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Important disclaimer

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LIST OF ACRONYMS

AIMWTMF	Abrolhos Islands and Mid West Trawl Managed Fishery
ALC	Automatic Location Communicator
ARMA	<i>Aquatic Resources Management Act 2016</i>
DPIRD	Department of Primary Industries and Regional Development
EBFM	Ecosystem Based Fisheries Management
EPBC (Act)	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
ERA	Ecological Risk Assessment
ESD	Ecologically Sustainable Development
ETP	Endangered, Threatened and Protected (species)
FRMA	<i>Fish Resources Management Act 1994</i>
FRMR	<i>Fish Resources Management Regulations 1995</i>
HCR	Harvest Control Rule
MSC	Marine Stewardship Council
MSY	Maximum Sustainable Yield
OCP	Operational Compliance Plan
VMS	Vessel Monitoring System
WA	Western Australia
WAFIC	Western Australian Fishing Industry Council

1. INTRODUCTION

Harvest strategies for aquatic resources in Western Australia (WA) that are managed by the Department of Primary Industries and Regional Development (DPIRD, the Department) are formal documents that support decision making processes and ensure these are consistent with the principles of Ecologically Sustainable Development (ESD; Fletcher 2002) and Ecosystem Based Fisheries Management (EBFM; Fletcher et al. 2012). 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 2016* (ARMA), Section 9, which will replace the FRMA once enacted.

This harvest strategy has been developed in line with the Department's Harvest Strategy Policy for Aquatic Resources (Department of Fisheries 2015) and is consistent with relevant national harvest strategy policies and guidelines (e.g. Sloan et al. 2014; Department of Agriculture and Water Resources 2018a, b). It makes explicit the performance indicators, reference levels, and harvest control rules (HCRs) designed to achieve the specific long and short term management objectives for the resource, and the broader goals of ESD and EBFM.

The publication of this harvest strategy 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). The strategy provides guidance for decision makers, but do not derogate from or limit the exercise of discretion required for independent decision making by 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.

Consistent with the Department's Stakeholder Engagement Guideline (Department of Fisheries 2016), this harvest strategy has been subjected to formal stakeholder consultation with industry members and peak commercial and recreational fishing sector bodies, as well as public consultation processes. It has been approved by the Minister for Fisheries.

1.1 Review Process

The WA Harvest Strategy Policy recognises that fisheries change over time and that a review period should be built into each harvest strategy to ensure that it remains relevant (Department of Fisheries 2015). 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 formal 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 relates to the saucer scallop (*Ylistrum balloti*) resource in waters around the Abrolhos Islands, WA, and the fishing activities influencing this resource. Saucer scallops in the waters of the Abrolhos Islands are commercially harvested by the Abrolhos Islands and Mid-West Trawl Managed Fishery (AIMWTMF: Figure 1) using low-opening otter trawls. The AIMWTMF is limited entry and consists of ten licences. Boats primarily target scallops within

the traditional trawl areas around the Abrolhos Islands, and occasionally in the kidney patch, east boundary and Port Gregory areas to the east of the Islands (Figure 2, Figure 3).

In addition to considering fishing impacts on the target species (i.e. the western saucer scallop), this harvest strategy also covers impacts on any other retained species, bycatch¹, endangered, threatened and protected (ETP) species, habitats and other ecological components to ensure any risks to these elements are managed effectively. Note that although fishers are permitted to fish for prawns with prawn mesh in the Port Gregory area (Figure 1, Figure 2), only the impacts of scallop trawling on these ecological components are considered in this harvest strategy.

2.1 Environmental Context

The Abrolhos Islands scallop resource occurs within the northern section of the West Coast Bioregion of WA, which is predominately a temperate oceanic zone but is influenced by the Leeuwin Current that transports warm tropical water southward along the edge of the continental shelf. The Leeuwin Current is responsible for the existence of the unusual Abrolhos Islands coral reefs and high species diversity at latitude 29°S. Sea surface temperature ranges from about 19 to 25° C, although during the marine heatwave in 2011, sea surface temperatures reached 27° C.

The Houtman Abrolhos Islands are located approximately 60 km off the coast of Geraldton (Figure 1) and are a complex of 122 low-lying islands and reefs on the edge of the continental shelf (Johannes et al. 1983). There are three major island groups, the North Island-Wallabi Group, the Easter Group and the Pelsaert (Southern) Group (Figure 2).

The Abrolhos Islands are within a Fish Habitat Protection Area and are of great significance to recreational, commercial (particularly the western rock lobster industry), tourism and conservation sectors. The Reef Observation Areas within the Fish Habitat Protection Area are permanently closed to trawling (Figure 1, Figure 2).

The Abrolhos Marine Park is located adjacent to the Abrolhos Islands. The Marine Park includes four zone types, National Park Zone, Habitat Protection Zone, Multiple Use Zone and Special Purpose Zone. No demersal trawl fishing is permitted in any of the zones that overlap the AIMWTMF (Figure 1). The Abrolhos Islands are one of the most important breeding sites for seabirds in the world and are the northernmost site of the Australian sea lion's range (Commonwealth of Australia 2008).

¹ *Bycatch* is described as the part of the catch which is returned to the sea (usually referred to as non-retained, unwanted or discarded) either because it has no commercial value, its capture could not be avoided or because legislative requirements preclude it being retained.

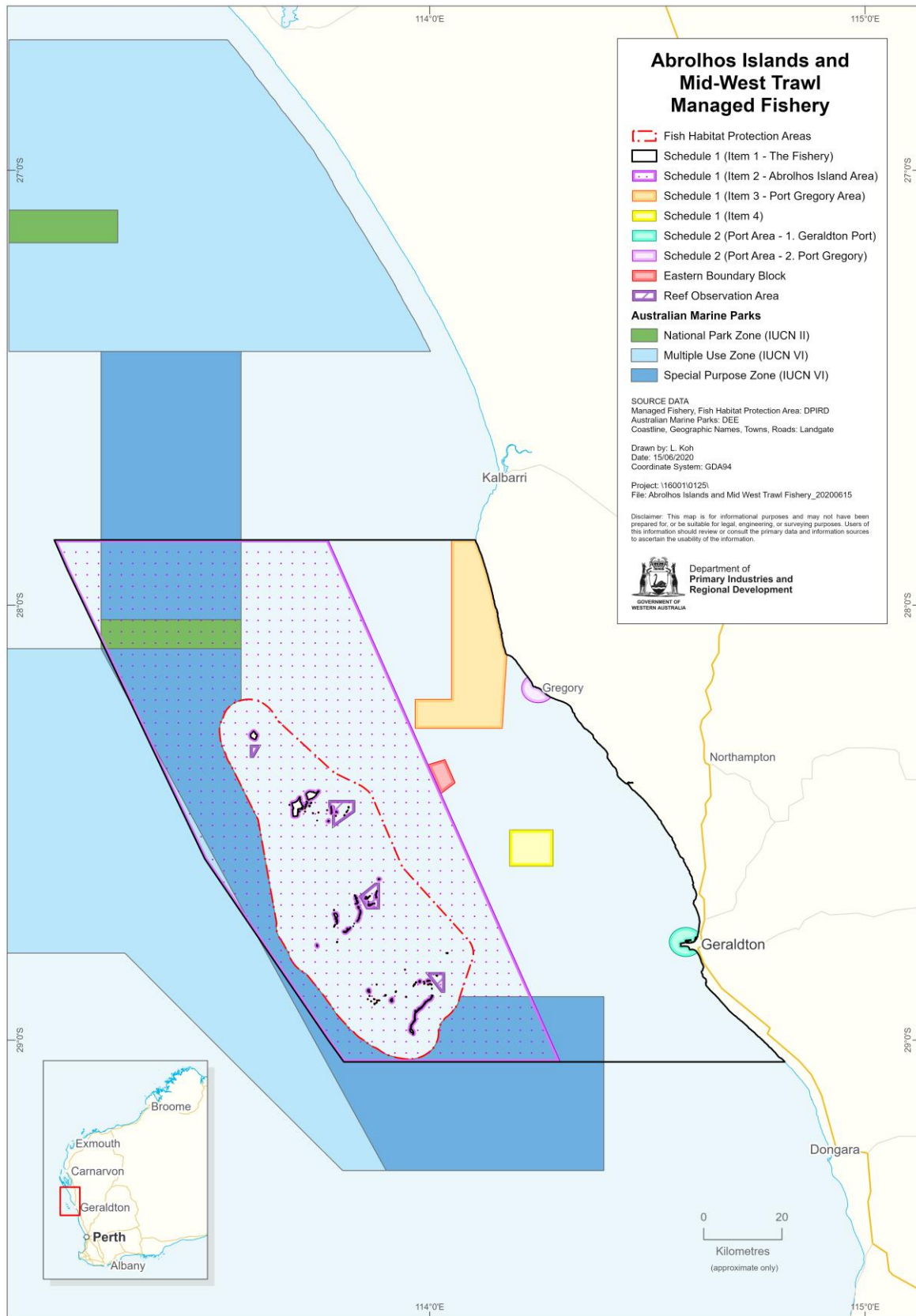


Figure 1. Boundaries and management areas of the Abrolhos Islands and Mid-West Trawl Managed Fishery in Western Australia, as prescribed in the *Abrolhos Islands and Mid West Trawl Managed Fishery Management Plan 1993* and Annual Notices.

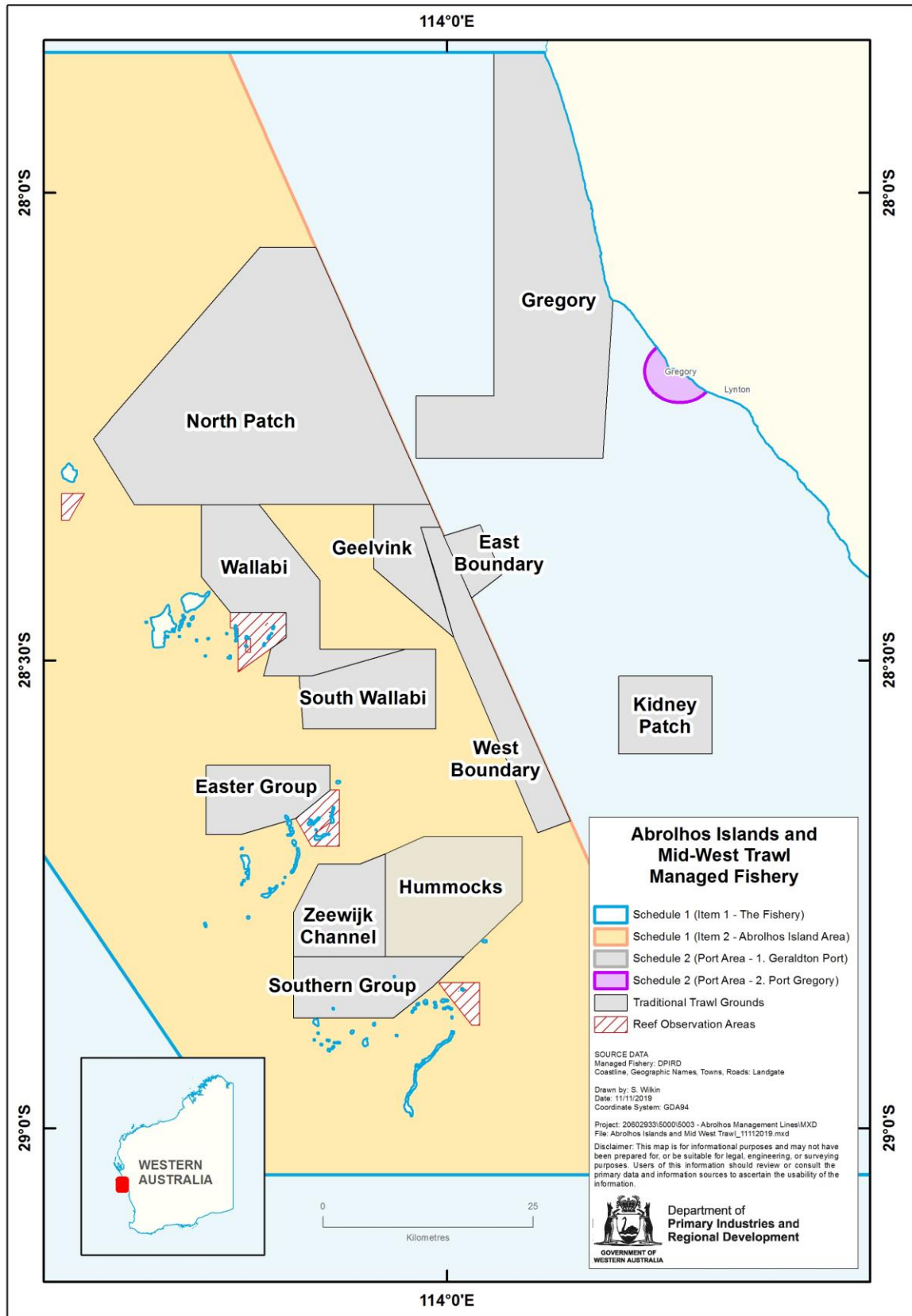


Figure 2. Traditional scallop trawl areas in the Abrolhos Islands that contain the standardised survey sites used to monitor the status of the scallop stock.

2.2 Target Species – Saucer Scallops

The saucer scallop (*Ylistrum balloti*, formerly *Amusium balloti*) is a bivalve mollusc that belongs to the family Pectinidae. It occurs on the east and west coast of Australia and in New Caledonia. The western population is distributed from Broome in the north to Israelite Bay in the south of WA, not overlapping with the eastern Australian population. Despite its extensive distribution, the species tends to be restricted to areas of bare sand in the more sheltered environments found in the lee of islands and reef systems. The greatest numbers in WA are found in Shark Bay and around the Abrolhos Islands (Joll 1989).

Saucer scallops have been recorded reaching 140 mm in length and living up to 3-4 years, however, most appear to live for 2-3 years and usually attain a maximum size around 115 mm (Heald 1978; Dredge 1981). Scallops are broadcast spawners, releasing their eggs and sperm into the surrounding waters for fertilisation to occur. Abrolhos Islands has a protracted spawning period from September to May, which can be separated into early (Sep-Jan) and late (Feb-May) spawning phases. Research suggests that reproduction and survival of larvae are greatly influenced by environment conditions, particularly water temperature (Chandrapavan et al. 2020).

2.3 Fishing Activities

2.3.1 Governance

The saucer scallop resource in the Abrolhos Islands can be targeted by commercial, recreational and customary fishing sectors. These fishing sectors are managed by the Department under the following legislation:

- *Fish Resources Management Act 1994* (FRMA, will be replaced by the ARMA once enacted);
- *Fish Resources Management Regulations 1995* (FRMR);
- FRMA Part 6 — *Abrolhos Islands and Mid West Trawl Managed Fishery Management Plan 1993* (AIMWTMF Management Plan); and,
- FRMA Section 115 Order — *Abrolhos Islands Fish Habitat Protection Area Order 1999*

Fishers must also comply with the requirements of the:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- *Marine Safety (Domestic Commercial Vessel) National Law Act 2012*;
- *Western Australian Marine Act 1982*;
- *Western Australian Biodiversity Conservation Act 2016*;
- *Western Australian Conservation and Land Management Act 1984*; and
- Any other legislation governing the use of the marine environment in which fishing activities occur.

2.3.2 Commercial Fishing

Commercial catches of saucer scallops were first recorded in the Abrolhos Islands in the late 1960s and were fished intermittently until 1980 due to variable catches (Joll 1989a). Catches and vessel numbers increased over the next few years until in 1986, the fishery moved from an open entry to a limited entry fishery with a maximum of 30 licences available. Subsequently, there was a further reduction in the number of boats allowed to operate to 17 licences. Industry funded buybacks and the surrender of a licence removed a further seven licences by 2010.

The current AIMWTMF comprises 10 licences with up to seven boats operating each year. The amount of effort fluctuates each year commensurate with scallop abundance. The fishery is currently managed through input controls including gear restrictions and spatial and temporal closures (see Section 3.3 and Table 2 for more detail). Fishing activity is monitored using the Vessel Monitoring System (VMS).

The AIMWTMF was closed to fishing for five years from 2012 to 2016 in response to low scallop abundance caused by adverse environmental conditions (2010/11 marine heatwave). Since the fishery reopened to limited fishing in 2017, catches have been between 150 and 650 tonnes whole weight, per year (30 to 130 tonnes meat weight). The status of scallop stocks in the Abrolhos Islands has now improved and the current harvest strategy aims to maintain these at sustainable levels using a conservative co-management approach.

2.3.3 Recreational Fishing

There is no recorded recreational fishing for scallops in the Abrolhos Islands.

2.3.4 Customary Fishing

Although there is no quantitative information available on the customary catch of saucer scallops in the Abrolhos Islands, these are likely to be negligible.

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).

This is followed by a more detailed description of:

- 4) the processes for assessing ecological sustainability (Section 3.4);
- 5) the processes for assessing fishery performance (Section 3.5); and
- 6) the specific monitoring and assessment procedures used to ascertain if objectives are being met (Section 3.6).

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, as well as a social and economic objective for the fishery as a whole. It is important to note that the social and economic objective is applied within the context of ESD.

3.1.1 Ecological Sustainability

- 1) To maintain spawning stock biomass of saucer scallops at a level where the main factor affecting recruitment is the environment;
- 2) To maintain spawning stock biomass of each retained species at a level where the main factor affecting recruitment is the environment;
- 3) To ensure fishing impacts do not result in serious or irreversible harm² to bycatch species populations;
- 4) To ensure fishing impacts do not result in serious or irreversible harm to endangered, threatened and protected (ETP) species populations;
- 5) To ensure the effects of fishing do not result in serious or irreversible harm to habitat structure and function; and
- 6) To ensure the effects of fishing do not result in serious or irreversible harm to ecological processes.

3.1.2 Economic and Social Benefits

To provide flexible opportunities to ensure fishers can maintain or enhance their livelihood through optimising the value of their catch, within the constraints of ecological sustainability, by considering the ability of fishers to retain scallops at times when it is most economically favourable (based on the size and quality of scallops).

3.2 Operational Objectives

Long term management objectives are typically operationalised as short term (e.g. annual or periodic) objectives through one or more performance indicators that can be measured and assessed against pre-defined reference levels to ascertain actual performance. Within the context of the long term ecological objectives provided above, operational objectives aim to maintain each resource above the threshold level (and, where relevant, close to the target level), or rebuild the resource if it has fallen below the threshold or the limit levels (see Section 3.4).

3.3 Harvesting and Management Approaches

This harvest strategy for the Abrolhos Islands saucer scallop resource is based on a *constant escapement approach*, which aims to maintain sufficient abundance of scallops prior to spawning. This helps to ensure that fishing does not deplete the residual stock to a level that

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.

affects recruitment. The harvest strategy recognises that scallop recruitment is highly variable and thus aims to provide the spawning stock with a high level of protection in years when scallops are naturally low in abundance.

Management of scallop fishing in the Abrolhos Islands is based primarily on fishery-independent survey information used to predict catches for the upcoming fishing season and ensure that fishing starts after the scallops have spawned. No scallop fishing is permitted in the Abrolhos Islands during the main scallop spawning closure (September to March; Figure 4). A scallop survey in the key scallop trawl grounds in November provides an index of spawning stock levels that is used to inform the management arrangements for the upcoming fishing season (see Table 1).

The scallop fishing season in the Abrolhos Islands nominally opens on 1 March, however, this may be delayed to increase protection of spawning scallops in years where the November spawning index is low (Figure 4). A second scallop survey undertaken in late February or early March provides information on the abundance of both residual (1+ year old) and early recruiting (0+) scallops. Where fishing has been delayed until the second survey has been completed, these data are used to confirm the later season opening and determine if any area specific closures are needed to minimise the catch of small scallops during the fishing season and thus maximise their contribution to the next scallop spawning (see Section 3.4.1). Commercial catch rates are monitored throughout the fishing season, with the frequency of monitoring increasing as the mean daily catch rates provided to the Department by the active vessels decline and approach a threshold level of 150 kg daily meat weight. Where the average daily catch rate of fishing vessels over seven consecutive fishing days³ falls below this level, fishing will cease for the remainder of the fishing season.

Central to this harvest strategy is a co-management approach, whereby industry will abide by voluntary closures of areas with an abundance of juvenile scallops. Where more than half of the scallop landed by a trawl shot are <60 mm in size, this information will be reported to the Department and all other fishing vessels so that the area can be avoided for the remainder of the fishing season. This cooperative framework is also used to monitor fishing in areas outside of the traditional trawl grounds within the fishery. In line with an agreed protocol (see Appendix 1), vessels which undertake exploratory fishing in areas outside of the traditional trawl grounds within the fishery, do so using try gear, with catch rate and size information from these try shots provided to the Department and other skippers within the fleet. To minimise impacts on vulnerable habitats when fishing outside non-traditional areas, a move on rule has been developed that triggers vessels that encounter vulnerable habitats to cease fishing in the area and return to the cumulative trawl footprint (Figure 3; see also Section 3.4.1.2).

³ To allow for the possible influence of bad weather affecting catch rates

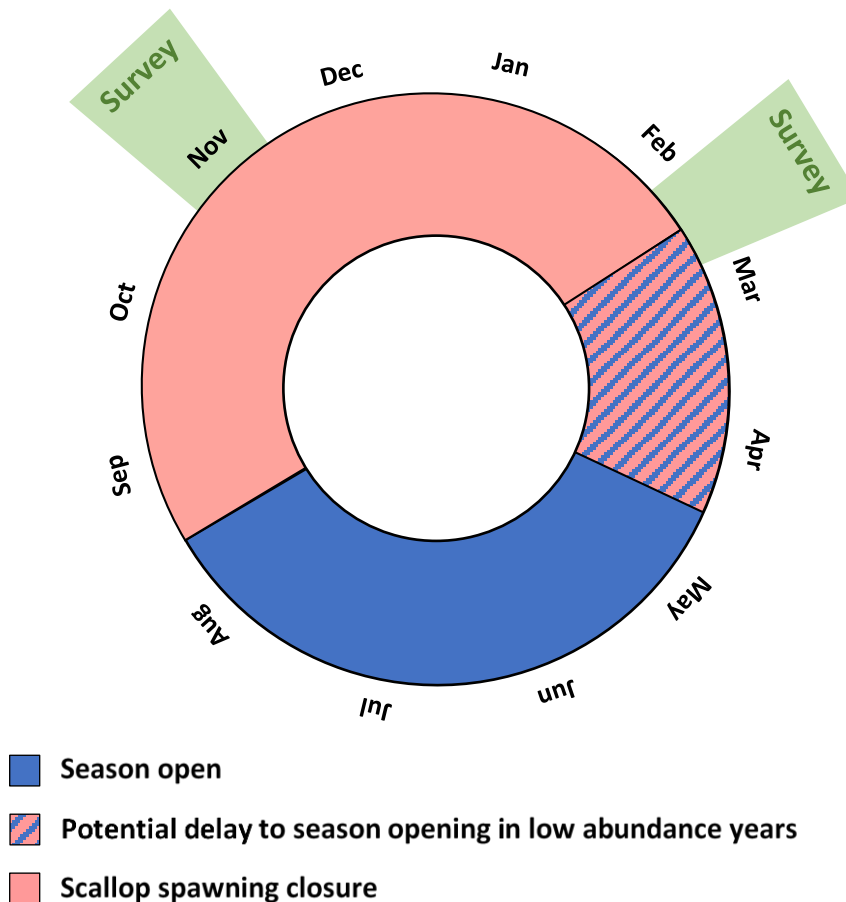


Figure 4. Schematic of the Abrolhos Islands scallop fishing season and timing of the two annual scallop surveys.

3.4 Ecological Sustainability

A formal, resource-level review process is undertaken by the Department to assess the status of relevant target stocks and performance in relation to each ecological management objective. Suitable indicators have been selected to determine the status of the Abrolhos Islands scallop resource and other ecological assets, against defined reference levels established to separate acceptable from unacceptable performance. Where relevant, these levels include:

- a target level (i.e. where you want the indicator to be);
- a threshold level (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).

HCRs define the management actions that should occur in relation to the value of each performance indicator relative to the reference levels (Section 3.4.2).

A summary of the management objectives, performance indicators, reference levels and HCRs is provided in Table 1.

3.4.1 Performance Indicators and Reference Levels

3.4.1.1 Saucer Scallops

The status of the Abrolhos Islands saucer scallop resource is assessed annually using fishery-independent and fishery-dependent data to monitor relative stock levels at certain times during the scallop fishing season.

The primary performance indicator is derived from an annual survey undertaken in November, which provides an index of scallop spawning stock abundance. These data have informed the current reference points for each component of the resource, including a limit below which recruitment may be impaired and thus the fishery will not open for the upcoming fishing season (Table 1). Given the highly dynamic and variable nature of the saucer scallop resource, the target level is considered as the range of index values above a threshold level, below which the season opening will be delayed to maximise the opportunity for scallops to spawn before fishing commences.

A supplementary survey undertaken in February/March 2014 and then regularly since 2016, will be used in conjunction with the information available from the November survey to review the appropriateness of the season opening. As data from this second survey also provides an indication of abundance of residual (1+) and early recruiting (0+) scallops resulting from the previous spawning season, any areas abundant with juvenile scallops will also be protected (Table 1).

Although used only as secondary performance indicators for monitoring scallop levels throughout the fishing season, fishery-dependent catch rates and size information provided to the Department by active fishing vessels is used to inform any further voluntary spatial closures to protect juvenile scallops, and when to cease fishing at the end of the season.

3.4.1.2 Other Ecological Components

Other ecological assets incorporated in this harvest strategy include other retained species, bycatch, ETP species, habitats and ecosystem processes that may be affected by scallop trawling (Table 1).

Where reliable quantitative information is available, reference levels used to monitor performance against management objectives relating to these ecological assets have been set based on data available from ongoing monitoring. The impact of scallop trawling on habitats is monitored by estimating the annual spatial trawl footprint of the scallop fishery and ensuring it does not extend across more than 20% of the entire AIMWTMF (Table 1; see also Section 3.6.2.2). Although the fishery generally operates over sandy areas to target scallops, and avoids areas that can damage fishing gear (e.g. reefs), there is potential for the fishery to interact with other benthic habitats which may be vulnerable to trawl fishing, such as sponges, seagrasses and soft corals. A move on rule will be triggered when the component of vulnerable habitat bycatch in the fishery exceeds a specified amount (Table 1).

For all ecological components, reference levels have also been set to differentiate acceptable fishery impacts from unacceptable fishery impacts according to the risk levels defined in Fletcher (2015). An ecological risk assessment for the Abrolhos Islands scallop fishery was undertaken in September 2019 to inform these components of the harvest strategy (Table 1), with these risk scores to be reviewed after no more than five years (see Section 3.6.2).

3.4.2 Application of Harvest Control Rules

For each ecological performance indicator and reference level, an accompanying HCR directs the management needed to meet the sustainability objectives (Table 1). These HCRs are designed to maintain the resource above the threshold level (i.e. within the target range), or rebuild it where it has fallen below the threshold (undesirable) or the limit (unacceptable) levels.

Where an indicator suggests that the fishery impact on a resource is no longer acceptable, the HCR typically initiates a review of all available information to determine an appropriate management response. The extent of management action taken is determined by the extent to which a performance indicator has breached a reference point, increasing in line with an increasing risk to the resource. This review process also includes consideration of future research and monitoring to ensure the indicator returns to the target level, as well as the compliance response needed to ensure management changes are adequately enforced.

Although a wide range of management measures may be used to achieve the management responses outlined by the HCRs (Table 1), examples for the Abrolhos Islands scallop resource include:

- delaying opening of the scallop fishing season to 1 May to maximise the opportunity for scallops to spawn;
- reducing the spatial extent of fishing to protect areas dominated by juvenile scallops; and/or
- increasing the commercial catch rate threshold to cease fishing earlier in the season where scallop recruitment is low to maximise their contribution to next year's catch and the spawning stock.

The ability to, and timeframe for, implementing these changes depends on the legal instrument under which the management measure occurs (see Section 4 for more information).

3.4.2.1 Recovering Depleted Stocks

A resource that has fallen below the acceptable level and for which suitable management adjustments have been implemented to reduce catch and/or effort (as outlined in the HCRs) is considered to be in a recovery phase. For target stocks that fall below the limit reference level, a recovery strategy will be developed and implemented to ensure that the resource can rebuild at an acceptable rate. Where the environmental conditions have led, or contributed significantly, to the resource being at an unacceptable level, the strategy needs to consider how this may affect the speed and extent of recovery (Department of Fisheries 2015).

Based on the approach used to recover the Abrolhos Islands scallop stock following the 2010/11 marine heatwave, a key component of the recovery strategy for this resource includes closing the fishery to scallop trawling until the stock has returned to above the threshold level (Appendix 2). Precautionary management measures (see section above) would be applied in the first few years after re-opening the fishery. Before the stock is considered to have rebuilt, a review of the harvest strategy will be undertaken to ensure the original HCRs remain appropriate to maintain the stock above the threshold levels in the future.

Table 1. Harvest strategy performance indicators, reference levels and control rules for the Abrolhos Islands saucer scallop resource, and associated ecological assets that may be impacted by fishing activities targeting scallops.

Component	Management Objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
Target species	To maintain spawning stock biomass of saucer scallops in the Abrolhos Islands at a level where the main factor affecting recruitment is the environment	Abrolhos Islands saucer scallops	November index of scallop spawning stock levels (mean survey catch rates across all main trawl areas)	Target: >750 scallops per nautical mile	If the index is above the Threshold, the scallop fishing season will be set to open on 1 March
				Threshold: 750 scallops per nautical mile	If the index is equal to or below the Threshold but above the Limit, delay scallop fishing season opening until February/March survey information is available to inform an appropriate management response (see below)
				Limit: 250 scallops per nautical mile	If the index is equal to or below the Limit, the scallop fishery will remain closed for the next fishing season and a recovery strategy implemented to return the stock to the target level
			1. February/March index of scallop residual levels (mean survey catch rates of 1+ scallops across all main trawl areas), and 2. February/March survey scallop size information (in each main trawl area)	Threshold: 750 1+ scallops per nautical mile; and/or >50% of scallops <60 mm (measured in baskets ⁴)	If either Threshold is breached, review all available information and implement precautionary management measures aimed to return the stock to the target level (e.g. delay season opening and/or implement spatial/temporal closures, see Section 3.4.2)
			Limit: 250 1+ scallops per nautical mile	If the index is equal to or below the Limit, fishery remains closed	

⁴ Basket dimensions: 600 L x 420 W x 320 H (mm)

Component	Management Objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
Other retained species	To maintain spawning stock biomass of each retained species at a level where the main factor affecting recruitment is the environment	All other retained non-target species (mainly bugs)	Periodic risk assessments incorporating: <ul style="list-style-type: none"> • current management arrangements, • annual fishing effort and catch, • species information, and • other available research 	Target: Fishing impacts are expected to generate an acceptable level of risk to retained species' populations, i.e. moderate risk or lower	Continue management aimed at achieving ecological, economic and social objectives
				Threshold: A potentially material change to risk levels is identified; or Fishing impacts are considered to generate an undesirable level of risk to any retained species' populations, i.e. high risk	Review the reasons for this variation within 3 months and implement an appropriate management response to reduce risk to an acceptable level as soon as practicable
				Limit: Fishing impacts are considered to generate an unacceptable level of risk to any retained species' populations, i.e. severe risk	Initiate an immediate management response to reduce the risk to an acceptable level as soon as practicable
Bycatch (non-ETP) species	To ensure fishing impacts do not result in serious or irreversible harm to bycatch species populations	All bycatch species (including prawns)	Periodic risk assessments incorporating: <ul style="list-style-type: none"> • current management arrangements, • use of BRDs, • annual fishing effort and catch, • number of reported ETP species interactions, • species information, and • other available research 	Target: Fishing impacts are expected to generate an acceptable risk level to bycatch species' populations, i.e. moderate risk or lower	Continue management aimed at achieving ecological, economic and social objectives
				Threshold: A potentially material change to risk levels is identified; or Fishing impacts are considered to generate an undesirable level of risk to any bycatch species' populations, i.e. high risk	Review the reasons for this variation within 3 months and implement an appropriate management response to reduce risk to an acceptable level as soon as practicable

Component	Management Objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
				Limit: Fishing impacts are considered to generate an unacceptable level of risk to any bycatch species' populations, i.e. severe risk	Initiate an immediate management response to reduce the risk to an acceptable level as soon as practicable
ETP species	To ensure fishing impacts do not result in serious or irreversible harm to endangered, threatened and protected (ETP) species populations	All ETP species	Periodic risk assessments incorporating: <ul style="list-style-type: none"> • current management arrangements, • use of BRDs, • annual fishing effort and catch, • number of reported ETP species interactions, • species information, and • other available research 	Target: Fishing impacts are expected to generate an acceptable risk level to ETP species' populations, i.e. moderate risk or lower	Continue management aimed at achieving ecological, economic and social objectives
				Threshold: A potentially material change to risk levels is identified; or Fishing impacts are considered to generate an undesirable level of risk to any ETP species' populations, i.e. high risk	Review the reasons for this variation within 3 months and implement an appropriate management response to reduce risk to an acceptable level as soon as practicable
				Limit: Fishing impacts are considered to generate an unacceptable level of risk to any ETP species' populations, i.e. severe risk	Initiate an immediate management response to reduce the risk to an acceptable level as soon as practicable
Habitats	To ensure the effects of fishing do not result in serious or irreversible harm to habitat structure and function	All habitats	1. Extent of fishing area (including permitted and closed areas) trawled annually 2. Periodic risk assessments incorporating: <ul style="list-style-type: none"> • current management arrangements, 	Target: Extent of trawling remains $\leq 20\%$; and Fishing impacts are expected to generate an acceptable risk level to the benthic habitat, i.e. moderate risk or lower	Continue management aimed at achieving ecological, economic and social objectives

Component	Management Objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
			<ul style="list-style-type: none"> • annual fishing effort, • extent of area trawled annually, and • other available research 	<p>Threshold: Extent of trawling is >20%;</p> <p>A potentially material change to risk levels is identified; or</p> <p>Fishing impacts are considered to generate an undesirable level of risk to any benthic habitats, i.e. high risk</p>	Review the reasons for this variation within 3 months and implement an appropriate management response to reduce risk to an acceptable level as soon as practicable
				<p>Limit: Fishing impacts are considered to generate an unacceptable level of risk to the benthic habitat, i.e. severe risk</p>	Initiate an immediate management response to reduce the risk to an acceptable level as soon as practicable
		Vulnerable habitats ⁵	Amount of fishery bycatch comprised of vulnerable habitats	<p>Threshold:</p> <p>>1 basket of vulnerable habitat per nautical mile trawled in a shot when undertaking exploratory fishing of non-traditional trawl grounds</p>	Move on rule triggered. Cease fishing and report coordinates for the area trawled during shot to the Department such that a notice can be distributed to all active vessels to avoid area. Return to the cumulative trawl footprint (Figure 3) until additional habitat assessments have been conducted.
Ecosystem	To ensure the effects of fishing do not result in serious or irreversible harm to ecological processes	Community structure and function	<p>Periodic risk assessments incorporating:</p> <ul style="list-style-type: none"> • current management arrangements, • use of BRDs, • catch levels, 	<p>Target: Fishing impacts are expected to generate an acceptable risk level to the ecosystem, i.e. moderate risk or lower</p>	Continue management aimed at achieving ecological, economic and social objectives

⁵ Structurally complex and/or ecological vulnerable habitats (e.g. seagrass, sponges, soft corals)

Component	Management Objectives	Resource / Asset	Performance Indicators	Reference Levels	Control Rules
			<ul style="list-style-type: none"> • number of reported ETP species interactions, • extent of area trawled annually, and • other available research 	<p>Threshold: A potentially material change to risk levels is identified; or Fishing impacts are considered to generate an undesirable level of risk to the ecosystem, i.e. high risk</p>	Review the reasons for this variation within 3 months and implement an appropriate management response to reduce risk to an acceptable level as soon as practicable
				<p>Limit: Fishing impacts are considered to generate an unacceptable level of risk to the ecosystem, i.e. severe risk</p>	Initiate an immediate management response to reduce the risk to an acceptable level as soon as practicable

3.5 Fishery Performance

Defining annual tolerance levels provides a formal but efficient basis to evaluate the effectiveness of current management arrangements in delivering the levels of catch and/or effort specified by the HCRs and, where relevant, any sectoral allocation decisions (Fletcher et al. 2016). In line with the principles of ESD, this fishery level review process also considers performance against any objectives relating to the economic and social amenity benefits of fishing. Where possible, and in due consideration of ecological sustainability, fisheries management arrangements can be adjusted or reformed to help meet these economic and/or social objectives.

A broad catch tolerance range based on the historical catch range (1990-1998) for this fishery has been set at 95-1,830 tonnes whole weight. These tolerance levels are reviewed annually and published in the State of Fisheries and Aquatic Resources Report.

If the annual catch/effort (or any other indicator specified to measure performance against the economic and social objectives) remains within the tolerance range, the fishery is considered to be operating ‘acceptably’ with no need to review the management settings. If any fishery performance indicator falls outside of the tolerance range and this cannot be adequately explained (e.g. documented evidence of environmental or market-induced impacts), this will result in a review of the cause and re-assessment of the resource status against the performance indicators and HCRs. This could potentially lead to a change in management settings and therefore a revision of the tolerance levels⁶.

The economic and social objective for the scallop fishery does not currently have explicit performance measures within this 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. This broadly considers the ability of fishers to retain scallops at times when it is most economically favourable based on the size and quality of scallops.

3.6 Monitoring and Assessment Procedures

3.6.1 Information and Monitoring

3.6.1.1 Commercial Fishing Information

A voluntary daily logbook program was introduced in 1998, with all vessels completing these since 2000. It has been a statutory requirement for fishers in the AIMWTMF to provide daily logbook records of catch (in weight and numbers) and effort (trawl start time and duration) since 2008. Prior to the logbook program the statutory return was a monthly catch and effort

⁶ Due to the naturally highly variable recruitment of scallops, breaches of the tolerance levels in years of hyper-abundance (with the stock well above the target reference levels) or in very low years due to extreme environmental conditions, may be excepted from management changes as these are considered rare events.

statistics return with limited spatial resolution. However, since 1998, the daily logbook reporting captures latitude and longitude coordinates for the start of each trawl.

Apart from a few scallops that are landed whole, the majority of catches have typically been shucked at sea and skippers record an estimate of the meat weight (on average approximately 20% of the whole weight) together with the number of baskets of whole scallops caught. Departmental staff check, enter and validate the logbook data against processor unload records on a monthly basis and any potentially erroneous entries or gaps are checked with skippers and possibly adjusted. Spatial data validation is undertaken by plotting maps of logbook effort and the Department uses the VMS to monitor all fishing activities in the fishery as part of its compliance plan (see Section 4.3.1).

Fishing efficiency has likely increased through advances in global positioning system and contour mapping technology, use of bigger boats and provision of annual survey information to allow skippers to focus on higher abundance areas with less exploration. For these reasons, fishery-independent survey data are considered a more reliable indicator of abundance than fishery-dependent catch rate data.

3.6.1.2 Recreational Fishing Information

Surveys of all boat-based recreational fishing in WA have been undertaken since 2011/12 to provide bioregional estimates of recreational boat-based catches, with no scallop catches reported (Ryan et al. 2013, 2015, 2017, 2019).

3.6.1.3 Fishery-Independent Information

Fishery-independent scallop surveys in the Abrolhos Islands have been undertaken annually in November since 1997, with an additional February/March survey first introduced in 2014 and undertaken regularly since 2016. The scallop surveys are used to estimate scallop abundance, as well as overall size composition and meat size/quality within standard sites in each major fishing ground (traditional trawl grounds, Figure 2). Environmental data (depth, water temperature, sea conditions) are also collected.

Twin, six-fathom headrope length flat nets with 50 mm mesh in the panels and 45 mm mesh in the cod-end are used on all surveys, and the duration of each trawl is 20 minutes. If the catch is in excess of two baskets, only one basket is counted and the total number of scallops obtained by multiplying the number of scallops in one basket for the total number of baskets. To obtain dorso-ventral length frequency measurements, samples of 100 to 150 scallops are taken and measured from one net except when there are low numbers and both sides are combined.

Due to the longer time series of data in November, this abundance index is used as the primary performance indicator to evaluate stock status and inform the opening of the next fishing season (see below). The February/March survey information is still considered in the overall weight of evidence assessments of the stock, and used to implement any spatial closures prior to the opening of the season. It is anticipated that these data will provide an independent index of recruitment in the future.

3.6.2 Assessment Procedures

3.6.2.1 *Saucer Scallops*

The status of the scallop stock is assessed using a weight of evidence approach that considers all available (fishery-independent and fishery-dependent) information.

The primary performance indicator is derived from a fishery-independent survey undertaken annually in November, which provides an index of scallop abundance (mainly 1+ residuals) and size composition. The current reference levels have been derived from empirical stock-recruitment-environment relationships based on a November indices of standing stock (a proxy of recruitment) and spawning stock (the previous year's standing stock that produced the current recruitment) since 1997. The limit levels have been set to the values of the November abundance index below which historical data for each stock indicates an unacceptable risk of recruitment impairment if fishing was to occur the next fishing season.

A February/March survey has recently been adapted and is currently used to determine areas of high density recruitment (0+ animals) and provide information on areas to avoid during the coming season. This survey is likely to be incorporated in the stock-recruitment relationship at a later date.

Fishery-dependant catch rate data is used to monitor fishing during the fishing season and a threshold level has been set at a level below which fishing for scallops will cease.

3.6.2.2 *Habitats*

The spatial extent of fishing in the AIMWTMF is calculated annually using fishery-dependent logbook data and vessel VMS data. For each trawl shot the logbook data includes a start location (latitude and longitude), date, time and duration of the trawl. The VMS collects consistent spatial information at regular and comparable time intervals between vessels, including vessel call signs, location (latitude and longitude), date, time, speed and bearing and is securely stored by DPIRD. The spatial location of fishing is plotted using the VMS data which is trimmed to the start and end times of fishing, as recorded in the fishery-dependent logbook data. This fine-scale spatial effort data can be used to overlay fishing effort to any available habitat information within the fishery to describe the level of direct interaction.

3.6.2.3 *Ecological Risk Assessments*

The Department uses a risk-based EBFM framework to assess the impacts of fishing on all parts of the marine environment, including the sustainability risks of other retained species (e.g. bugs), bycatch, ETP species, habitats and the ecosystem. This framework has led the development of a periodic risk assessment process, which is used to prioritise research, data collection, monitoring needs and management actions for fisheries and to ensure that fishing activities are managed both sustainably and efficiently.

An ecological risk assessment for the AIMWTMF was most recently undertaken in September 2019. The risk assessment considered the impacts of scallop fishing on each ecosystem

component. The risks to all ecological components (i.e. retained species, bycatch and ETP species, habitats and the ecosystem) were considered acceptable, primarily determined to be negligible to low.

Risk assessments for the Abrolhos saucer scallop resource will continue to be undertaken periodically (at least every five years) to reassess any current or new issues that may arise in the fishery. However, a new risk assessment can also be triggered if there are significant changes identified in fishery operations or management activities or controls that are likely to result in a change to previously assessed risk levels.

4. MANAGEMENT MEASURES AND IMPLEMENTATION

4.1 Management Measures

There are a number of management measures in place for the AIMWTMF that target the Abrolhos Islands scallop resource (Table 2). These measures can be amended as needed to ensure management objectives are achieved, however, they do not preclude the consideration of other options.

Table 2. Management measures and instrument of implementation for the Abrolhos Islands scallop resource.

Measure	Description	Instrument
Limited Entry	Only 10 Managed Fishery Licences are permitted to operate in the AIMWTMF.	<i>AIMWTMF Management Plan</i>
Temporal Closures	No retention of scallops is permitted during the key spawning period.	<i>AIMWTMF season arrangements</i>
Spatial Closures	Parts of the fishery are permanently closed to trawling activities. Areas are also periodically closed to protect aggregations of juvenile and spawning scallops. There are also two port area closures in place within three nautical miles of Geraldton and Port Gregory. The Reef Observation Areas within the Fish Habitat Protection Area are permanently closed to trawling.	<i>AIMWTMF Management Plan and Voluntary agreement</i> <i>Section 115 Order — Abrolhos Islands Fish Habitat Protection Area Order 1999</i>
Gear Restrictions	Includes controls on size of ground chain, mesh size and shape, headrope length and the dimensions of otter boards.	<i>AIMWTMF Management Plan</i>
Bycatch Reduction Devices (BRDs)	The fleet is required to have BRDs in the form of grids in all standard nets.	<i>AIMWTMF Management Plan</i>
Reporting	Fishers are required to report all retained species catches, effort, ETP species interactions and fishing location in statutory daily logbooks. Fishing activities are also monitored via the satellite VMS.	<i>FRMR</i> <i>AIMWTMF Management Plan</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 three to five 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 reviews of aspects of research and management.

There are two main processes for making decisions about the implementation of management measures and strategies for the Abrolhos Islands scallop resource:

- Annual decision making processes that may result in measures to meet the short term fishery objectives (driven by the HCRs); and
- Longer term decision making processes that result in new measures and/or strategies to achieve the long term fishery objectives (i.e. changes to the management system).

However, 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 legislation, such as the commercial fishery management plan, regulations and orders. These changes generally require consultation with all affected parties and 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) The Department is the primary source of management advice; and
- 2) The peak bodies of 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.

4.2.1.1 Commercial Sector Consultation

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

Management meetings between the Department, WAFIC and licence holders in the AIMWTMF are an important forum to consult on the management of the fishery and are generally held biennially. During these meetings, current and future management issues that may have arisen during the previous fishing season and any proposed changes to the management arrangements are discussed. Follow-up meetings may be held as required. The Department also consults directly with industry, where relevant, on specific management and operational issues.

When necessary, pre-season meetings are held after the November survey (usually in December) and after the February/March survey (usually in March) to discuss the results and the season arrangements prior to the start of fishing operations. Skipper's briefings are also conducted in Geraldton to ensure all management arrangements, and in particular, reporting requirements for the season are understood.

4.2.1.2 Consultation with Other Groups

Consultation on scallop management with Recfishwest, customary fishers and non-fisher stakeholders, including Government agencies, conservation sector non-Government organisations and other affected/interested parties is undertaken in accordance with the Departmental Stakeholder Engagement Guideline (SEG) (Department of Fisheries 2016).

The Department'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.

Parts of the AIMWTMF are within the Abrolhos Islands Marine Park (however, no trawling is permitted), key stakeholders that have been identified in accordance with the SEG include the Department of Biodiversity, Conservation and Attractions.

4.3 Compliance and Enforcement

As the key regulatory agency, the Department's compliance role is to achieve economic, social, equity and sustainability objectives by addressing:

- our ability and capacity to influence compliance with the rules; and
- the effectiveness, capacity and credibility of the compliance program.

The Western Australian Fisheries Compliance Strategy (the Strategy; DPIRD 2018) was published in 2018. The purpose of the Strategy is to provide an understanding of the principles underlying the Department's compliance role and how its compliance services are delivered to the WA community. The Strategy aligns with, and complements, the Department's Compliance Framework and Risk Assessment Policy which informs the risk based model, compliance planning and the governance structure applied to fisheries compliance services.

The Department's compliance model is based on the Australian Fisheries National Compliance Strategy 2016 - 2020 (the National Strategy). The Department's compliance program is aligned to support the three key compliance strategies recommended by the National Strategy:

- maximising voluntary compliance;
- effective deterrence; and
- organisational capability and capacity.

4.3.1 Operational Compliance Plans

Management arrangements for the Abrolhos Islands scallop resource are enforced under an Operational Compliance Plan (OCP) that is informed and underpinned by a compliance risk assessment. The OCP has the following objectives:

- to provide clear direction and guidance to officers regarding compliance activities that are required to support effective management of the fishery;
- to provide a mechanism that aids the identification of future and current priorities;
- to encourage voluntary compliance through education, awareness and consultation activities; and
- to review compliance strategies and their effective implementation.

The OCP is reviewed every 1-2 years.

4.3.1.1 Compliance Strategies

Compliance strategies and activities that are used to protect the Abrolhos Islands scallop resource include:

- land and sea patrols;
- catch validation against managed fishery licences;
- inspections of scallop wholesale and retail outlets;
- inspections at scallop processing facilities;
- inspections of vessels in port and pre-season briefings;
- at sea inspection of fishing boats; and
- closed area/season monitoring via VMS.

Inspections may involve:

- inspection of all compartments on board the vessels;
- inspection of all authorisations;
- inspection of logbooks; and
- inspection of catch on board the boat.

REFERENCES

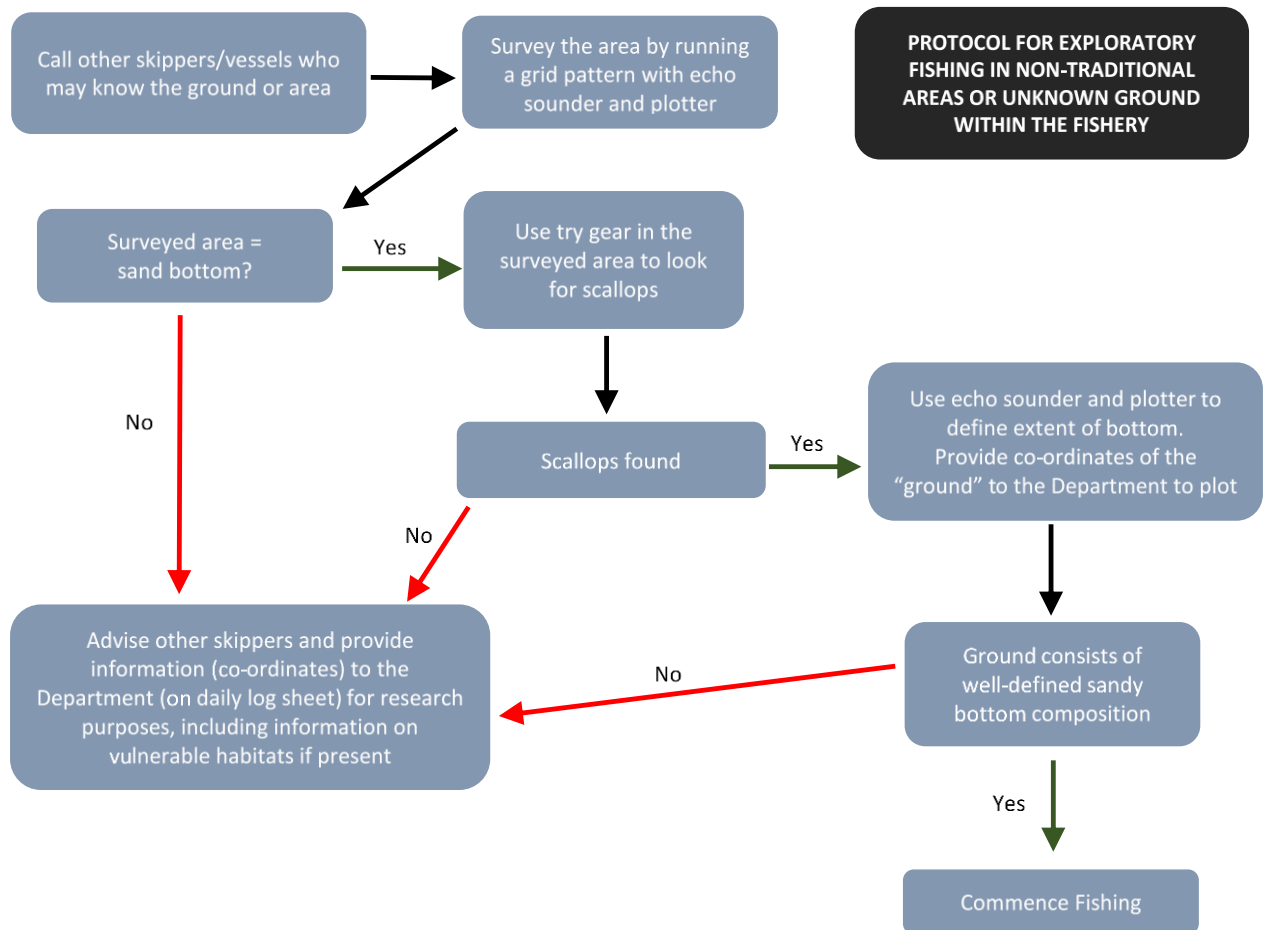
- Chandrapavan, A, Kangas, M.I & Caputi, N (in prep. 2020). Understanding recruitment variation (including the collapse) of saucer scallop stocks in Western Australia and assessing the feasibility of assisted recovery measures for improved management in a changing environment. Final Report FRDC 2015/026. Fisheries Research Report No. TBA. Department of Fisheries, Western Australia.
- Dredge, M.C.L. (1981). Reproductive biology of the saucer scallop *Amusium japonicum balloti* (Bernardi) in central Queensland waters. *Australian Journal of Marine and Freshwater Research* 32: 775–787.
- Department of Agriculture and Water Resources (2018a). Commonwealth Fisheries Harvest Strategy Policy. Canberra, June. CC BY 4.0.
- Department of Agriculture and Water Resources (2018b). Guidelines for the Implementation of the Commonwealth Fisheries Harvest Strategy Policy. Canberra, June. CC BY 4.0.
- Department of the Environment and Water Resources (2007). Guidelines for the ecologically sustainable management of fisheries 2nd Edition.
- Department of Fisheries (2015). Harvest Strategy Policy and Operational Guidelines for the Aquatic Resources of Western Australia. Fisheries Management Paper No. 271. Department of Fisheries, Western Australia.
- Department of Fisheries (2016). Guideline for stakeholder engagement on aquatic resource management-related processes. Fisheries Occasional Publication No. 131. Department of Fisheries, Western Australia.
- Department of Primary Industries and Regional Development (DPIRD) (2018). Fisheries compliance strategy. DPIRD, Western Australia.
- Fletcher, W.J. (2002). Policy for the implementation of ecologically sustainable development for fisheries and aquaculture within Western Australia. Fisheries Management Paper No. 157. Department of Fisheries, WA.
- Fletcher, W.J. (2015). Review and refinement of an existing qualitative risk assessment method for application within an ecosystem-based management framework. *ICES Journal of Marine Research* 72: 1043- 1056.
- Fletcher, W. J., Gaughan, D. J., Metcalf, S. J., & Shaw, J. (2012). Using a regional level, risk based framework to cost effectively implement Ecosystem Based Fisheries Management (EBFM). *In: Global progress on Ecosystem-Based Fisheries Management*, Kruse, G.H. et al. (eds.), pp. 129-146, Alaska Sea Grant College Program, Fairbanks, Alaska.
- Fletcher, W.J., Wise, B.S., Joll, L.M., Hall, N.G., Fisher, E.A., Harry, A.V., Fairclough, D.V., Gaughan, D.J., Travaille, K., Molony, B.W. and Kangas, M. (2016). Refinements to harvest strategies to enable effective implementation of Ecosystem Based Fisheries Management for the multi-sector, multi-species fisheries of Western Australia. *Fisheries Research* 183: 594-608.
- Francesconi, K.A. and Clayton, D. (1996). Shark Bay World Heritage Area – management paper for fish resources. Fisheries Management Paper No. 91. Department of Fisheries, Western Australia.

- Heald, D. (1978). A successful marking method for the saucer scallop, *Amusium balloti* (Bernardi). *Australian Journal of Marine and Freshwater Research* 29: 845-851.
- Joll, L.M. (1989). History, biology and management of the Western Australian stocks of the saucer scallop *Amusium balloti*. In: Proceedings of the Australian scallop workshop, Dredge, M.L.C., Zacharin, W.F. and Joll, L.M (eds.), pp. 30-41, Hobart, Tasmania.
- Joll, L.M and Caputi, N. (1995). Environmental influences on recruitment in the saucer scallop (*Amusium balloti*) fishery of Shark Bay, Western Australia, *ICES Marine Science Symposia* 199: 47-53.
- Kangas, M., Sporer, E., Brown, S., Shanks, M., Chandrapavan, A. and Thomson, A. (2011). Stock Assessment for the Shark Bay Scallop Fishery. Fisheries Research Report No. 226. Department of Fisheries, Western Australia.
- Ryan, K.L., Wise, B.S., Hall, N.G., Pollock, K.H., Sulin, E.H. and Gaughan, D.J. (2013). An integrated system to survey boat-based recreational fishing in Western Australia 2011/12. Fisheries Research Report No. 249. Department of Fisheries, Western Australia.
- Ryan, K.L., Hall, N.G., Lai, E.K., Smallwood, C.B., Taylor, S.M. and Wise, B.S. (2015). Statewide survey of boat-based recreational fishing in Western Australia 2013/14. Fisheries Research Report No. 268. Department of Fisheries, Western Australia.
- Ryan, K.L., Hall, N.G., Lai, E.K., Smallwood, C.B., Taylor, S.M., Wise, B.S. (2017). Statewide survey of boat-based recreational fishing in Western Australia 2015/16. Fisheries Research Report No. 287. Department of Primary Industries and Regional Development, Western Australia.
- Ryan, K.L., Hall, N.G., Lai, E.K., Smallwood, C.B., Taylor, S.M., Wise, B.S. (2019). Statewide survey of boat-based recreational fishing in Western Australia 2017/18. Fisheries Research Report No. 297. Department of Primary Industries and Regional Development, Western Australia.
- Sloan, S.R., Smith, A.D.M., Gardner, C., Crosthwaite, K., Triantafillos, L., Jeffries, B. and Kimber, N. (2014). National Guidelines to Develop Fishery Harvest Strategies. FRDC Report – Project 2010/061. Adelaide, South Australia.
- Walker, D.I. (1989). Seagrass in Shark Bay – the foundations of an ecosystem. In: Seagrasses: A Treatise on the Biology of Seagrasses with Special Reference to the Australian Region, W.D. Larkum, A.J. McComb and S.A. Shepherd (eds.), pp.182-210, Elsevier/North Holland: Amsterdam.

APPENDIX 1

Protocol for Exploratory Fishing in Non-Traditional Areas or Unknown Ground Within the Fishery

Skippers should take every precaution to know and understand the ground they are working on before they commence fishing. The following protocol should be observed when exploring new or unknown ground within the fishery:



APPENDIX 2

Abrolhos Islands Saucer Scallop Recovery Strategy

Introduction

Scallop abundance fluctuates naturally from year to year due to variations in recruitment success. In the key scallop fisheries in WA, there have been several periods of low scallop recruitment. On a number of occasions, scallops have been found to recover naturally within four years when environmental conditions were favourable and spawning stock levels were adequate.

In 2012, the scallop fishery in the Abrolhos Islands was formally closed in response to low stock levels (below the limit reference level) that followed a marine heatwave event that severely influenced scallop survival and recruitment. By 2016, there had been sufficient recovery of the stock to allow a limited catch to be taken.

This recovery strategy outlines the management actions to be implemented to help rebuild the scallop stock in the Abrolhos Islands, if it falls below the limit reference level in future years. It also includes the monitoring and assessment processes to evaluate how rebuilding is occurring. The recovery strategy is an ancillary document to be read in conjunction with the harvest strategy and will remain in place until the stock is considered recovered. Due to the short generation time of scallops (~1 year), the timeframe for the recovery strategy has been set to five years.

Recovery Plan

The current harvest strategy takes a very precautionary approach to recovery by providing for an immediate closure of the scallop fishery. If the index of abundance from the November and/or February/March surveys is below the limit reference level, the fishery will be closed to scallop fishing.

The key management objective of this recovery strategy is to:

- Protect the residual biomass of saucer scallops to allow stock to recover to above the threshold level within 5 years, to ensure the ecological objective is met.

To achieve this objective, three key steps have been identified:

Step 1: Initiate recovery of the stock and rebuild to above the limit level.

Step 2. Rebuild scallop stock to above the threshold level.

Step 3: Ensure recovery by maintaining scallop abundance above the threshold level for two years.

To initiate the recovery of the scallop stock, the harvest strategy requires that management action be taken to prohibit scallop harvest by the AIMWTMF, to enable a return to above the threshold within five years. The fishery closure will remain in place until the index of stock abundance has increased to above the threshold level (Figure 1). The recovery plan allows for

a conservative harvest once the stock has rebuilt to above the threshold level, however, requires precautionary management measures to be in place for the first two years of fishing, before the stock can be considered rebuilt. If the stock has not recovered to above the limit level within two years, further research to understand the effect of the environment on scallop recovery will be undertaken.

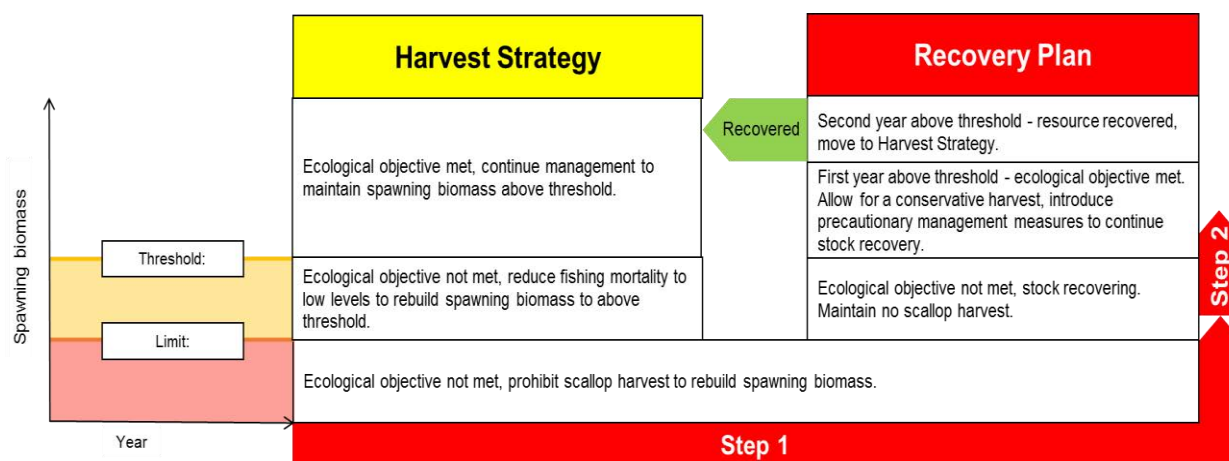


Figure 1. Schematic of the scallop resource of Abrolhos Islands harvest control rules when under the harvest strategy or recovery plan.

Monitoring & Assessment

The Department undertakes fishery-independent surveys of scallop abundance each year, in November and February/March. Although both important to inform the recovery of the scallop stock, the November index is annually compared to reference levels to measure performance of the recovery strategy. The additional surveys in February will also be considered as part of the broader weight of evidence assessment of stock status.

Research Initiatives

An essential component of this recovery strategy is to improve the understanding of the natural and anthropogenic factors influencing scallop recovery including how environmental factors are changing and how they are influencing the biology and ecology of scallops leading to impacts on distribution, recruitment, growth and survival. Where recovery is taking longer than expected, such research will be initiated.