. In line with this framework, periodic risk assessments are conducted for the Octopus Resource. These assessments are used to prioritise research, data collection and monitoring needs, as well as management actions for sectors exploiting the Octopus Resource to ensure that fishing activities are managed both sustainably and efficiently.

Risk assessments will be undertaken periodically (every 3 – 5 years) to reassess any current or new issues that may arise for the Octopus Resource; however, a risk assessment can also be triggered if there are significant changes identified in fishing operations or management activities or controls that may change current risk levels.

4 MANAGEMENT MEASURES AND IMPLEMENTATION

4.1 Management Measures

There are a number of management measures in place for managing the Octopus Resource (Table 3). These measures can be amended as needed to ensure the management objectives are achieved but do not preclude the consideration of other options.

Table 3. Management measures and instruments of implementation for the Octopus Resource. Additional measures relevant to managing octopus captured by the WCRLMF are outlined in the *West Coast Rock Lobster Managed Fishery Management Plan 2012*⁴

Measure/Control	Description	Instrument
Limited Entry	OIMF: A limited number of Managed Fishery Permits (7) are permitted to operate; two have entitlement in Zones 1 and 2, one has entitlement in Zone 1 only, two have entitlement in Zone 2 only, and two have entitlement in Zone 3 only. Entitlement may be transferred among permit holders and new permits temporarily granted, subject to minimum entitlement levels.	<i>OIMF Management Plan 2015</i> (Clause 8)
	CSLPMF: A limited number of Managed Fishery Licences (11) are permitted to operate.	<i>CSLPMF Management Plan 1995</i>
Other Licence Requirements	Commercial: All commercial boats used in fishery require a Fishing Boat Licence. Masters and crew undertaking fishing activities are required to hold a Commercial Fishing Licence.	FRMR
	Recreational: All recreational fishers fishing from a boat require a Recreational Fishing from Boat Licence.	FRMR
Effort Controls	OIMF: The maximum number of traps that can be set within each zone of the fishery is specified in the Management Plan and these are allocated through units of entitlement: Zone 1: 20,550 units Zone 2: 34,908 units Zone 3: 12,213 units Permit holders must hold a minimum entitlement of 600 units.	<i>OIMF Management Plan 2015</i> (Clause 13).
	CSLPMF: The maximum number of pots (13,005) in the fishery is specified in the management plan and these are allocated through units of entitlement.	<i>CSLPMF Management Plan 1995</i>
Gear Restrictions	OIMF: Traps are the only gear type permitted within	<i>OIMF Management Plan</i>

⁴ [https://www.slp.wa.gov.au/gazette/gazette.nsf/0/798980909FF0A04648257A990042B081/\\$file/gg187.pdf](https://www.slp.wa.gov.au/gazette/gazette.nsf/0/798980909FF0A04648257A990042B081/$file/gg187.pdf)

	the fishery and they must conform to a range of design specifications outlined in the management plan. The management plan allows for both 'active' and 'passive' traps (trigger traps and shelter pots, respectively).	2015
	CSLPMF: Unbaited, open-ended pots (shelter pots) are the only permitted gear type for capturing octopus.	<i>CSLPMF Management Plan 1995</i>
	Recreational: Fishing for octopus using unbaited pots is permitted within parts of the Shoalwater Islands and Marmion Marine Parks. Fishing for octopus using up to six trigger traps is currently permitted under exemption until 31 March 2020. Octopus pots and trigger traps must conform to a range of design specifications.	<i>RFMA</i>
Spatial Restrictions	OIMF: Commercial fishing is prohibited in Oyster Harbour and Princess Royal Harbour.	<i>OIMF Management Plan 2015 (Clause 25)</i>
	All sectors: Commercial and recreational fishing is restricted or prohibited in a range of fisheries management and marine conservation areas that overlap with the octopus resource.	<i>Conservation and Land Management Act 1984, FRMA, FRMR</i>
Species Restrictions	OIMF: Fishers are only entitled to retain octopus.	<i>OIMF Management Plan 2015</i>
	CSLPMF: Octopus can only be captured using pots.	<i>CSLPMF Management Plan 1995</i>
	Recreational: A daily bag limit (15) and boat limit (30) applies for octopus, squid and cuttlefish combined.	<i>FRMR</i>
Reporting	Commercial: Commercial fishers are required to report all retained (target and non-target) species catches, effort, ETP species interactions and fishing locations in statutory logbooks.	<i>FRMR</i>

4.2 Implementing Changes to the Management Arrangements

Decision-making processes can be triggered following the identification of new or potential issues as part of an ecological risk assessment (generally reviewed every 3 – 5 years), results of research, management or compliance projects or investigations, monitoring or assessment outcomes (including those assessed as part of the Harvest Strategy) and /or expert workshops and peer review of aspects of research and management.

There are two main processes for making decisions about the implementation of management measures and strategies for the Octopus Resource:

- Annual decision-making processes that may result in measures to meet the operational objectives (driven by the Harvest strategy), and

- Longer-term decision-making processes that result in new measures and /or strategies to achieve the long-term objectives (i.e. changes to the management system).

If there is an urgent issue, stakeholder meetings may be called as-needed to determine appropriate management action.

4.2.1 Consultation

Management changes are generally given effect through amendments to subsidiary legislation, and Exemption. These changes generally require the approval of the Minister for Fisheries and/or the CEO (or appropriate delegates). In making decisions relevant to fisheries, the Minister for Fisheries may choose to receive advice from any source, but has indicated that:

- 1) DPIRD is the primary source of management advice; and
- 2) the peak bodies the Western Australian Fishing Industry Council (WAFIC) and Recfishwest are the primary source of advice and representation from the commercial and recreational harvesting sectors respectively.

The peak bodies are funded by Government under Service Level Agreements (SLA) to undertake their representation/advisory and consultation roles.

4.2.1.1 Commercial Sector Consultation

Under its SLA with DPIRD, WAFIC has been funded to undertake statutory consultation functions related to fisheries management and the facilitation of management meetings for licensed fisheries.

Management meetings between DPIRD, WAFIC and licence holders are used as the main forum to consult with stakeholders and licence holders on the management of the OIMF, CSLPMF and the WCRLMF. During these meetings, current and future management issues that may have arisen during the previous fishing season, and any proposed changes to the management structure, are discussed. Follow-up meetings may be held as required.

4.2.1.2 Consultation with Other Groups

Consultation with Recfishwest, customary fishers and non-fisher stakeholders including Government agencies, conservation sector Non-Government Organisations, statutory advisory committees and other affected / interested parties is undertaken in accordance with the departmental stakeholder engagement guidelines (Department of Fisheries, 2016). DPIRD's approach to stakeholder engagement is based on a framework designed to assist with selecting the appropriate level of engagement for different stakeholder groups and includes collaborating with and involving key stakeholders, seeking input from interested parties through a public consultation process and keeping all parties fully informed through the provision of balanced, objective and accurate information. Key fishery-specific

documents such as harvest strategies, recovery plans and bycatch action plans are subjected to both formal key stakeholder consultation and public consultation processes.

4.3 Compliance and Enforcement

A primary objective of DPIRD's compliance strategy is to encourage voluntary compliance through education, awareness and consultation activities.

4.3.1 Operational Compliance Plan

The enforcement of management arrangements (Table 3) are planned using Operational Compliance Plans (OCP). An OCP is informed and underpinned by a compliance risk assessment conducted for each fishery and reviewed every 1 – 2 years. A specific plan has been developed for the WCRLMF while the OIMF and CSLPMF are considered as part of a state-wide compliance risk assessment that includes smaller fisheries. Each OCP has the following objectives:

- To provide clear and un-ambiguous direction and guidance to Fisheries Officers for the yearly delivery of compliance in the relevant fishery;
- To protect the fisheries' environmental values, whilst providing fair and sustainable access to the fisheries' commercial and social values;
- To encourage voluntary compliance through education, awareness and consultation activities; and
- To provide processes which ensure that the fisheries are commercially viable in the international market yet environmentally sustainable in the local context.

4.3.1.1 Compliance Strategies

Compliance strategies that are used include:

- Catch unload inspections in port;
- At sea fishing boat inspections; and,
- Education strategies.

Inspections may involve:

- Inspection of all authorisations;
- Observations of fishing processes and crew activity; and
- Inspection of holding tanks, freezers and fish on-board the vessels.

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6 APPENDIX 1

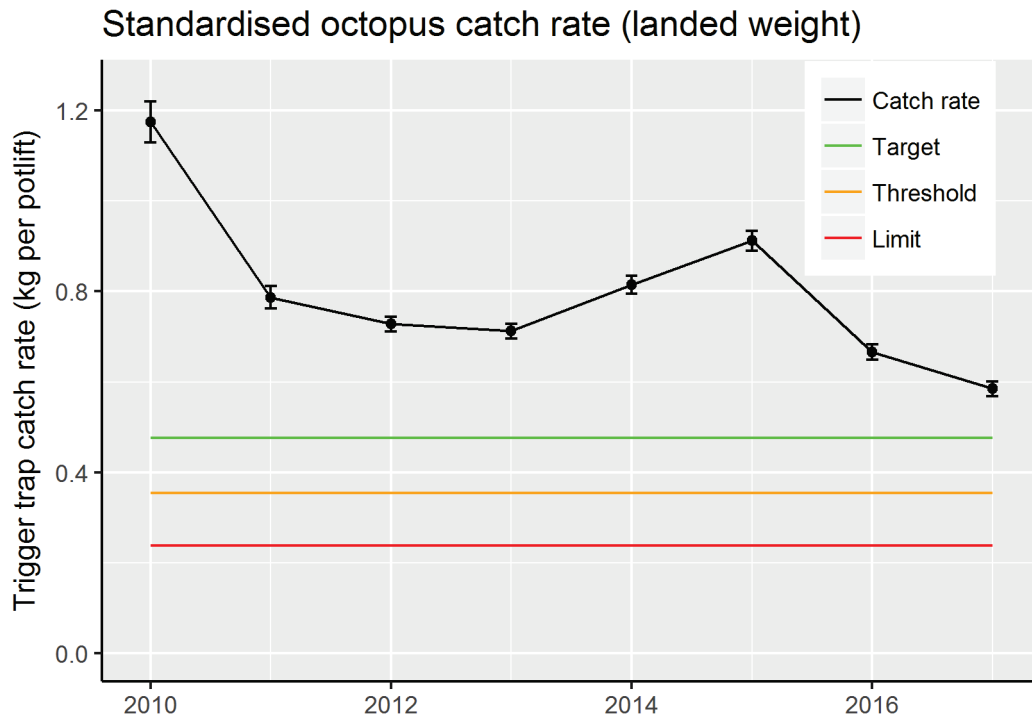


Figure A 1. Standardised catch rate performance measure and associated Target, Threshold and Limit levels of *Octopus cf. tetricus* caught in the OIMF (Zone 1 and 2). Error bars are 60 % confidence intervals.