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Draft Western Rock Lobster Fishery Environmental Management Strategy November 2010 – October 2015

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Fish for the future

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OPPORTUNITY TO COMMENT

This paper was prepared by the Department of Fisheries. It is designed to encourage public involvement in the decision making process for the West Coast Rock Lobster resource.

Comments about this discussion paper are sought from all stakeholders, including commercial and recreational fishers, industry members and organisations, relevant community interest groups, government agencies and interested members of the public.

Once the public comments on this draft discussion paper have been received and considered, a final version of the EMS will be published on the Department of Fisheries website.

Your views are sought on any of the matters in the document that are of significance to you and/or your group. To ensure your submission is as effective as possible, please:

- Make it clear and concise.
- List your points according to the topic sections and page numbers in this paper.
- Describe briefly each topic or issue you wish to discuss.
- State whether you agree or disagree with any or all of the information within each topic, or just what is of specific interest to you. Clearly state your reasons, particularly if you disagree, and give sources of information where possible.
- Suggest alternatives to address any issues that you disagree with.

Where and when to send your submission

The closing date for submissions is **Tuesday 15 June 2011**. Please send your submission before this date, along with your full name, address, and association details (if applicable) to:

The Chief Executive Officer
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The Department of Fisheries

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Or by email to:

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Executive Summary

The Environmental Management Strategy (EMS) for the Western Rock Lobster Fishery 2010 – 2015, describes the objectives and actions taken and planned to minimise the adverse effects of the fishery on target and non-target species, communities and habitats. A detailed explanation of the fishery's overall management system is provided in the Governance of the Western Rock Lobster Fishery document, which is currently in press. Since the publication of the first EMS in 2002[1], two separate Ecological Risk Assessments (ERAs) have been undertaken, one in 2005[2] and the other in 2007[3]. This EMS addresses the findings of the 2007 ERA and issues that have arisen since its publication.

The 2007 ERA (Stoklosa 2007) utilized an Ecological Risk Assessment for Effects of Fishing (ERAEF) methodology to assess potential ecological risks posed by the western rock lobsters fishery. It identified four moderate risks: 1) fishing efficiency increases, 2) central west coast deep water effects of fishing, 3) Kalbarri / Big Bank deep water effects of fishing, and 4) dusky whaler sharks mortality caused by bait bands. In addition to these four moderate risks, a further two risks were identified by the Department of Fisheries post the 2007 ERA – low puerulus settlements and Abrolhos Islands sea lion interactions with lobster fishing gear.

This EMS describes the management objectives, operational objectives, management actions and targets to deal with the risks identified at the 2007 ERA (Stoklosa 2007) and subsequently, and where appropriate they have been linked to Marine Stewardship Council (MSC) certification conditions that relate to them.[4]

Newly Identified Risks

Low Puerulus Settlement

Management Objectives

1. *To investigate the possible causes of the recent (2006/07-2010/11) low puerulus settlements.*

2. *Ensure management measures are in place to deal with the expected low recruitments to the fishery that will result from the low puerulus settlements, so that the breeding stock is protected into the future.*

3. *To assess the potential ecological impacts of reduced levels of puerulus settlement.*

Low Puerulus Settlement Operational Objectives

Operational Objective 1

Undertake a multi-disciplinary investigation of the possible causes of the low puerulus settlement.

Action Plan

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[1] The first EMS covered the period 2002 – 2006.

[2] See the 2005 ERA report at: http://www.fish.wa.gov.au/docs/op/op025/index.php?0706

[3] See the 2007 ERA report at http://www.fish.wa.gov.au/docs/op/op056/index.php?0706

[4] For a full list of MSC conditions see http://www.msc.org/track-a-fishery/certified/south-atlantic-indian-ocean/western-australia-rock-lobster/reassessment-downloads-1 and go to Surveillance report No 3 – 13 January 2010.

In April 2009, a *"Low Puerulus Settlement Risk Assessment Workshop"* [5] was held to examine the possible causes of the low puerulus settlement. There were three potential major areas of concern that were examined – a) problems with puerulus collectors and or sites, b) short or long-term environmental changes, and c) a decline in breeding stock levels (overall or in specific locations). Six FRDC[6] funded projects were initiated to examine the potential causes of the low puerulus settlements including – oceanographic, environmental, genetic and phyto-plankton / faunal community studies (Appendix 2). The results of these projects will provide a broader understanding of the factors that may be influencing the levels of puerulus settlement. See de Lestang et al. (2010a) for further information on investigations into possible environmental and breeding stock causes of the low puerulus settlements. A workshop to review the six FRDC projects is planned for 24 May 2011.

Operational Objective 2

Implement precautionary management measures to deal with the low recruitments to the fishery and ensure protection of the breeding stock into the future.

Action Plan

Due to the low puerulus settlements, there will be low recruitments into the fishery and later into the breeding stock, over the next five to seven years. To mitigate this, precautionary management changes have been implemented that included significant reductions in fishing effort in 2008/09 (~50%) and the setting of a conservative 5,500 tonne catch limit for the 2009/10, 2010/11 and 2011/12 seasons. Modelling indicates that these measures will keep the breeding stock above its sustainable threshold level for the foreseeable future.

The Big Bank area of the fishery (north of the Abrolhos Is.) was identified as an area where the breeding stock had been depleted in recent years due to a combination of fishing and reduced recruitment into the area. This area has been closed to fishing since 2008/09.

Further details of the impact of the management arrangements on breeding stock levels are provided in the *Western Rock Lobster International Stock Assessment and Modelling Workshop Report* at: http://www.fish.wa.gov.au/docs/op/op081/index.php?0706 and the *Draft Stock Assessment for the West Coast Rock Lobster Fishery* at http://www.fish.wa.gov.au/docs/frr/frr217/index.php?0401

Information on the management arrangements for 2009-10 can be found at: http://www.fish.wa.gov.au/sec/com/fisheries/WCRockLobster0910Consultation.php?0206

Operational Objective 3.

Develop a research plan to examine potential ecological impacts of low levels of puerulus settlement.

Related to MSC Condition 2.1.2.1 Non-Conformance 2009-2-3:

The client must develop an integrated plan of research that specifically addresses the ecological impacts of low levels of puerulus settlement across the full spatial scale of the fishery.

Action Plan

The very low levels of puerulus settlement that have occurred since the 2006/07 season could result in changes to the trophodynamics of coastal ecosystems, e.g. prey switching. Potential ecosystem impacts associated with this issue have been assessed using the trophodynamic

[5] The report of the *"Low Puerulus Settlement Risk Assessment Workshop" can be found at: http://www.fish.wa.gov.au/docs/op/op071/index.php?0706*
[6] FRDC – Fisheries Research and Development Corporation.

model recently developed for shallow water ecosystems on the central west coast. The results from the model indicate that there will not be any significant ecological impact, as the western rock lobster is not an ecosystem engineer or a key stone species, but rather an ecosystem tracker. A publication on the results of the modelling work is currently in preparation.

Abrolhos Islands Sea Lions

Management Objective

To introduce sea lion exclusion devices (SLEDs) in the identified risk areas at the Abrolhos Islands.

Operational Objective

Mandatory implementation of SLEDs in relevant waters at the Abrolhos Islands.

<u>Related to MSC Condition 2.2.1.4 Non-Conformance 2009-2-5:</u>

The implementation of SLEDs into the risk areas of the fishery in the Abrolhos is required for the 2011 Zone A fishing season.

Action Plan

To facilitate implementation, a working group comprised of members of the former Sea Lion Scientific Reference Group and industry and other stakeholder representatives met on 1 October 2010 to provide final advice to the Department on the risk area around the Southern and Easter Island Groups. The minutes and maps associated with this meeting are provided at Appendix 5. The Minister for Fisheries has announced that SLEDs will be mandatory in relevant waters at the Abrolhos Islands from the commencement of the 2010/11 Abrolhos season, i.e. 15 March 2011 and the regulations have now been implemented.

A formal consultation process was undertaken with commercial and recreational peak bodies to inform them of the implementation of SLED zones at the Abrolhos Islands and a letter was sent to all commercial rock lobster fishers informing them of the SLED requirements and date of implementation. Information regarding the new SLED zones will be included in future recreational rock lobster fishing guides.

Risks Identified During the 2007 ERA

Fishing Efficiency Changes

Management Objective

Improve the estimate of the fishing efficiency gains that have occurred in the fishery.

Operational Objective

Investigate and implement methods to improve estimates of increases in efficiency.

<u>Related to MSC Condition 1.1.5.1 (2009):</u>

Undertake an international peer review of the current (2009) stock assessment and work with the peer reviewer(s) to develop a robust assessment of the stock. Issues to be addressed include:

Estimating efficiency change within the assessment model.[7]

[7] The other issues associated with this MSC condition can be found in *Western Rock Lobster International Stock Assessment and Modelling Workshop Report* at: http://www.fish.wa.gov.au/docs/op/op081/index.php?0706 or on

Action Plan

An international stock assessment review was conducted between the 20 – 24th May 2010 (Department of Fisheries 2010), with fishing efficiency estimations being one of the aspects addressed. Estimates of fishing efficiency are currently being assessed within the stock assessment model (de Lestang et al. 2010a).

FRDC project 2009/019 (Appendix 3) has been developed to address the fishing efficiency increase issue. The project is being undertaken in collaboration with internationally-recognized experts in this field, i.e. Professor Norm Hall (Murdoch University), Assoc Professor Stewart Frusher (Tasmania Aquaculture and Fisheries Institute, University of Tasmania), and Professor John Hoenig (Virginia Institute of Marine Science in the United States). The objectives include assessing current data sources and their potential for use in estimating harvest rates and efficiency increases in the western rock lobster fishery, as well as whether additional sources of information are needed to produce more robust estimates of harvest rate and efficiency increases. The main concern is that efficiency increase may have been underestimated, which could have lead to overestimates of breeding stock levels. This project is due to be completed in December 2011, but relevant findings during the course of the project will be incorporated into the assessment model predictions of breeding stock levels.

An international journal publication is being prepared which explores the relationships in catch rate trends between standardized (no efficiency increase) and commercial (where effort efficiency has increased) fishing in the same locations. This work is producing promising estimates of fishing efficiency changes in deepwater locations of the fishery.

Current research and the management actions that have been implemented, e.g. the fishing effort reductions and catch limits that have been set in response to the low levels of puerulus settlement, are consistent with the Risk Assessment Panel's assessment that ongoing management is appropriate for mitigating this hazard (2007 ERA; Stoklosa 2007[8]).

For further details see:

a) de Lestang et al. (2010a),

b) The *Western Rock Lobster International Stock Assessment and Modelling Workshop Report* (2010) at http://www.fish.wa.gov.au/docs/op/op081/index.php?0706

c) *Draft Stock Assessment for the West Coast Rock Lobster Fishery* at http://www.fish.wa.gov.au/docs/frr/frr217/index.php?0401, and

d) Management arrangements for 2008/09 to 2011/12 at http://www.fish.wa.gov.au/sec/com/fisheries/WCRockLobster.php?0206

Deepwater Ecology – Central west coast

Management Objectives

To provide an assessment of the effect of large scale lobster removal on deepwater ecosystems through investigations involving areas closed to fishing.

Operational Objectives

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the MSC's website at http://www.msc.org/track-a-fishery/certified/south-atlantic-indian-ocean/western-australia-rock-lobster/reassessment-downloads-1 and go to Surveillance report No 3 – 13 January 2010.

[8] See the 2007 ERA report at http://www.fish.wa.gov.au/docs/op/op056/index.php?0706

A second FRDC project (2008/13) commenced in 2009 to address some of the findings of the 2007 ERA and recommendations of the Ecological Scientific Reference Group (EcoSRG) Effects of Fishing Workshop (Department of Fisheries 2008)[9], which identified deepwater ecology was a moderate risk. This risk ranking was primarily due to the paucity of data on deepwater lobster ecology in general and the ecological impacts of lobster removals due to fishing in particular. The operational objectives of this EMS are directly related to those of the FRDC project and the recommendations of the newly formed Effects of Fishing Advisory Group (EFAG) that had its inaugural meeting on 2-3 November 2010. A report of the meeting and their review of the effects of fishing research plan are available at: http://www.fish.wa.gov.au/docs/op/op091/index.php?0706.

Operational Objective 1

Identification and assessment of suitable reference areas in deep water, from which rock lobster fishing could be excluded.

Action Plan

A closed area working group comprising DoF and stakeholders was formed in 2009 with the specific aim of identifying and ranking areas on their potential as closed areas for effects of fishing research based on objective criteria. After general information from habitat mapping was provided, the working group nominated a total of six locations, between the Abrolhos and the Capes, as potential sites. Each location was assessed against the selection criteria developed by the EcoSRG at the 2007 Effects of Fishing Workshop (Department of Fisheries 2008) and reviewed by the Effects of Fishing Advisory Group (EFAG) in November 2010. On the basis of detailed benthic habitat mapping information and lobster demographics (Bellchambers 2010), agreement was reached on a closed area of 12 nm^2 straddling the 30°S latitude line demarcating the boundary between B and C zones. A change to the rock lobster management plan was required to implement the closure. Three annual ecological surveys were conducted prior to the gazetting of the closed area in March 2011. A letter was sent to all licensed commercial rock lobster fishers informing them of the closure.

Operational Objective 2

Development of a qualitative trophodynamic model that will provide a conceptual framework for determining sampling protocols, indictors and targets for deepwater ecological research.

Action Plan

A qualitative trophodynamic model was developed and results from it indicate that small fish (wrasses and sweep) and small invertebrates (amphipods and isopods) would be good indicators of ecosystem health and, as such, will be incorporated into future sampling protocols for the closed and open deepwater research areas (Metcalf et al. in press).

Operational Objective 3

To provide cost effective methods to measure deep water ecosystems in fished and unfished reference areas.

Action Plan

The development of cost effective methods to measure deep water ecosystems in both fished and unfished reference areas is being progressed. Particular consideration has been given to the faunal groups identified by qualitative modelling as potential indicators of the effects of fishing. An independent scientific advisory group met in February 2010 to provide advice on

[9] See proceedings of the Western Rock Lobster Ecological Effects of Fishing Workshop 8 – 10 August 2007 Fisheries Occasional Publication 53 (http://www.fish.wa.gov.au/docs/op/op053/index.php?0706)

the proposed methods to be use in FRDC project 2008/13 and their advice has subsequently been incorporated into a draft methods document, which is part of the project. The EFAG also reviewed this draft methods document at its meeting on 2-3 November 2010, and its recommendations have been incorporated into the final version of the methods document.[10]

Habitat Mapping

Habitat mapping is a component of Deep Water Ecology / Effects of Fishing research work and has a MSC condition associated with it.

MSC Condition 2.1.1.1 Non-conformance 2009-2-1:

The client is required to provide stakeholder-agreed report(s) containing detailed plans to:

1) ***correct the mapping deficiency** and*
2) *deploy appropriate rapid assessment protocols to identify two further (additional to the present 30^o line) areas for subsequent follow up studies in representative deep and shallow water areas of a northern and southern area of the fishery.*

The EFAG met on 1 and 2 November 2010 to review the Effects of Fishing Research Plan, which included an assessment of the habitat mapping that had been undertaken (EFAG 2010). The existing mapping projects that have been completed by a range of agencies and institutions have been summarised in the report *Western Rock Lobster Ecology – The State of Knowledge* document (at http://www.fish.wa.gov.au/docs/op/op089/index.php?0706), which presents the habitat maps currently available for the Central West Coast of WA. DoF has secured funding to appoint a GIS specialist to combine bathymetric data with mapping data from Geoscience Australia and agreements are in place to access this data. This will be used as a first pass habitat map of the region and then combined with detailed correlations between bathymetry and habitat structure obtained from the initial FRDC project (Bellchambers 2010) to predict habitat structure within the rock lobster fishing region. The GIS person is expected to be appointed in early 2011 and the maps finalized by about mid 2011.

Bait bands – Dusky whalers

Dusky Whaler Management Objective

To eliminate the use of bait bands in the western rock lobster fishery

Dusky Whaler Operational Objective

To eliminate the use of plastic bait bands from the Western Rock Lobster Managed Fishery.

Related to MSC Condition 2.1.3.1:

The client must present evidence in the form of a scientifically defensible examination of the fishery's compliance with the Bait Handling Code of Practice that assesses the risks associated with the use and disposal of bait bands. Scientifically defensible here means that the study is quantitative and statistically relevant in terms of identifying how these materials are treated at sea, and evaluates the number of bands and the mass of materials taken onto and off fishing vessels, in various seasons and regions of the fishery. This must be completed prior to the third annual surveillance of the fishery.

[10] The methodology to measure deep water ecosystems can be found in "*Western Rock Lobster Ecology – The State of Knowledge*" document at http://www.fish.wa.gov.au/docs/op/op089/index.php?0706 .

If results show that compliance with the Code of Practice is not sufficient, the client must adopt methods of enforcing the Code of Practice. This must be implemented prior to the fourth annual surveillance of the fishery.

The client must also develop and implement methods to assess compliance on an ongoing basis. This must be implemented prior to the fourth annual surveillance of the fishery.

Action Plan

The Minister for Fisheries initially announced a prohibition on the use of plastic bait bands on "active" rock lobster fishing boats from the start of the 2010/11 season (15 November 2010), however, he later extended the ban to all active fishing boats in Western Australia, including recreational fishing boats. Legislation is currently being prepared to implement the ban, but due to consultation requirements with the other sectors of the fishing industry that are now included in the ban, it was not finalised in time for the commencement of the 2010/11 season, but it will be implemented prior to the 2011/12 rock lobster season.

Reviewing and Updating the EMS

The contents of the EMS will be reviewed, and updated, as necessary, on an annual basis and in full every five years. Risks, and some of the strategies to manage them, are likely to carry over from one five-year period to the next.

Introduction

In 2000 the Western Australian Rock Lobster (*Panulirus cygnus*) became the first fishery in the world to be certification as a 'well-managed and sustainable fishery' by the Marine Stewardship Council (MSC). It was re-certified in November 2006 for a further five-year period, subject to conditions, which included improved ERA practices that have subsequently been met.[11] The fishery is due to undergo recertification for a third five-year period by November 2011.

This Environmental Management Strategy (EMS) is based on the 2007 Ecological Risk Assessments (ERA) and it deals with the moderate risks, as identified in the 2007 ERA (Stoklosa 2007)[12] and the new risks identified by the Department of Fisheries (the Department or DoF) in 2008 and the associated management responses and objectives, including the operational action plans. This report has also drawn on the findings of the 2001 and 2005 ERAs[13] and the WRLF's first EMS which was published in 2005 (Department of Fisheries 2005).[14]

The Western Australian Rock Lobster fishery

Target species

The Western Rock Lobster occurs off the western coast of Australia, with the post-larval stages inhabiting the continental shelf from 1 to 200 meters in depth, with the highest densities occur in waters less than 60 m depth (Kailola et al. 1993).

The species, *Panulirus cygnus*, is a spiny lobster with long antennae. The anterodorsal aspect of the carapace bears two distinct, smooth supraorbital spines and behind them are two rows of 4–8 smaller spines. Each abdominal segment has a transverse groove. The older juveniles and adult lobsters (except migratory 'whites') assume a reddish-purple colour with each moult. The carapace is uniformly coloured without obvious spots and markings, although the abdomen is spotted dorsally and laterally. Each walking leg has a broad, pale longitudinal stripe on its dorsal surface.

Life history

The life cycle of the western rock lobster includes a long (approximately nine month) oceanic larval phase with puerulus settlement being low during years of weak Leeuwin Current associated with El Niño events. Hatching of eggs occurs in summer (mostly December and January) on the outer continental shelf. The larvae disperse up to 1500 km offshore spending the better part of the year in the south-eastern Indian Ocean. The larvae then return to the continental shelf from about July onwards and metamorphose into the final 'puerulus' larval stage which moves onshore and settles in shallow reefs in less than 30m of water (Kailola et al. 1993; Phillips and Pearce 1997). Juveniles remain on shallow coastal reefs for three to four years before recruiting to the fishery (Philips et al. 1991).

[11] For all the MSC annual audits and recertification reports on the WRLF see http://www.msc.org/track-a-fishery/certified/south-atlantic-indian-ocean/western-australia-rock-lobster/reassessment-downloads-1 and go to Surveillance report No 3 – 13 January 2010 for the current conditions applying to the WRLF.
[12] See 2007 ERA report at http://www.fish.wa.gov.au/docs/op/op056/index.php?0706).
[13] See the ERA reports from 2001 at http://www.fish.wa.gov.au/docs/op/op063/index.php?0706 and 2005 at http://www.fish.wa.gov.au/docs/op/op025/index.php?0706
[14] See 2005 EMS at http://www.fish.wa.gov.au/docs/op/op017/index.php

Adults mate between July and December and females carry the spermatophores until eggs are spawned between August and February. Depending upon the female's size, 100 000 to 1 million eggs are spawned. These eggs are carried on the underside of the female's abdomen until they hatch, which may take up to ten weeks depending on the water temperature.

The size at which lobsters reach sexual maturity has been assessed only for females and varies with location and growth rate. Generally females are sexually mature at approximately five to six years of age, when their carapace length measures 90–95 mm. The sex ratio is usually 1:1.

Growth rates vary considerably along the coast. In general, pueruli settle at approximately 8 mm carapace length. One year after settlement, juveniles are about 25 mm in carapace length. Studies have shown three-year-old juvenile lobsters of 39 to 55 mm carapace length, four-year-olds between 56 and 68 mm carapace length, and five-year-old and older animals with a carapace length greater than 69 mm.

P. cygnus are omnivorous and feed at night. Their diet changes according to moult stage, season and habitat. Post-moult lobsters prefer epiphytic coralline algae (eg. *Corallina* species, *Metagonolithon* species) and inter-moult forms prefer molluscan items. Adults eat similar, but larger food, to that of juveniles (e.g. epiphytic coralline algae, molluscs, small crustaceans, polychaete worms and sipunculids – Joll and Phillips 1984).

Predators include, but are not limited to, reef fish, sharks and octopus (*Octopus* species).

Fishery description

The commercial fishery for western rock lobster is the most valuable single species wild capture fishery in Australia, worth between $A200 and $A400 million annually and usually representing about 20 percent of the total value of Australia's fisheries.

The fishery also supports a significant recreational fishery. About 25 050 rock lobster licenses were used to catch 225 tonnes in 2008/09. The recreational catch is normally between 200 and 400 tonnes, which is approximately two to four percent of the total catch (commercial plus recreational). The license entitles recreational fishers to use two traps and/or dive for rock lobster and keep up to six lobsters per day. For further details see the *State of the Fisheries* (Fletcher and Santoro, 2010).[15]

As one of the first managed fisheries in Western Australia, data have been kept on the Western Australia rock lobster fishery since the early 1900s. The rock lobster fishery was declared limited entry in March 1963 when license and pot numbers were frozen. Since 1963, boat numbers have declined from 836 to 293 (as of January 2010). The commercial catch has varied between 5,500 (a TACC) and 14 500 t over the last 30 years, mostly due to natural fluctuations in annual recruitment. The settlement of puerulus (one year old lobsters) is used to predict recruitment levels, and hence catches three to four years ahead.

Management arrangements have included a number of measures to pursue the legislative objectives of resource conservation and sustainability and they are widely recognized as being successful. However, fisheries management objectives dealing with the ecological impacts of fishing are still at the research assessment stage (see "*Western Rock Lobster Ecology – State of Knowledge*" (Department of Fisheries 2010)[16] for further details). Up until the 2008/09 season the main catch control mechanism used was an overall cap on fishing effort, i.e. a total allowable effort (TAE) was imposed by limiting the total number of commercial pots that could be used in the fishery (for further details see de Lestang et al. 2010a). Relatively liberal

[15] State of the Fisheries 2009-2010 at: http://www.fish.wa.gov.au/docs/sof/2009/index.php?0706
[16] *"Western Rock Lobster Ecology – State of Knowledge" at:* http://www.fish.wa.gov.au/docs/op/op089/index.php?0706

transferability provisions allowed market forces to determine the most efficient use of licenses and available traps. This system of management was known as an Individually Transferable Effort (ITE) system.

In 2009/10 a competitive nominal TACC of 5,500 tonnes was introduced. In 2010/11 the fishery management changed to an individual catch quota system with a 5,500 t TACC, which is planned to continue for 2011/12 season, unless research shows it needs to be reduced. TACCs have been introduced due to low levels of puerulus settlement in previous years to enable carryover of stock into the projected years of low recruitment.[17] Initially under the new quota system, effort controls (including reduced pot usage) will generally remain in force.[18]

Western rock lobsters are distributed from Augusta on the South coast of Western Australia up to Exmouth, north of Shark Bay (Figure 1). The fishery is divided into three access zones, that distribute fishing effort across the fishery, rather than permitting the fleet to concentrate effort on areas of seasonally high productivity, thereby avoiding higher than acceptable exploitation rates. Zone management also enables management controls aimed at addressing zone specific issues, for example, there are currently different maximum size restrictions in the northern and southern regions of the fishery. A number of small areas have been closed to commercial fishing, e.g. at Rottnest and Quobba Point and the Fish Habitat Fish Protection Areas at Cottesloe, Yallingup and Lancelin Island. Other closed areas exist under the Marine Park management system administered by the Department of Environment and Conservation (DEC). More recently a large area north of the Abrolhos Is, know as Big Bank has been closed to protect the breeding stock in that area.

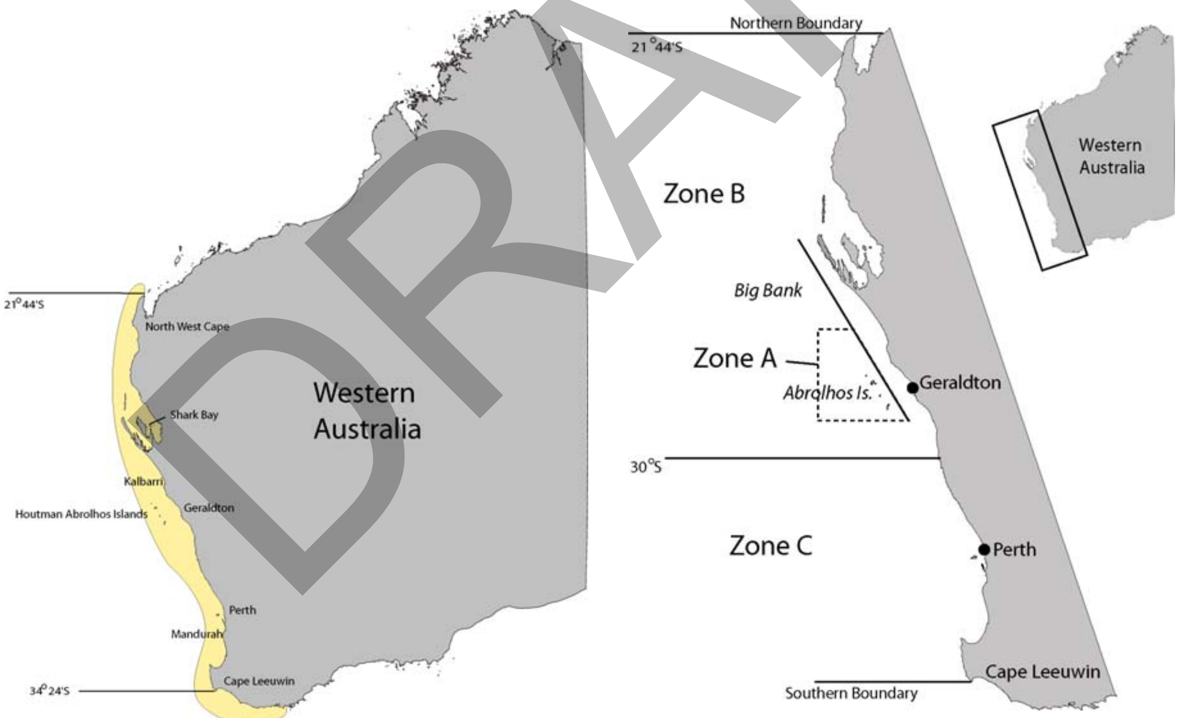

Figure 1. Distribution of western rock lobster (yellow) and lobster fishing zones (right) in Western Australia.

17 See the levels of puerulus settlement at http://www.fish.wa.gov.au/docs/pub/PuerulusSettlement/index.php?0405

18 See management arrangements for 208/09 to 201/12 at http://www.fish.wa.gov.au/sec/com/fisheries/WCRockLobster.php?0206

Other management tools of note are those of a biological nature. Specifically, harvesting excludes females in breeding condition, and animals outside the limits of minimum and maximum carapace length. Gear restrictions that constrain the design and construction of the pots, including the requirement for escape gaps, also play a significant role in controlling exploitation rates and mortality due to handling.

For further information of the management system for the western rock lobster fishery see *Governance of the Western Rock Lobster Fishery* (2011) which will be available on Department of Fisheries website by June 2011.

Processes Underlying the Development of this EMS

This version of the Environmental Management Strategy for the Western Rock Lobster (WRL) fishery describes the objectives and actions taken and planned to minimise adverse effects of the fishery on target and non-target species and habitat and communities. The management of the WRL Fishery is based around decisions made by the Minister for Fisheries who seeks advice from the Department of Fisheries (DoF) and consults with stakeholders directly, through stakeholder working groups, public comment processes and particularly through peak representative bodies, e.g. the Western Australian Fishing Industry Council (WAFIC), Western Rock Lobster Council (WRLC) for the WRL commercial fishery, and Recfishwest for recreational fishers and the Conservation Council of Western Australia and World Wide Fund (WWF Australia) for the environment.

There has always been an implicit regard for the marine environment that supports the productivity of the WRL stock, however the gaining of MSC certification and the Australian Government's Environmentally Sustainable Development initiative have required an explicit shift to managing the effects of the fishery on the environment, compared with the previous focus on single species management.

Ecological Risk Assessment

An ERA of the commercial WRL fishery was undertaken in Feb 2001 (IRC Environment 2009[19]) as a condition of the initial 2000 MSC certification and again in February 2005 (Burgman 2005) in support of the re-certification assessment that was due in 2006. Following the 2005 ERA, the certifying body—Scientific Certification Systems Inc (SCS)—advised that an improved ERA was needed to meet the requirements of MSC re-certification. In particular, SCS required re-assessment of the ecological hazards identified in the 2005 ERA, that were ranked by one or more persons as a 'moderate' risk or above, using what they considered was a more rigorous risk assessment methodology. This requirement is reflected in a formal condition of re-certification (SCS 2006a).

The Department, on behalf of WAFIC (the then "client" for MSC certification[20]), engaged E-Systems Pty Limited on the recommendation of CSIRO Marine and Atmospheric Research to undertake preparations for and to facilitate the required ERA, which took place on 2-3 April 2007. Mr Richard Stoklosa of E-Systems had been previously engaged by CSIRO to perform a peer review of the ERAEF methodology during its development, and had a detailed understanding of its practical use (Stoklosa 2003).

The expected outcome of the April 2007 ERA was to provide transparent and confident classification of risks associated with the activities of the WRLF, and to identify management strategies to mitigate risk where necessary. Only one of the moderate risks to a by-catch species (Bronze Whaler shark) required further assessment under a Level 2 ERAEF analysis, which yielded further information to characterise risk and propose management actions.

Selection of the assessment method[21]

Prior to embarking on a risk assessment of the fishery, E-Systems recommended a review of the possible ERA approaches that could be used to obtain explicit assessment outcomes and

[19] The 2001 ERA was published on the DoF website in 2009, however, it was made available to stakeholders in 2001. The 2001 ERA report can be found at http://www.fish.wa.gov.au/docs/op/op063/index.php?0706 .
[20] The Western Rock Lobster Council became the MSC client in November 2006.
[21] Reproduced from Stoklosa 2007.

meet the requirements of MSC re-certification. A requirement of any ERA method was to ensure consistency with the Australian/New Zealand Standard for risk management (AS/NZS 4360 2004). A review of the 2005 ERA (Department of Fisheries 2005) identified shortcomings and opportunities for improvement (Burgman 2005). A clear objective of re-assessment was to elicit more confident judgements of risk and to address the necessary improvements identified by Burgman (2005) and SCS (2006a). Selection of the ERA assessment method was subject to consultation with the Department, WAFIC and CSIRO.

A decision was made to use the 'Ecological Risk Assessment for Effect of Fishing' (ERAEF) methodology[22], developed jointly by CSIRO Marine and Atmospheric Research, and the Australian Fisheries Management Authority (Hobday et al. 2007). The ERAEF methodology provides a hierarchical framework for a comprehensive assessment of the ecological risks arising from fishing, with impacts assessed against five ecological components:

- target species;
- by-product and by-catch species;
- threatened, endangered and protected (TEP) species;
- habitats; and
- ecological communities.

The ERAEF also provided an explicit approach to uncertainty in assessment of the ecological risks from fishing.

ERAEF Methodology

The ERAEF methodology is a hierarchical approach, which proceeds through four stages of analysis:

- Scoping;
- An expert judgement-based Level 1 analysis described as 'Scale, Intensity and Consequence Analysis' (SICA);
- An empirically-based Level 2 analysis described as 'Productivity-Susceptibility Analysis' (PSA); and
- A deterministic model-based Level 3 analysis.

The hierarchical approach provides a way of screening hazards, with increasing time and attention paid only to those hazards that are not eliminated as 'acceptably low risk' at lower levels in the analysis. Risk management responses may be considered at any level in the hierarchy to eliminate hazards or reduce risk.

A review of the 2005 ERA (Burgman 2005) noted that 27 hazards received a risk ranking of 'moderate' or higher by at least one of up to 13 'voting' experts who participated in the workshop. The advice of SCS was to subject the 27 hazards to a Level 2 Productivity-Susceptibility Analysis (PSA) under the ERAEF methodology (inferring that 'moderate' or higher risks from the 2005 ERA were similar to the medium, high or extreme risk levels defined in the ERAEF methodology).

It was noted that the Level 2 ERAEF methodology currently addresses the potential ecological threats from activities related to the fishery being assessed. While external hazards are assessed at Level 1, Level 2 is not designed to consider hazards associated with external

[22] The ERAEF method was also suggested by the MSC's certifying body, SCS.

threats (e.g. introduction of disease pathogens in bait, climate change, impact of urban development, etc). As such, some of the 27 hazards identified in the 2005 ERA could not progress to Level 2 PSA assessment using the ERAEF methodology. The set of 27 hazards were transparently categorised in the language of activities and ecological components of the ERAEF, to identify hazards that were appropriate to continue to Level 2 assessment. Of the 27 hazards, 15 were potential candidates for Level 2 assessment, as was explained to stakeholders by Stoklosa in November 2006 (Table 1).

Table 1[23] – List of hazards identified during stakeholder workshop (workshop 1) and the associated risk assessment (workshop 2) as part of the 2005 ERA, and their corresponding 2001 ERA rating (if they were identified). The median score of the 2005 ERA is presented with the range of scores shown in parentheses. Risks in bold, were eligible for assessment under the 2007 ERAEF methodology (Stoklosa 2007)

Hazard	2001 rating	2005 rating
1. Possibility that estimate of egg production is incorrect (effect on spawning biomass)	Moderate (low to)	Moderate
2. Increasing recreational fishing population (effect on spawning biomass)	Moderate	Low (to high)
3. Increase in fishing efficiency - shift to campaign fishing (effect on spawning biomass)	**New hazard**	**Moderate (low to extreme)**
4. Mortality and loss of productivity from handling undersized and setose individuals (effect on spawning biomass)	**Low**	**Low (to moderate)**
5. Market decline and additional pressure of the resource (effect on spawning biomass)	New hazard	Low (to moderate)
6. Effects of fishing on the genetic structure of the lobster population	New hazard	Low (to moderate)
7. Removal of octopus (bycatch)	**Low**	**Low (to moderate)**
8. Removal of scale fish and sharks (bycatch)	**Low**	**Low (to moderate)**
9. Removal of deep sea crabs (bycatch)	Low	Low
10. Whale entanglements in pot ropes (ecological impact)	**Low**	**Low (to moderate)**
11. Whale entanglements in pot ropes (social impact)	New hazard	Moderate (low to extreme)
12. Sea lion mortality in pots (without management)	**Moderate**	**Moderate (low to extreme)**
13. Sea lion mortality in pots (with management)	New hazard	Low (to moderate)
14. Sea turtles	**Moderate**	**Low (to moderate)**
15. Manta rays	Low	Low
16. Moray eels	Low	Low
17. Sea horses	New hazard	Low
18. Uncertainty in data relating to	New hazard	Low (to moderate)

[23] Adapted from Table 6.1 Burgman 2005.

endangered, threatened and protected species		
19. Effect of fishing on the Abrolhos environment	**New hazard**	**Low (to high)**
20. Effect of fishing on the Leeuwin-Naturaliste environment	**New hazard**	**Low (to moderate)**
21. Effect of fishing on the central west coast shallow environment (including coastal development)	**New hazard**	**Moderate (low to high)**
22. Effect of fishing on the central west coast deep environment	**New hazard**	**(Low to) moderate**
23. Effect of fishing on the Kalbarri – Big Bend environment	**New hazard**	**Low (to moderate)**
24. Ghost fishing	Low	Low
25. Fishing effects (pots and boats) on benthic biota (coral, limestone reefs, seagrass)	**Moderate**	**Low (to moderate)**
26. Effects on other fisheries of demand for bait	New hazard	Low (to moderate)
27. Introduction of diseases or pathogens in bait	Low	Low (to moderate)
28. Changes in behaviour of attendants (birds, dolphins, sharks, sea lions, sea lice)	Low	Low
29. Illegal feeding of dolphins	Low	Low
30. Abrolhos Is marine issues		**Low (to moderate)**
31. Abrolhos Is terrestrial biosecurity	Low	(to moderate)
32. Dusky whaler shark entanglement in bait bands	**Low**	**Low (to moderate)**
33. Trawling effects on seagrass	New hazard	Low
34. Effects of aquaculture	New hazard	Low
35. Oil spills	New hazard	Low
36. Climate change	New hazard	Low (to moderate)
37. Jurisdictional issues	New hazard	Low (to moderate)

The 15 potential hazards eligible for ERAEF Level 2 analysis are listed in Table 2, with the details of the risk as either internal or external threats, its relevant ecological component and mode of interaction, as either direct capture or other. These hazards were specifically considered in the 2007 ERA (Stoklosa 2007).

Table 2. Hazards from the 2005 ERA relevant to ERAEF Level 2 analysis.

Hazard identified in the 2005 ERA	Internal or external threat	Ecological component	Direct capture or other interaction
Efficiency changes	Internal	Target species	Direct capture
Mortality, productivity loss from handling	Internal	Target species	Direct capture
Octopus	Internal	By-catch species	Direct capture
Scalefish and sharks	Internal	By-catch species	Direct capture
Whales	Internal	TEP species	Direct capture
Sea lions	Internal	TEP species	Direct capture
Sea turtles	Internal	TEP species	Direct capture
Abrolhos ecosystem	Internal	Community	Direct capture
Leeuwin – Naturaliste	Internal	Community	Direct capture
Central west coast – shallow	Internal	Community	Direct capture
Central west coast – deep	Internal	Community	Direct capture
Kalbarri – Big Bank	Internal	Community	Direct capture
Benthic biota	Internal	Habitat	Direct capture
Marine issues – Abrolhos water quality	External	Community	Other interaction
Bait bands – Dusky whalers	Internal	By-catch species	Other interaction

It is also noted from the hierarchical approach of the ERAEF that for medium, high or extreme risks identified from the Level 1 SICA assessment (substituted here by the outcomes of the 2005 ERA), that there are two possible responses – a Level 2 PSA assessment; or a risk management response and re-assessment of the hazard, adopting the guidance contained in AS/NZS 4360 (2004). Consideration of risk management options early in a hierarchical risk assessment process is a common and recommended practice, to eliminate or otherwise reduce the risk of a hazard to an acceptable level and obviating the need for more rigorous risk analysis, which does not in itself contribute to risk management. Remedial action is not, however, limited to high risk activities and should not be precluded for less serious risks that cannot be classified with certainty and where appropriate remedial action may be recommended as a precautionary measure. Suggested management responses to the four moderate risks identified are listed in Table 3

Table 3 – Hazards ranked as moderate risks at the 2007 ERA and remedial actions suggested*

Hazard No**.	Hazard description	Ecological component	Planned or suggested remedial action	Risk ranking (treated risk)	Remarks and post April 2007 ERA information
3	Fishing efficiency increases	Target species	Contemplating offsetting efficiency gains with effort reductions. Improve the estimate of the efficiency gains in the fishery.	Low	Opinion expressed that no specific new management response is needed—ongoing management is appropriate for mitigating this hazard. Additional research and modelling was undertaken in 2008.
22	Central west coast, deep – effects of fishing on the ecosystem	Community	Planned workshop in August 2007 with international experts and the WRL Ecological Scientific Reference Group, to review deepwater research, and to develop ongoing project proposals including the possible use of fished and unfished areas. WA Marine Science Institution (WAMSI) projects. Research to begin informing management decisions, beginning about 2008 (as expressed in MSC timetable).	(not re-assessed, but considered Moderate at the Feb 2005 ERA)	Moderate risk under existing management controls. The workshop was held in August 2007 and the Eco SRG[24] recommended the use of fished and unfished area comparisons to further research the effects fishing on the ecosystem, i.e. removing large numbers of rock lobsters for deepwater (>30m).[25] A new FRDC funded project using fished and unfished area comparisons officially commences on 1 January 2009.
23	Kalbarri–Big Bank, deep	Community	Same as for Central west coast, deep.	(not re-assessed, but considered to be the same as Central West Coast deep)	Moderate risk under existing management controls.
32	Bait bands: mortality of Dusky whalers	By-catch species	Zero tolerance of bait bands by the rock lobster fishery.	No risk	Suggested elimination of bait bands eliminates hazard.

* - Adapted from the hazard table on pgs 28 to 30 of the Feb 2005 ERA report which can be found at http://www.fish.wa.gov.au/docs/mp/mp203/index.php?00

**** – Hazard numbers referred to are from the hazard table on pgs 28 to 30 of the Feb 2005 ERA report above.

[24] Eco SRG – Ecological Effects of Fishing Scientific Reference Group was established by Rock Lobster Industry Advisory Committee in August 2003 and was dissolved in 2010 when RLIAC was wound up. It has been replaced by the Effects of Fishing Advisory Group.

[25] See the Eco SRG's Effects of Fishing Research Plan at http://www.fish.wa.gov.au/docs/op/op039/index.php?0706

Newly Identified Risks

Two new risks have been identified by the Department of Fisheries since the 2007 ERA (Stoklosa 2007). These were; low puerulus settlements, which began in 2008, and Sea Lion interactions with lobster pots at the Abrolhos Islands, which was identified in 2008.

Low Puerulus Settlement

Management Assessment

Puerulus settlement rates have been measured monthly since the late 1960s using artificial seaweed collectors (Phillips 1972). These have been deployed at various locations along the Western Australia coast in shallow near shore areas or around shallow reef at the Abrolhos Islands. The numbers of puerulus settling have been used to predict western rock lobster catches three to four years after settlement, providing the ability to adjust management measures to deal with fluctuations in recruitment to the fishery before they occur (de Lestang et al., 2009). Puerulus settlement rates have shown a strong environmental relationship with increasing numbers of puerulus settling in seasons where there have been higher water temperatures (Figure 2) and strong westerly winds in autumn (see de Lestang et al. 2010).

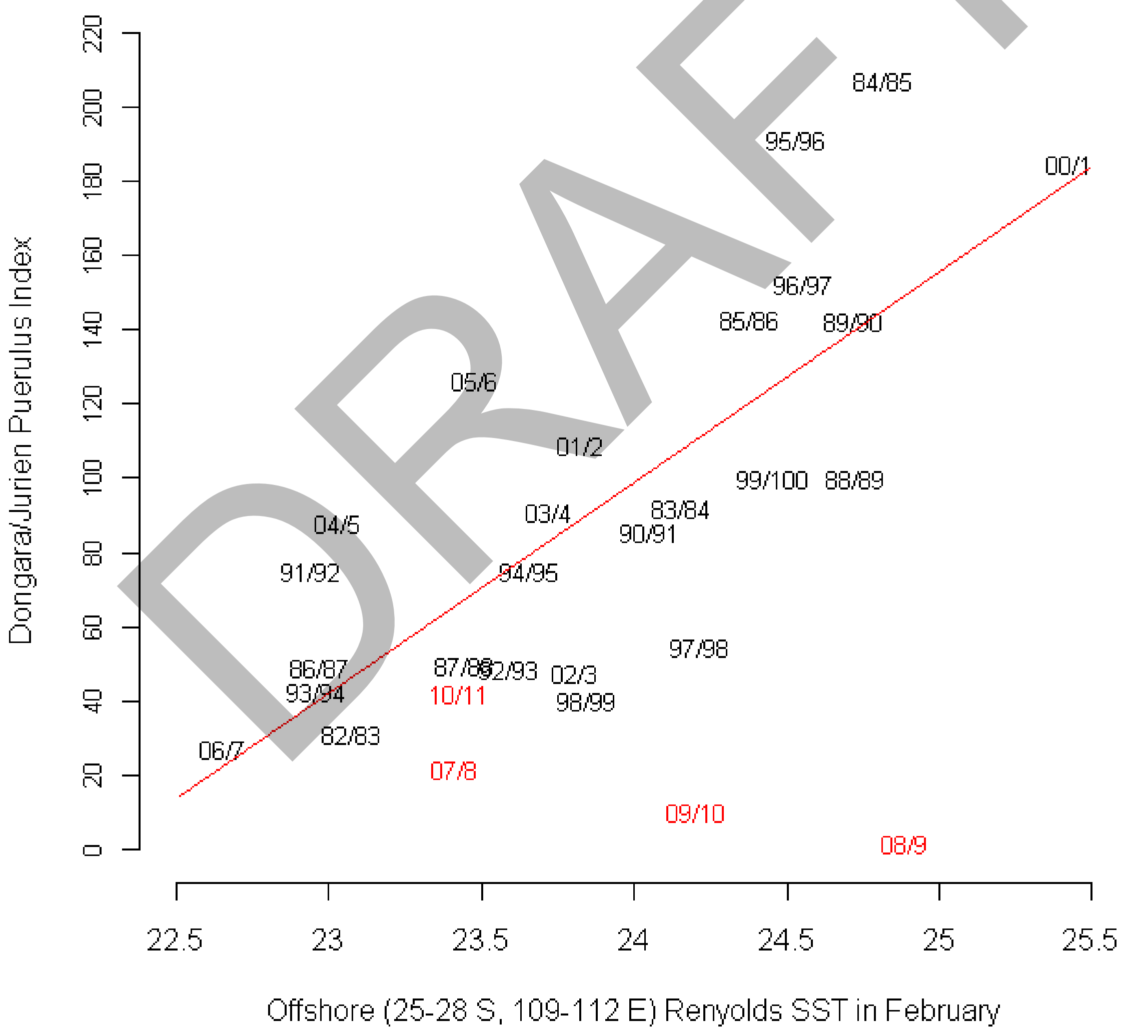

Figure 2 – Puerulus settlement index for Dongara and Jurien and its relationship with offshore water temperatures in February for years 1982 – 2010. Red numbers indicate years with lower puerulus settlement and the current 2010/11 settlement season.

Since the below average settlement in 2007/08, there have been three further seasons (2008/09, 2009/10 and 2010/11) of lower than expected puerulus settlement at all sites throughout the fishery.

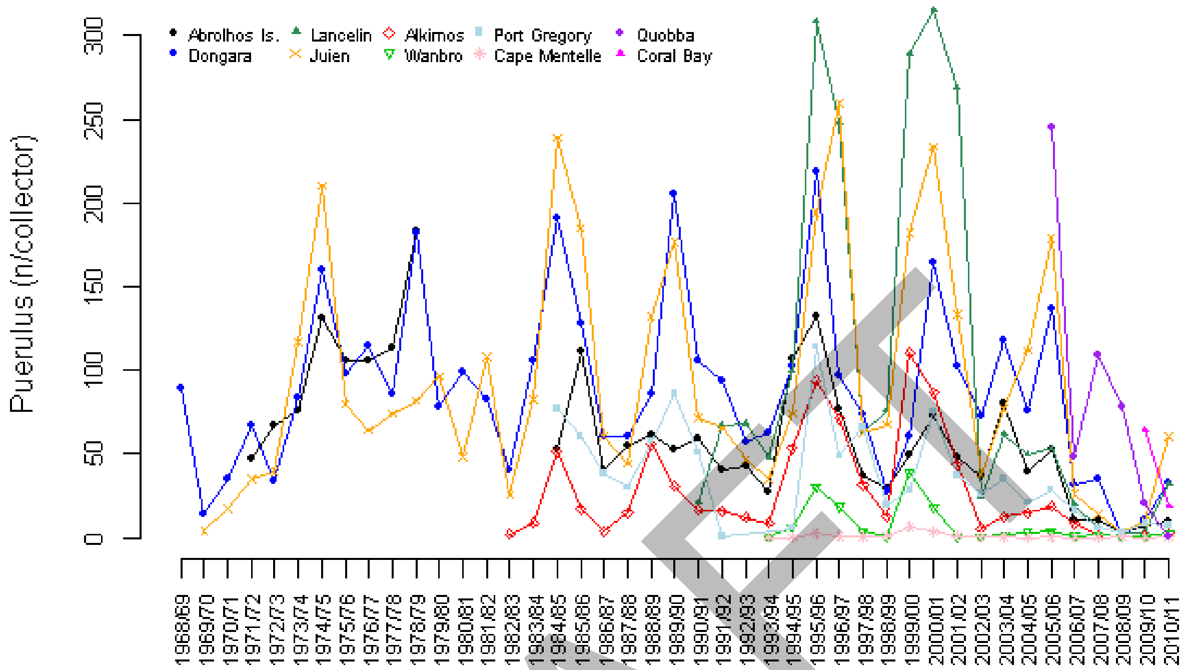

Figure 3 – Long term puerulus settlement patterns for sites along the West Australian coast

Management Objectives

1. *To investigate the possible causes of the recent low puerulus settlements.*

2. *Ensure management measures are in place to deal with the expected low recruitments to the fishery that will result from the low puerulus settlements, so that the breeding stock is protected into the future.*

3. *To assess the potential ecological impacts of reduced levels of puerulus settlement.*

Operational Objectives

Operational Objective 1

Undertake a multi-disciplinary investigation of the possible causes of the low puerulus settlement.

Action Plan

In April 2009, a Low Puerulus Settlement Risk Assessment Workshop was held to examine potential causes for the low puerulus settlement (Brown 2009). There were 12 risks identified as potential cause of the low puerulus settlement (Table 4).

Table 4 - Likelihood of the factor assessed causing the low puerulus settlement. Likelihoods: 1 – Remote, 2 – Unlikely, 3 – Possible, 4 - Likely (adapted from Brown 2009).

Categories, and specific factors potentially causing low puerulus settlement	**Average**
Puerulus Collectors	
Observation error caused by the puerulus collectors	1
Changes in Environmental Conditions	
Short term	2.5
Long term	3.5
Decline in Breeding Stock	
Over the entire fishery	3
Breeding Stock Decline in Specific Areas of the Fishery	
Big Bank and the northern deepwater area of the Abrolhos Is	3
Zone A (Abrolhos) 'core' area, i.e. waters around the island groups	1
Zone B waters generally greater than 36 m	2.5
Zone C waters generally greater than 36 m	1.5
Other Possible Causes	
Combination of changes in the environment and a decline in the breeding stock	3.5
Disease affecting the eggs, larvae and / or puerulus	1
Increased predation of the larvae and / or puerulus	1
Increases in ocean acidity	1

The workshop made 12 recommendations to address the three major areas of concern, namely:

- problems with puerulus collectors and or sites,
- short or long term environmental change, and
- breeding stock levels (either overall or in specific locations).

A summary of the recommendations from the Low Puerulus Settlement Risk Assessment Workshop are listed below (for full details see Brown 2009).

Recommendations

1. Review the puerulus collector program and add an extra site north of Quobba.
2. Assess water column productivity (chlorophyll A) in eastern Indian Ocean over time and its relationship with phyllosoma or puerulus development and survival.
3. Assess eastern Indian Ocean productivity / nutrition processes related to phyllosoma or puerulus survival, and genetically sample phyllosoma or puerulus.
4. Management and industry to develop plans based on a continuation of low puerulus settlement (including a review of the management system).
5. Review of proposed management for 2009/10 to occur immediately after puerulus settlement figures become available.
6. Management to continue to protect the breeding stock, and reduce effort / exploitation in areas where it has declined.
7. Big Bank should remain closed.
8. Special consideration for protecting and increasing breeding stock north of the Abrolhos Islands.

9. Obtain more precise estimates of breeding stock in Zones A, B, C and for Big Bank.
10. The relationship of stock and recruitment should be reviewed, particularly for the 1995/96 to 2008/09 period.
11. Monitoring and data analysis programs to be developed to assess the management changes from 2008/09 onward on the breeding stock in Zones A, B, C and for Big Bank.
12. Review of the commercial monitoring program with possible expansion into Big Bank and northern and southern Abrolhos Islands areas.

Five FRDC funded projects have been initiated to examine various causes of the low puerulus settlement, including oceanographic, environmental, genetic and faunal community studies. These studies are of varying durations, with results from each designed to compliment a broader understanding of the factors influencing puerulus settlement (Appendix 2). One of the five FRDC project will look at fishing efficiency changes and alternative ways of estimating biomass, particularly breeding biomass levels (a more detailed description of the project is provided at Appendix 3).

<u>Low Puerulus Operational Objective 2.</u>

Precautionary management measures to ensure protection of the breeding stock

Action Plan

The anticipated lower recruitment into the fishery over the next four years, as a result of the low puerulus settlements, has resulted in significant changes in the management of the lobster fishery.

In 2007/08 there were several effort reductions (e.g. a reduction in the number of pots used), which varied between zones. Zone A had the unit value altered from 0.74 from 15 November to 15 April then 0.82 through to season end, while B Zone had 0.74 from 15 November to 15 March then 0.82 to season end. C Zone had a constant unit value of 0.82.

In 2008/09 there were further effort reductions, both in terms of pot usage and temporal and spatial closures (e.g. Big Bank north of the Abrolhos Is). These management changes were adaptive, to keep the overall catch limited to 7 800 tonnes, a pre-set total allowable commercial catch (TACC) for this season.[26]

The continued low puerulus settlement, and the large number of management changes (effort reductions) that were required to deliver the 7,800 tonne TACC in the 2008/09 season, saw a move to a modified management regime in 2009/10. The most significant change was to a competitive TACC allocated by zone.[27] Catch was monitored weekly from processor returns to limit it to nominal TACC of 5 500 tonnes and each zone was closed when it reached its share. The same TACC will be used in the 2010/11 and 2011/12 season, but it will be in the form of individual fisher quotas. Modelled breeding stock estimates indicate that these management arrangements will maintain breeding stock levels above their thresholds in each of the three management zones (Figure 4). This modelling is currently being updated to take into account comments from the stock assessment review held in 2010.

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[26] Further information on the management arrangements can be found at: http://www.fish.wa.gov.au/sec/com/fisheries/WCRockLobster.php?0206 and http://www.fish.wa.gov.au/sec/com/fisheries/WCRockLobster0910Consultation.php?0206
[27] Ibid

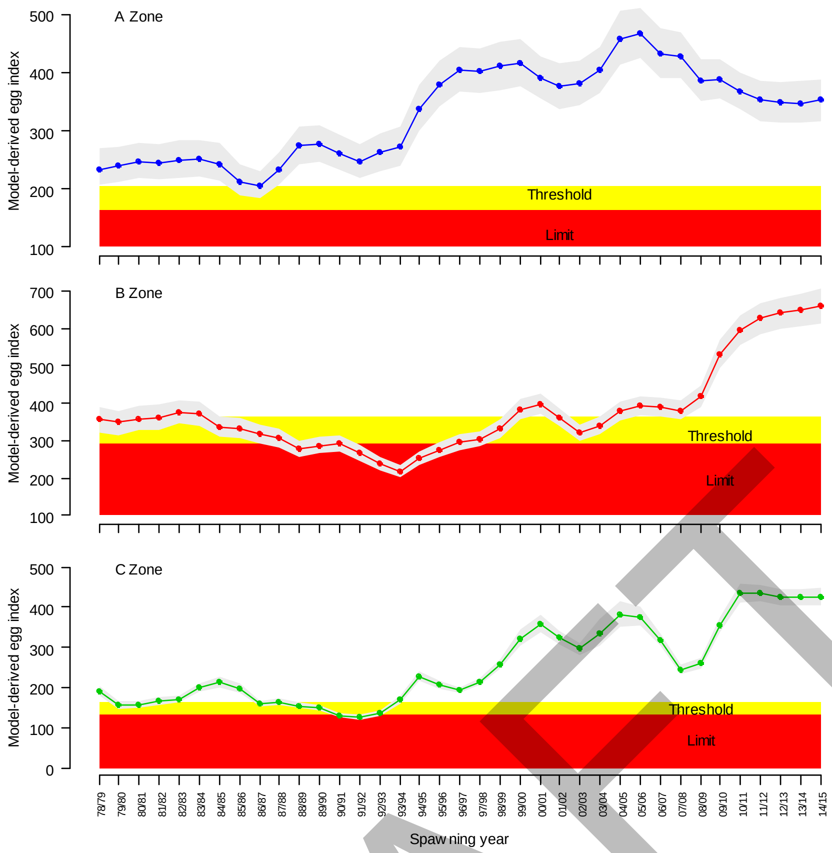

Figure 4 – Modelled breeding stock by zone, relative to the threshold and limit reference points (for further details see Department of Fisheries 2010 and the *Draft Stock Assessment for the West Coast Rock Lobster Fishery* at http://www.fish.wa.gov.au/docs/frr/frr217/index.php?0401).

Management for the 2010/11 season has seen a shift from an effort controlled TACC to a individual transferable quota (ITQ) system, however, most effort control measures will also remain in place for the present, e.g. a 0.5 unit value, and no fishing on weekends. Each unit in the fishery has been allocated an individual catch quota depending on the zone TACC. Further modifications to this system, particularly reductions in effort controls, will occur in future seasons. A nominal TACC of 5,500 tonnes was implemented for the 2009/10 season and it also will be maintained for the 2010/11 and 2011/12 seasons. For further details of the management arrangements for the 2009-10 see http://www.fish.wa.gov.au/sec/com/fisheries/WCRockLobster0910Consultation.php?0206

Low Puerulus Operational Objective 3.

Instigation of a research plan to examine potential ecological impacts of low puerulus settlement (in accordance with MSC Condition 2.1.2.1)

MSC Condition 2.1.2.1 Non-Conformance 2009-2-3:

The client must develop an integrated plan of research that specifically addresses the ecological impacts of low levels of puerulus settlement across the full spatial scale of the fishery.

Action Plan

The significantly lower numbers of puerulus since the 2006/07 settlement season may result in changes to the trophodynamics of coastal ecosystems, such as prey switching. Potential ecosystem impacts associated with reduced puerulus numbers have been assessed using the trophodynamic model developed for shallow water, the area that will be most effected by the low puerulus settlements. The results from the model indicate that there will not be any significant ecological impact, as the western rock lobster is not an ecosystem engineer or a key stone species, but rather an ecosystem tracker. A publication on the results of the modelling work is currently in preparation.

Abrolhos Islands Sea Lions

Management Assessment

A report on new research tabled with the Sea Lion Scientific Reference Group (SL SRG) meeting in August 2008 (Appendix 4) detailed interactions of sea lion pups with lobster pots at the Abrolhos Islands. Previous research had not detected any interactions, however, during the 2007/08 season there was a dead sea lion pup found on the Department of Fisheries jetty at the Abrolhos Is, which post-mortems revealed had drowned. While it was not possible to determine how the pup died, further research has shown that sea lion pups do interact and depredate lobster pots at the Abrolhos. Given the small size of the sea lion population at the Abrolhos, even a small additional mortality due to interactions with lobster's pots (1-3 pups per 12 – 18 months) could lead to extinction of the population.

Satellite tracking of both juvenile and female sea lions revealed most foraging occurred in shallow (<20m) waters in and around the Easter and Southern Groups and, as such, represented risk areas for interactions. The SL SRG therefore recommended there be a voluntary implementation of SLEDs in the risk areas for the 2010 Zone A season, and that SLEDs be made mandatory in the risk areas for the 2011 season.

Consideration of the proposed SLED zone at the Abrolhos Islands, landward of the 20m isobath in the Easter and Southern Groups, was not supported by RLIAC on the basis that it was not necessary to have such a large area defined as the risk area in order to mitigate the fishery's interaction with sea lions.

Management Objectives

1. *To introduce sea lion exclusion devices (SLEDs) in the identified risk areas at the Abrolhos Islands.*

Operational Objectives

<u>Abrolhos Islands Sea Lions Objective 1.</u>

The mandatory implementation of SLEDs in relevant waters at the Abrolhos Islands

<u>*MSC Condition 2.2.1.4 Non-Conformance 2009-2-5:*</u>

The implementation of SLEDS into the risk areas of the fishery in the Abrolhos is required for the 2011 Zone A fishing season.

Action Plan

To facilitate implementation, a working group comprised of members of the former Sea Lion Scientific Reference Group and industry and other stakeholder representatives met on 1 October 2010 to provide final advice to the Department on the risk area around the Southern and Easter Island Groups. The minutes and maps associated with this meeting are provided at Appendix 5. The Minister for Fisheries has announced that SLEDs will be mandatory in relevant waters at the Abrolhos Islands from the commencement of the 2010/11 Abrolhos season, i.e. 15 March 2011 and the regulation has now been implemented.

A formal consultation process was undertaken with commercial and recreational peak bodies to inform them of the implementation of SLED zones at the Abrolhos Islands and a letter was sent to all commercial rock lobster fishers informing them of the SLED requirements and date of implementation. Information regarding the new SLED zones will be included in future recreational rock lobster fishing guides.

Risks Identified at the 2007 ERA

Below are the four risks that were identified as moderate at the 2007 ERA (Stoklosa 2007). A list of low or negligible risks, as identified by the 2007 ERA (Stoklosa 2007), can be found at Appendix 1.

Efficiency Changes

Management Assessment

There have been previous studies dealing with efficiency increases in the rock lobster industry; primarily those associated with uptake of new technologies (e.g. radar, GPS etc) or pot types and bait (Brown *et al.* 1995, Fernandez *et al.* 1997). However, since these studies, there have been further adjustments to datasets to account for other increases in efficiency (e.g. increased fisher knowledge) particularly in the deep water fishery (de Lestang et al. 2010a). Increases in efficiency can lead to over estimates of indices if they are not taken into account, especially indices based on catch rates, such as Breeding Stock Indices (BSI).[28]

There has been concern among stakeholders that the actual efficiency creep may be higher than is currently estimated, and hence the BSIs may be lower than estimated. In line with these concerns, the 2007 ERA assessed fishing efficiency gains as a moderate risk and made the following recommendation:

2007 ERA Recommendation 1:

> No further risk assessment of fishery efficiency gains to the target species is recommended at the present time, pending a commitment of the WRL fishery managers to improve estimates of efficiency gains and take them into account in the assessment and management of the fishery. An ERAEF Level 2 assessment would not be expected to add value to the management of this hazard, as it would not provide any additional information that might change the recommended action.

The management package for the 2009/10 season (and the following two seasons, 2010/11 and 2011/12), represented an effective effort reduction of 52% from the 2008/09 season. This is significantly more than the highest estimates of fishing efficiency increase (de Lestang et al. 2010a).

Fishing efficiency is now incorporated into estimates of breeding stock (de Lestang et al. 2010a), and therefore implicitly accounted for in any management decisions to ensure breeding stock levels are maintained above threshold levels (Figure 5). See further details in the *Draft Stock Assessment for the West Coast Rock Lobster Fishery* at http://www.fish.wa.gov.au/docs/frr/frr217/index.php?0401

[28] See further details in the *Draft Stock Assessment for the West Coast Rock Lobster Fishery* at http://www.fish.wa.gov.au/docs/frr/frr217/index.php?0401

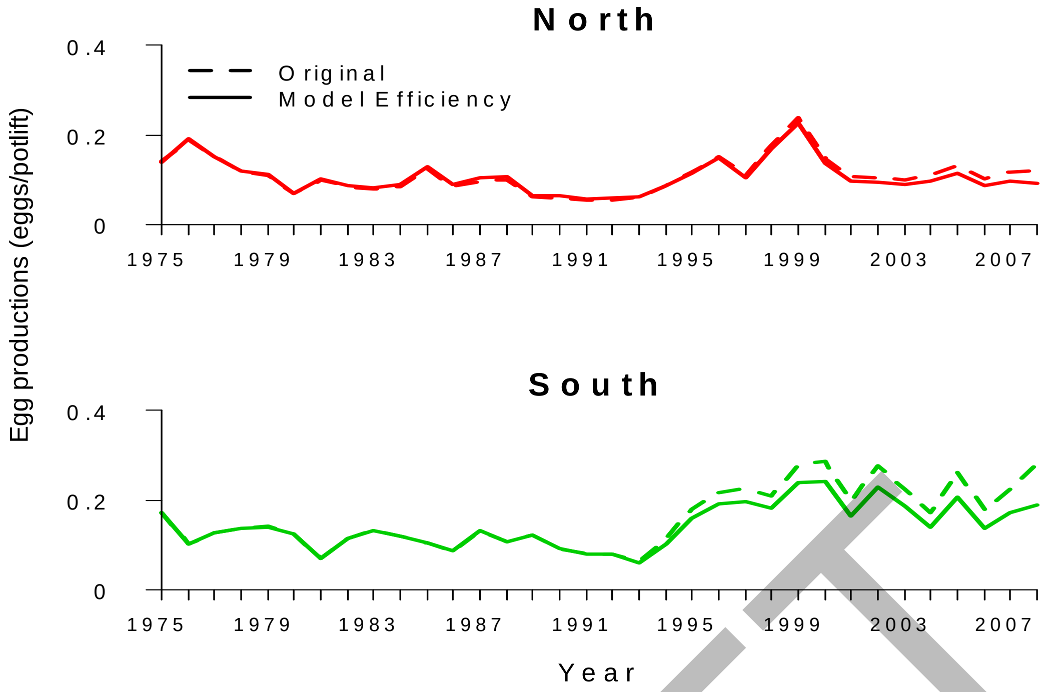

Figure 5 – Breeding stock indices from fishery dependent data with fishing efficiency increases included (solid) and raw estimates without efficiency increases included (dashed line) for the northern and southern coastal area of the fishery.

This is consistent with the Technical Panel and Stakeholder Working Group's opinion (2007 ERA) that ongoing management is appropriate for mitigating this hazard (Table 3).

Management Objective

Improve the estimate of the efficiency gains in the fishery

Operational Objective

Efficiency Operational Objective.

Investigate methods to improve estimates of increases in efficiency (in accordance with part of MSC Condition 1.1.5.1 (2009).

MSC Condition 1.1.5.1 (2009):

Undertake an international peer review of the current (2009) stock assessment and work with the peer reviewer(s) to develop a robust assessment of the stock. Issues to be addressed include:

- *Estimating depletion within the model by fitting to seasonal trends in catch rates*
- *Reintroducing breeding stock indices into the objective function (after the condition for indicator 1.1.1.5 is met)*
- ***Estimating efficiency change within the assessment model***
- *Identifying key uncertainties in assumptions and data and undertaking appropriate sensitivity analyses*

Issues to be considered include:

- *Estimating the relationship between puerulus settlement and recruitment within the assessment model*
- *Incorporating size data into the assessment*

The client shall than provide a report to SCS of the outcome of the review, including an updated 2009 quantitative stock assessment report, based on recommendations and findings of the review. Assuming a satisfactory resolution of the current uncertainties and problems in the assessment, the new assessment model would then be used as the basis for the 2010 assessment and for the provision of management advice for the 2010/11 fishing season

Action Plan

An international stock assessment review was conducted between the 20 – 24th May 2010 (Department of Fisheries 2010), with the issue of fishing efficiency estimations one of the main aspects addressed. Estimates of fishing efficiency are assessed within the stock assessment model (de Lestang et al. 2010a and the *Draft Stock Assessment for the West Coast Rock Lobster Fishery* at http://www.fish.wa.gov.au/docs/frr/frr217/index.php?0401).

FRDC project 2009/019 (Appendix 3), in collaboration with internationally recognized experts in this field, i.e. Professor Norm Hall (Murdoch University), Assoc Professor Stewart Frusher (Tasmania Aquaculture and Fisheries Institute, University of Tasmania), and Professor John Hoenig (Virginia Institute of Marine Science in the United States), has been developed to address the fishing efficiency increase issue. The objectives include assessing current data sources and their potential for use in estimating harvest rates and efficiency increases in the western rock lobster fishery, as well as whether additional sources of information are needed to produce more robust estimates of harvest rate and efficiency increases (Appendix 3). The main concern is that efficiency increase may have been underestimated, which could have lead to overestimates of breeding stock levels. This project is due to be completed in December 2011, but any significant findings during the project will be incorporated into the assessment model predictions of breeding stock levels and provided to stakeholders and managers.

An international journal publication is being prepared which explores the relationships in catch rate trends between standardized (no efficiency increase) and commercial (where effort efficiency has increased) fishing in the same locations. This work is producing promising estimates of fishing efficiency changes in deepwater locations of the fishery.

Current research and the management actions that have been implemented, e.g. the fishing effort reductions and catch limits (quota management) that have been set in response to the low levels of puerulus settlement, are consistent with the Risk Assessment Panel's assessment that ongoing management is appropriate for mitigating this hazard (2007 ERA; Stoklosa 2007[29]).

For further details see:

a) de Lestang et al. (2010a),

b) The *Western Rock Lobster International Stock Assessment and Modelling Workshop Report* 2010 at http://www.fish.wa.gov.au/docs/op/op081/index.php?0706 and

c) The *Draft Stock Assessment for the West Coast Rock Lobster Fishery* at http://www.fish.wa.gov.au/docs/frr/frr217/index.php?0401

d) Management arrangements for 2009-10 at http://www.fish.wa.gov.au/sec/com/fisheries/WCRockLobster0910Consultation.php?0206

[29] See the 2007 ERA report at http://www.fish.wa.gov.au/docs/op/op056/index.php?0706

Deepwater Ecology – Central West Coast

Management Assessment

Western rock lobsters inhabit depths from shallow coastal (<1m) to deep offshore (>200m) reefs, with the great bulk of the population in less than 100 m. Juveniles are predominantly found in the shallow waters and when they become sub-adults they migrate as "whites", to offshore reefs where they integrate with the breeding stock (de Lestang et al. 2010a).

Since 2003 an independent scientific group, initially the Ecological Scientific Reference Group (EcoSRG – 2003 to 2010) [30] and then the Effects of Fishing Advisory Group (EFAG – established 2010), has provide advice on research programs on the ecological effects of fishing. The EcoSRG recognised that there had already been considerable research on the ecology of shallow water lobsters including studies on diet (Joll & Phillips 1984, Edgar 1990 and MacArthur 2009) and foraging behaviour (Chittleborough 1974, Jernakoff 1987, Jernakoff et al. 1987, Jernakoff & Phillips 1988, MacArthur 2009) and that additional shallow water projects were being undertaken, or were planned, by the Department of Conservation (DEC), CSIRO (e.g. Strategic Research Fund for the Marine Environment – SRFME), the Universities and Western Australian Marine Science Institution (WAMSI) in the Jurien Marine Park and other marine reserves within the rock lobster fishery (e.g. Marmion and Rottnest Island). Some of this research was focused on investigating the ecological effects of lobster removal by fishing and would thus be complementary to any deepwater rock lobster ecology research. It was also recognized that most of the lobster biomass in shallow water was comprised of sub-legal size lobsters, therefore the removal of legal size lobsters would be unlikely to have a significant ecological impact. Based on this information the EcoSRG concluded that undertaking effects of fishing research in shallow water was not a priority.

A significant portion of the harvested biomass, however, comes from deep water (>20 fathoms; >36m), where legal size lobsters form the bulk of the biomass and hence large scale removals could impact significantly on the ecology (Department of Fisheries 2008). There is also a lack of knowledge regarding deep water lobster ecology in general. Based on the large biomass removal and the paucity of ecological information in deepwater, the EcoSRG identified it as a priority for research. [31]

While the central west coast and Kalbarri – Big Bank were identified as two separate risks in the 2007 ERA, it was recognise that they were similar in terms of deep-water ecology, hence they were combined and are referred to as central west coast (Stoklosa 2007). The EcoSRG recommended that the initial research should focus on identifying and observing any ecosystem patterns associated with levels of fishing pressure (as an indicator of lobster abundance), lobster population size structure and benthic structure. The patterns observed across these gradients (particularly abundance) were expected to provide some information on the effect of biomass removal and to assist in determining whether research comparing fished with unfished areas would be necessary.

A four year FRDC project (2004/049) provided critical baseline data on the relationships between the abundance and size distributions of rock lobster and their different benthic habitats located in deeper waters (Belchambers 2010). The project also provided preliminary

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[30] RLIAC and it subcommittees, of which the EcoSRG was one, was wound-up in 2010. The EcoSRG has been replaced by the Effects of Fishing Advisory Group (EFAG), which reports to the Department of Fisheries and the Western Rock Lobster Council.

[31] See Proceedings of the Western Rock Lobster Ecological Effects of Fishing Workshop 8 – 10 August 2007 Fisheries Occasional Publication 53 (http://www.fish.wa.gov.au/docs/op/op053/index.php?0706) and the *Western Rock Lobster Ecology – The Current State of Knowledge* at http://www.fish.wa.gov.au/docs/op/op089/index.php?0706

information on the trophic role of rock lobsters in these depths (>40 m). However, despite the identification of gradients in the abundance of lobsters within similar habitats, this technique ultimately proved ineffective in providing sufficient information to clarify trophic relationships to a level that could be used to assess the impact of large scale lobster biomass removals. Therefore the EcoSRG concluded that research on the effect of fishing in deep waters could only be progressed by comparing fished and unfished areas, which would require the collection of baseline information to enable ongoing comparisons to be made (EcoSRG 2006).[32] Based on the outcomes of FRDC project 2004/049, the risk levels determined by the Stoklosa (2007) and the recommendations of the EcoSRG workshop (Department of Fisheries 2008)[33], a new FRDC project, 2008/13, on the effect of fishing in deep water using research closures commenced in 2009.

2007 ERA Recommendation 2:

> No further risk assessment of hazards to the central west coast or Kalbarri–Big Bank deep-water ecological communities is recommended in the short term. The hazards of fishing activity interactions with deep-water ecological communities has been assessed in an EcoSRG workshop (August 2007[34]), which recommended ongoing research of fished and unfished areas. If new information becomes available as a result of future research, the risk level should be reviewed and validated by the WA Department of Fisheries and WAFIC in consultation with independent experts.

Management Objectives

1. *To provide information on the effect of large scale lobster removal on deepwater ecosystems through investigations involving areas closed to fishing*

Operational Objectives

A second FRDC project (2008/13) began in 2009 to address some of the findings of Stoklosa (2007) and Eco SRG workshop (Department of Fisheries 2008), which determined that deepwater ecology was a moderate risk, primarily due to the paucity of data on lobster removals due to fishing. The operational objectives of this EMS are directly related to those of the FRDC project.

Deepwater Ecology Operational Objective 1.

Identification and assessment of suitable unfished reference areas to exclude rock lobster fishing in deep water (associated with MSC Condition 2.1.1.1).

<u>*MSC Condition 2.1.1.1 Non-conformance 2009-2-1:*</u>

The client is required to provide stakeholder-agreed report(s) containing detailed plans to:

1) correct the mapping deficiency; and

2) deploy appropriate rapid assessment protocols to identify two further (additional to the present 30^o line) areas for subsequent follow up studies in representative deep and shallow water areas of a northern and southern area of the fishery.

Action Plan

[32] See Effect of Fishing Research Plan at: http://www.fish.wa.gov.au/docs/op/op039/index.php?0706
[33] Proceedings of the Western Rock Lobster Ecological Effects of Fishing Workshop 8 – 10 August 2007 Fisheries Occasional Publication 53 (http://www.fish.wa.gov.au/docs/op/op053/index.php?0706)
[34] Ibid

A closed area working group was formed with the specific aim of identifying and ranking areas on their potential as closed areas on the central west coast for research. The working group nominated a total of six locations, between the Abrolhos and the Capes, as potential sites. Each location was assessed against the selection criteria developed by the EcoSRG at the 2007 workshop (Department of Fisheries 2009)[35]. On the basis of the benthic habitat information and lobster demographics, agreement has been reached for a closed area around the 30°S latitude line demarcating the boundary between B and C zones. An area of 12 nm^2 has been selected and the legislation for the closure was implemented on 15 March 2011. A map showing the closed area can be found in *"Western Rock Lobster Ecology – The State of Knowledge"* document at http://www.fish.wa.gov.au/docs/op/op089/index.php?0706.

Deepwater Ecology Operational Objective 2.

Development of a qualitative trophodynamic model that will provide a conceptual framework for determining sampling protocols, indictors and targets.

Action Plan

A qualitative trophodynamic model has been developed. Analysis from the model reveals that small fish (wrasses and sweep) and small invertebrates (amphipods and isopods) may be good indicators of ecosystem health and as such will be incorporated into future sampling designs.

Deepwater Ecology Operational Objective 3.

To provide cost effective methods to measure deep water ecosystems in both fished and unfished reference areas. See details in *Western Rock Lobster Ecology – The State of Knowledge* document at http://www.fish.wa.gov.au/docs/op/op089/index.php?0706.

Action Plan

The development of cost effective methods to measure deep water ecosystems in both fished and unfished reference areas is currently underway. Particular consideration has been given to the faunal groups identified by qualitative modelling as potential indicators of the effects of fishing. A local independent scientific advisory group (SAG)[36] met in February 2010 to advise on the proposed methods and their advice has subsequently been incorporated into a draft methods document. Monitoring of deepwater ecosystems commenced in 2010 and the final methods document has been reviewed by the FRDC. The Effects of Fishing Advisory Group met on 2-3 November 2010 and its recommendations have also been incorporated into the final version of the methods document.[37] A report of the EFAG meeting and its review of the effects of fishing research plan can be found at:
http://www.fish.wa.gov.au/docs/op/op091/index.php?0706

Habitat Mapping

Habitat mapping is a component of Deep Water Ecology / Effects of Fishing research work and has a MSC condition associated with it.

<u>*MSC Condition 2.1.1.1 Non-conformance 2009-2-1:*</u>

The client is required to provide stakeholder-agreed report(s) containing detailed plans to

***1) correct the mapping deficiency;** and*

[35] Ibid

[36] The SAG has members drawn from local universities and DEC. It meets regularly to provide advice on the FRDC deep water effects of fishing project (2008/13), which began in 2009.

[37] The methodology to measure deep water ecosystems can be found in *"Western Rock Lobster Ecology – The State of Knowledge"* document at http://www.fish.wa.gov.au/docs/op/op089/index.php?0706 .

2) *deploy appropriate rapid assessment protocols to identify two further (additional to the present* 30^{o} *line) areas for subsequent follow up studies in representative deep and shallow water areas of a northern and southern area of the fishery.*

The EFAG met on 1 and 2 November 2010 to review the Effects of Fishing Research Plan, which included an assessment of the habitat mapping that had been undertaken (EFAG 2010). The existing mapping projects that have been completed by a range of agencies and institutions have been summarised in the report *Western Rock Lobster Ecology – The State of Knowledge* document (at http://www.fish.wa.gov.au/docs/op/op089/index.php?0706), which presents the habitat maps currently available for the Central West Coast of WA. DoF has secured funding to appoint a GIS specialist to combine bathymetric data with mapping data from Geoscience Australia and agreements are in place to access this data. This will be used as a first pass habitat map of the region and then combined with detailed correlations between bathymetry and habitat structure obtain from the initial FRDC project (Bellchambers 2010) to predict habitat structure within the rock lobster fishing region. The GIS person is expected to be appointed in early 2011 and the maps finalized by about mid 2011.

Bait bands: Dusky whalers

Management Assessment

Catches of dusky whalers (*Carcharhinus obscurus*) are collectively recorded as bronze whalers along with catches of *Carcharhinus brachyurus* (which are about 3% of the total catch). The catch increased from the 1970s to 1980s before falling in the early 1990s (McAuley et al 2005), with approximately 45% of the catch being neonates (McAuley 2004). The declining catch rates, with increased fishing effort saw the introduction of several managed fisheries along the states south, west and north coasts (McAuley et al 2005).

Dusky whalers was the only hazard subjected to a Level 2 Productivity-Susceptibility Analysis' (PSA) under the ERAEF methodology to assess their susceptibility to mortality associated with bait bands. The analysis revealed that *C. obscurus* was a low productivity species; making bait bands a threat to the stock as they lack resilience to by catch mortality (Stoklosa 2007).

In light of the susceptibility of the dusky whaler populations to mortality associated with discarded bait bands from the western rock lobster fishery, the Stoklosa (2007) made three recommendations:

2007 ERA Recommendation 3:

> No further risk assessment of bait band entrapment hazards to the by-catch species *Carcharhinus obscurus* (Dusky whaler shark) is recommended in the short term.

2007 ERA Recommendation 4:

> Alternatives to bait bands, to avoid the use of materials that can entangle *C. obscurus* and other by-catch species, should be investigated as a matter of improving environmental management of the Western Rock Lobster fishery. If the bait band hazard is eliminated, no other specific actions would need to be taken by the Western Rock Lobster fishery to avoid impacts to this species.

2007 ERA Recommendation 5:

> If bait bands continue to be taken to sea by the Western Rock Lobster fishery, on-going stock assessments of *C. obscurus* should consider the threat of mortality due to bait band interactions, and investigate methods for collecting data to monitor any increased mortality with a high level of confidence.

Management Objectives

1. *To eliminate the use of bait bands in the western rock lobster fishery*

Operational Objective

<u>Dusky Whaler Operational Objective 1.</u>

To eliminate the use of plastic bait bands from the Western Rock Lobster Managed Fishery (in accordance with MSC Condition 2.1.3.1)

<u>*MSC Condition 2.1.3.1:*</u>

The client must present evidence in the form of a scientifically defensible examination of the fishery's compliance with the Bait Handling Code of Practice that assesses the risks associated with the use and disposal of bait bands. Scientifically defensible here means that the study is quantitative and statistically relevant in terms of identifying how these materials are treated at sea, and evaluates the number of bands and the mass of materials taken onto *and off fishing vessels, in various seasons and regions of the fishery. This must be completed prior to the third annual surveillance of the fishery.*

If results show that compliance with the Code of Practice is not sufficient, the client must adopt methods of enforcing the Code of Practice. This must be implemented prior to the fourth annual surveillance of the fishery.

The client must also develop and implement methods to assess compliance on an ongoing basis. This must be implemented prior to the fourth annual surveillance of the fishery.

Action Plan

The Minister for Fisheries initially announced a prohibition on the use of plastic bait bands on “active” rock lobster fishing boats from the start of the 2010/11 season (15 November 2010), however, he later extended the ban to all active fishing boats in Western Australia, including recreational fishing boats. Legislation is currently being prepared to implement the ban, but due to consultation requirements with the other sectors of the fishing industry that are now included in the ban, it was not finalised in time for the commencement of the 2010/11 season, but it will be implemented prior to the 2011/12 rock lobster season.

This is in line with the second part of Recommendation 4 from the 2007 ERA (Stoklosa 2007), and hence eliminates the need for any specific actions regarding dusky whalers.

Low or negligible risks

A list of low or negligible risks, as identified by the 2007 ERA (Stoklosa 2007), can be found at Appendix 1.

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APPENDICES

Appendix 1 – Negligible or Low Risks

There have been a number of risks which have been classified as moderate risks in previous ERAs. They have now been reclassified as low based on mitigating management arrangements.

Sea lion interactions with pots – West Coast

This was identified as a moderate risk in the initial 2001 ERA (IRC Environment 2009) where "*Sea-lion pups potentially becoming entangled in pots / Potential change to population*". A sea lion scientific reference group was formed and research conducted into possible mitigation of the risk. A sea lion exclusion device (SLED) was developed as a result of this research (Campbell 2005), with its proposed mandatory introduction to areas of "potential sea lion interaction". This risk was then re-assessed in 2005, based on either the introduction of or not of SLEDs (Burgman 2005). Without the use of SLEDs, the risk assessment remained at moderate, though mitigating management through the use of SLEDs reduced the risk to low. SLEDs were introduced into the central west coast area (Figure A1) in 2006/07 season, and hence reducing the risk to low as it was defined in the 2007 ERA (Stoklosa 2007).

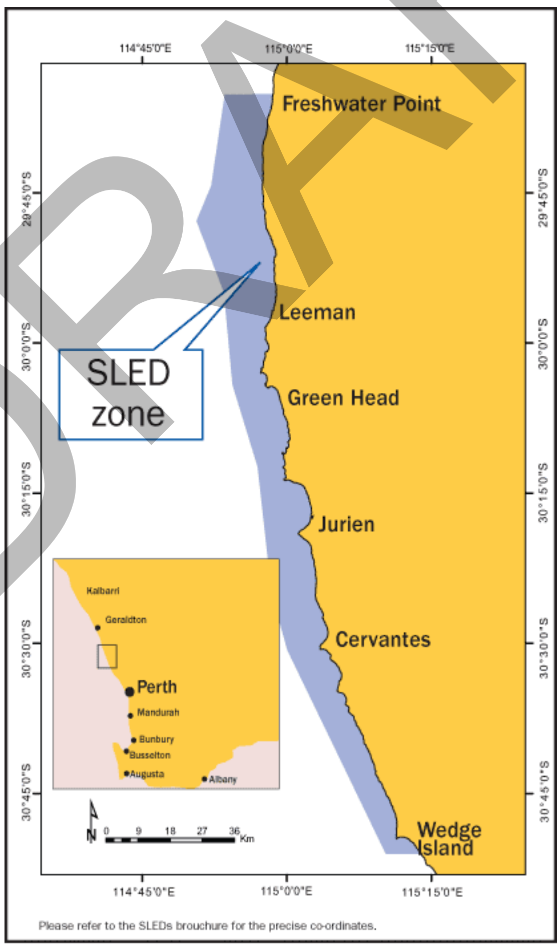

Figure A1 - Location of the SLED zone along the mid-west coast of Western Australia. Co-ordinates of boundaries available at
http://www.fish.wa.gov.au/docs/pub/SeaLoinExclusionDevices/SeaLoinExclusionDevices.pdf

MSC requirements necessitated the on-going monitoring of sea lion interactions with the following condition:

Condition 2.2.1.4 Non-Conformance 2009-2-6:

At the 2010 audit, a report on bycatch, an independent verification of the level of bycatch, and ***information on compliance with SLED deployments (voluntary and mandatory) in all risk zones in the last 3 years of the fishery will be required as evidence to demonstrate ongoing compliance***

There has been on going independent at sea compliance checks of pots with regard to SLEDs within the current SLED zone on the mid-west coast of Western Australia. Estimates of non-compliance are generally less than 5%, which is a conservative estimates as it is based on the confirmed (minimum) number of pots checked, with potentially considerably more pots having actually been checked that complied with the SLEDs requirements. It is expected that compliance to gradually increase as fisherman become more accustomed to having the SLEDs and the areas in which they are compulsory. Non compliance also includes post that have SLEDs installed but they are not functioning as per the legislative requirements (e.g. they are bent out of shape).

Table A1 – Compliance pot checks and non-compliant SLED pots for the last four seasons for the coastal at risk area.

	Season			
	2006/07	2007/08	2008/09	2009/10
Pots Checked (minimum)				
Commercial	563	139	638	278
Recreational	182	93	114	244
Non-compliant Pots				
Commercial	14	2	0	12
Recreational	0	1	10	13
Percentage non-compliant				
Commercial	2.5	1.4	0	4.3
Recreational	0	1.1	8.8	5.3

Interactions with sea turtles

The interactions with the lobster fishery were with entanglement with lobster pot ropes or boat strikes, with the risk that this may impact on the population/s. This was identified as a moderate risk in the 2001 ERA (IRC Environment 2009) with four recommendations from that report directly pertaining to sea turtle interactions.

- Begin collecting data on turtle entanglement – species, time, location and a systematic study to understand how turtles are caught in ropes and placed in broader population context i.e. how important are the turtle mortalities in a local and regional context;
- Ensure that if possible, dead turtles are brought back for analysis or photographs, description, location GPS/depth of turtle in water;
- Better educate fishers to collect information on turtle sightings and captures;
- Investigate through newsletters, magazines if other fishing activities regularly sight turtles.

Information presented at the 2005 ERA (Burgman 2005) from voluntary surveys of lobster fishers from 1999/2000 – 2001/02 seasons highlighted 34 turtle interactions with 5 mortalities over the three seasons (Table A1)

Table A1 – Interactions and mortalities of turtles from three years of annual bycatch surveys (Burgman 2005).

Season	Interactions	Mortalities
1999/2000	12	1
2000/2001	17	3
2001/2002	5	1

The assessment of the expert groups, while considering the consequence of further impacts as severe or major given the decline sea turtle populations, the likelihood of extra mortalities associated with fishery adding appreciably to this issue as very unlikely. This resulted in a reclassification of this risk as low.

Due to recent management changes and the shift to a quota management system, there has been a significant decrease in fishing effort (~50%), which will significantly reduce interactions with turtles.

Abrolhos water quality

Recommendations leading from the 2001 ERA (IRC Environment 2009) pertaining the moderately ranked risk of "Dumping of domestic waste into ocean at Abrolhos Is / Potential reduction in ocean environment quality", were to:

- Examine the outcomes of the review by the Abrolhos Islands Management Advisory Committee (AIMAC) to implement appropriate waste management strategies;

A study by Marine Science Associates and Environmental Contracting Services (1998) stated, "No pattern of elevation of nutrients was seen on the Rat Island home reef compared to a nearby control reef but some small elevation of nutrient levels occurred adjacent to Rat Island where domestic outfalls were discharged." (from Burgman 2005). As such the resultant score of this risk was deemed to be low.

Benthic biota

Part of the lobster fishery coincides with areas of high coral cover, namely around the Abrolhos Islands. The risk for damage to this habitat was assessed following concerns that it may impact of this fragile habitat and its potential for tourism.
Initial assessments of this risk in 2001 were moderate with the following recommendations pertaining to it;

- Implement the outcomes and recommendations for studies/actions from an Abrolhos workshop to be held during 2001;
- Increase fisher awareness of the importance of coral habitats and environment;
- Undertake an international review of pot damage to habitats

The outcomes of the Abrolhos workshop (Chubb et al 2002) were that most of the potting occurred on robust areas of reef, with most pots being set adjacent to the reef on sandy areas. This resulted in a revision of the risk to coral reef systems particularly at the Abrolhos Islands as low (Burgman 2005).

Since then, a 3 year study has been undertaken by the Department of Fisheries to examine potential coral damage from potting on sensitive reef habitats at the Abrolhos Islands. A research report on this work is scheduled for publishing in late 2011.

Central west coast – shallow

This was a new hazard identified as part of the 2005 risk assessment process (Burgman 2005). The rationale for the moderate risk in this review was primarily driven by the large amount of biomass that was removed from the area and the desire for increased research in the area. This was despite findings that a large proportion of the lobster biomass remains in the area as unexploited undersize animals. A CSIRO study at in the central west coast saw no difference in prey species of lobsters that would preferentially be predated upon by larger lobsters (legal size) compared to small lobsters (sub-legal). Therefore it was considered the biomass removal of legal size lobsters for shallow water was not likely to cause major community shifts (see Burgman 2005).

Utilising the new ERAEF methodology for risk assessment, the 2007 ERA adjudged this risk as low to negligible (Stoklosa 2007).

See *Western Rock Lobster Ecology – The State of Knowledge* 2010, draft at http://www.fish.wa.gov.au/docs/op/op089/index.php?0706 for further details of the results and conclusions of the shallow water research and the Effects of Fishing Advisory Group meeting report of 2-3 November 2010 and its review of the effects of fishing research plan at: http://www.fish.wa.gov.au/docs/op/op091/index.php?0706

Estimates of Breeding Stock

This risk deals with the possibility that the method of estimating the breeding stock being wrong, or that the estimate of safe levels of egg production is wrong. This was ranked as a moderate risk in the 2005 ERA (Burgman 2005), though it was unlikely (likelihood score of 3: median score of participants in the expert panel), the consequences of such a recruitment failure was severe (consequence 3), resulting in the moderate risk score.
The estimates of breeding stock when the 2005 ERA was conducted were an empirical measure from the fishery dependent monitoring data (details see de Lestang et al. 2010), which could be significantly influenced by changes in fishing efficiency and sample numbers. Subsequently by the time of the 2007 ERA, estimates of breeding stock were produced from an integrated stock assessment model, which is regarded as worlds best practise. This altered the risk assessment for the 2007 ERA where it was adjudged as low to negligible risk (Stoklosa 2007).

Since the 2007 ERA considerable research has been conducted in this area, particularly regarding model assessments of the breeding stock (see *Draft Stock Assessment for the West Coast Rock Lobster Fishery* at http://www.fish.wa.gov.au/docs/frr/frr217/index.php?0401)

Whales Entanglement (ecological and social)

The ecological impacts of whale entanglements were a low biological risk (2001, 2005 and 2007 ERAs), the 2005 ERA also assessed the social impacts of whale entanglement (Burgman 2005). This was rated as a high risk due to the possible (L4) or occasional (L5) likelihood of major political or social problems associated with regular pot entanglements of whales. However, because the new ERAEF methodology was used, the social impacts of whale entanglement were not able to be assessed, and given the environmental nature of a ERA and EMS, it wasn't appropriate to deal with social issues. The ecological risk on entanglement of whales also was assessed as low to negligible in 2007 (Stoklosa 2007), because the number of entanglements was very low and the fishery had developed a code of practice to reduce interactions. Also due to recent management changes and the shift to a quota management system, there has been a significant decrease in fishing effort (~50%), which will significantly reduce interactions with whales.

Other Low or Negligible Risks

The following risks which were able to be assessed under the ERAEF methodology and or previous ERAs, have been deemed to be low or negligible. Details of their risk assessments can be found in Burgman (2005).

- Mortality, productivity loss from handling
- Abrolhos ecosystem
- Octopus
- Scalefish and sharks
- Leeuwin – Naturaliste

Octopus, scalefish and sharks are all by-catch in the western rock lobster fishery. As such they are subject to the MSC condition

Condition 2.2.1.4 Non-Conformance 2009-2-6:

At the 2010 audit, a report on bycatch, an independent verification of the level of bycatch*, and information on compliance with SLED deployments (voluntary and mandatory) in all risk zones in the last 3 years of the fishery will be required as evidence to demonstrate ongoing compliance*

By-catch levels are reported annually as part of the Department of Fisheries' State of the Fisheries (SoF). The most recent report (SoF 2009/10; Fletcher and Santoro 2010) reporting on the 2008/09 season saw catches of a range of scalefish and sharks (Table A2). This is reported through an independent research monitoring program on board commercial boats (details see de Lestang et al. 2010).

Table A2 – Catch rate of bycatch in lobster pots recorded during at sea observer monitoring programs in 2008/09. The total number caught is an estimate based on the catch rate and the total number of pot lifts in the 2008/09 fishing season (de Lestang et al 2010b).

Bycatch Species	Catch /1000 Pot lifts	Est. Total No Caught (whole fishery)
Baldchin Groper (*Choerodon rubescens*)	0.64	2908
Break Sea Cod (*Epinephelus armatus*)	1.57	7063
Cuttlefish (*Sepia* sp.)	0.64	3250
Eel (Muraenidae)	0.37	1161
Leatherjacket (Monocanthidae)	0.09	415
Port Jackson Shark (*Heterodontus portusjacksoni*)	0.74	6697
Scorpion Fish (Scorpaenidae)	0.37	1661
Unknown fish	1.47	6647
Wobbegong shark (*Orectolobus* spp.)	1.84	8309
Wrasse (Labridae)	0.55	2492
Total		**41904**

Appendix 2 – Titles and objectives of FRDC studies addressing low puerulus settlement

(from Brown 2009)
A workshop to review the results of the five projects described below will undertaken on 24 May 2011. A report of the workshop will be published on the Department of Fisheries' website.

Project 1 (FRDC 2009/018)
Identifying factors affecting the low western rock lobster puerulus settlement in recent years.
Objectives
1. To use a larval advection model and the rock lobster population dynamics model to assess the effect of the spatial distribution of the breeding stock on the puerulus settlement.
2. To assess environmental factors (water temperature, current, wind, productivity, eddies) and breeding stock affecting puerulus settlement.
3. To examine climate change trends of key environmental parameters and their effect on the western rock lobster fishery.
4. Provide industry (WRLC), RLIAC and Fisheries managers with an evaluation of relative impact of breeding stock and environmental effects on the puerulus settlement and its implications for management in the protection of the breeding stock.

Project 2 (FRDC 2008/087)

Evaluating source-sink relationships of the Western Rock Lobster Fishery using oceanographic modeling.

Objectives

1. To determine the relative contribution of larval production from different areas to the abundance and spatial distribution of puerulus settlement over 15 years using a larval advection model.

2. Provide industry (WRLC), RLIAC and Fisheries managers with an evaluation of source-sink relationships and its implications for management in the protection of the breeding stock

Preliminary Findings[38]*:*

The project has provided a preliminary assessment of the source-sink relationship in the western rock lobster fishery, with the model indicating a general north-south trend in the likelihood of successful settlement from releases from the main part of the fishery i.e. from Abrolhos (28°S) to the Fremantle region (32°S). While the average trend in settlement success was from north to south, there was variability in this trend between years that will be examined further. The modelling results also suggest that settlement success is better from phyllosoma released from deeper water areas closer to the edge of the continental shelf. These results suggest that breeding stocks in all

[38] From "Outcomes Achieved to Date" in FRDC Project 2008/087 FINAL REPORT Evaluating source-sink relationships of the western rock lobster fishery using oceanographic modelling Nick Caputi, Ming Feng, James Penn, Dirk Slawinski, Simon de Lestang, Evan Weller and Alan Pearce

regions need to be maintained, but particularly those in the northern areas, including the deep-water Big Bank stocks.

Project 3 (FRDC 2009)
Evaluating the use of novel statistical techniques for determining harvest rates and efficiency increases in the Western Rock Lobster Fishery. The project looks at using change-in-ratio and index removal to further examine fishing efficiency and harvest rates and pulls together some of the best mathematicians in this field, i.e. Professor Norm Hall, Assoc Professor Stewart Frusher and Professor John Hoenig
Objectives
1. Assess current data sources and their potential for use in estimating harvest rates and efficiency increases in the western rock lobster fishery.
2. Evaluate whether additional sources of information are needed to produce more robust estimates of harvest rate and efficiency increase.
3. Assess whether the estimates of harvest rate and fishing efficiency are reliable and could be used to assist in the management of the western rock lobster fishery.
4. Provide industry (WRLC), RLIAC and fisheries managers with an evaluation of change-in-ratio and index removal techniques for determining harvest rates and efficiency creep.

Project 4 (FRDC 2009)
Evaluation of population genetic structure in the western rock lobster
Objectives
1. Develop additional new microsatellite markers for western rock lobster.
2. Test whether the adult population of western rock lobster is genetically homogeneous throughout its range.
3. Test whether the spatial genetic structure in the next generation of recruits (pueruli) matches the spatial genetic structure found in adults. (If so, this suggests spatial structure is due to limited dispersal or local adaptation).
4. Estimate effective population size of the western rock lobster and test for severe bottlenecks in population size.

Project 5 (FRDC 2008)
Assessing possible environmental causes behind the reduced colonization of puerulus collectors by a wide suite of species.
Objectives
1 Begin monitoring the community composition of marine flora and fauna along the Western Australian coastline during this current poor settlement period.
2 Develop standard methodology for monitoring the spatial and temporal variability in the settlement of marine flora and fauna.
3 Determine what environmental parameters may be linked to the majority of variation in the floral and faunal communities colonizing puerulus collectors, focusing on those relating to puerulus settlement.
4 Identify indicator marine flora and fauna species for monitoring the influences of environmental change on Western Australian marine environment.
5 Detect any known or potential introduced marine pests within the Western Australian environment.

Appendix 3 – Fishing Efficiency Changes FRDC project 2009/019

Background

The sustainable management of an input controlled fishery, such as that for western rock lobster, which is controlled via a total allowable level of effort (TAE), relies heavily on accurate measurement of relative effort. The number of pot lifts used by fishers, which is a direct measure of effort, is not relative between time periods as it fails to take into account how that effort is employed. For example, fishing with 100 pots, half set on sand and the other on reef would produce essentially the same catch as 50 pots set on reef. Although the same catch has been achieved, markedly different catch rates have been produced, suggesting very different population sizes. A far better measure of effort is produced by incorporating the magnitude of effort (pot lifts) with the efficiency with which they were applied. This is termed effective effort. Effective effort is a standardized measure of effort that allows for direct comparisons of catch-rate based data sets between time periods.

Determining changes in fishing efficiency is difficult and has been the aim of a number of studies in this and other fisheries. Initial estimates of efficiency changes in this fishery (Brown et al. 1995; Fernandez et al. 1997) were based on changes in catch rates between vessels with and without various technologies, e.g. colour echo sounders. Although good for examining the impact of technology, this method fails to take into account the influence of gains in knowledge or the movement of pots from poorer to better fishers. More recently Wright et al. (2006) used depletion analysis to examine changes in fishing efficiency and as a by-product, produced the first harvest rate indices for this fishery. A major limitation of the depletion technique however is the requirement that all catch data is adjusted for changes in catchability from external factors such as water temperature and swell. Incorrect adjustment or a lack of correcting for all factors can significantly bias the results from depletion analysis.

This bias can however, be both removed and measured during analysis of efficiency changes (and other indices) by combining two, traditionally land-based, statistical techniques (Frusher et al. 1997). These two novel techniques, change-in-ratio and index removal, have successfully been employed to produce robust estimates of residual biomass, exploitation rate and increases in fishing efficiency in the Tasmanian southern rock lobster fishery, from data sources similar to those available for the western rock lobster fishery.

Objectives

1 Assess current data sources and their potential for estimating harvest rates and increases in efficiency in the western rock lobster fishery using change in ratio and index removal techniques

2 Evaluate whether additional sources of information are needed to produce more robust estimates of harvest rate and efficiency increase

3 Assess whether the estimates of harvest rate and fishing efficiency are reliable and could be used for the management of the western rock lobster fishery

Appendix 4 – Report on interaction between Australian sea lions and the WCRLF at the Abrolhos Islands.

BACKGROUND

The introduction of SLEDs on the mid-west coast in the WCRLF in the 2006/07 season occurred due to concerns for the viability of the Australian sea lion (ASLs) population in this area. Reported levels of incidental mortality from the fishery suggested that some management response was required to mitigate the level of bycatch. It was stated by the Sea Lion Scientific Reference Group that the small population of ASL at the Abrolhos Islands may be under even greater threat from incidental mortality due to its small size and likely genetic isolation (SRG 2003). Whilst no fishery-dependent reporting of incidental capture of sea lions has occurred, there was still some concern over the threat that incidental bycatch may represent to the population. The Abrolhos Islands represents a very small, remnant population of ASL, with an estimated 70-85 animals and a seasonal pup production of just less than 20 pups. Prior to the Dutch shipwreck survivors, whalers and explorers exploiting the sea lion resource of the Abrolhos during the 17-19th centuries, there may have been as many as 500 animals throughout the islands. Breeding occurs as isolated events in the Easter Group predominantly, with low levels present every season in the Southern Group as well. There has been no contemporaneous reports of breeding activity in the Wallabi Group or at North Island.

Risk analysis suggests that very low levels of chronic additional mortality would severely compromise the viability of this population (see Fig. 1). Even for the most optimistic scenarios of this population's underlying growth rate, an additional 4 mortalities every 18 months may tip this population towards extinction.

A research plan to investigate the in-water interactions of ASL with rock lobster pots at the Abrolhos was recommended by the SLSRG, along with investigations of the spatial patterns of habitat use by ASL and the overlap with rock lobster fishing effort.

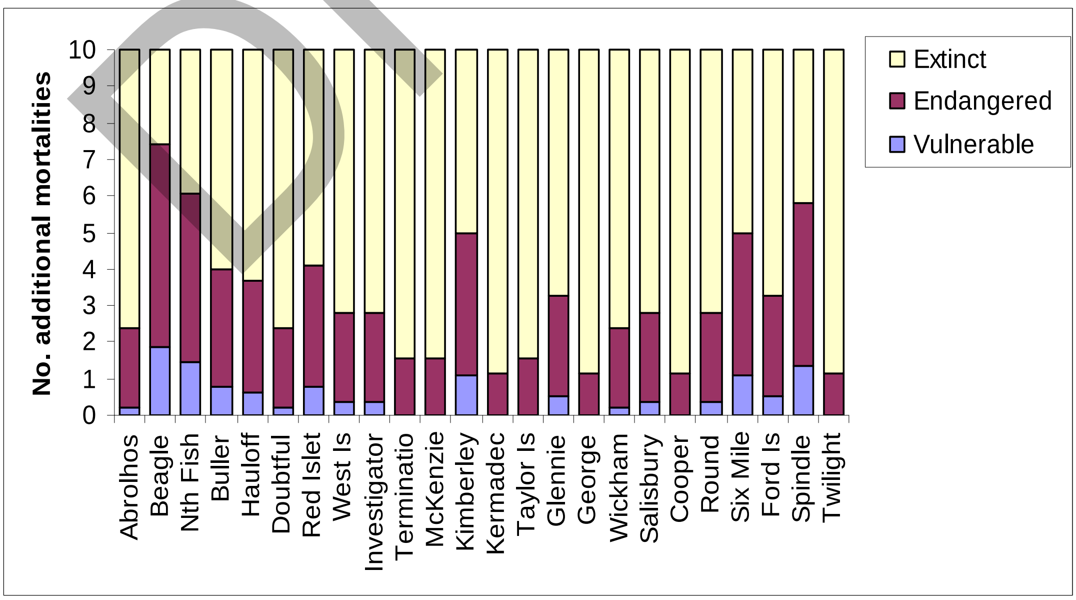

Figure 1-The nominal number of additional mortalities pre breeding cycle (~1.5 yrs) of pre-recruit females under a stable population trajectory (r=0) for each breeding colony to qualify it for different risk categories.

RESULTS

Satellite tracking of juvenile and adult female (cows) ASLs at the Abrolhos (Easter Grp) showed that these animals had a strong preference for foraging in shallow waters (<20 metres) within the island group. Only one adult female made a significant excursion outside of the Easter Group during the deployment (4 weeks), and spent approximately 24 hours in the Southern Group before returning to the Easter Group. The animals utilised a variety of islands to haulout other than the site on which they were captured for the tagging. There was considerable overlap of the spatial habitat use with the observed rock lobster potting effort in the shallow waters of the Easter Group (Fig. 2).

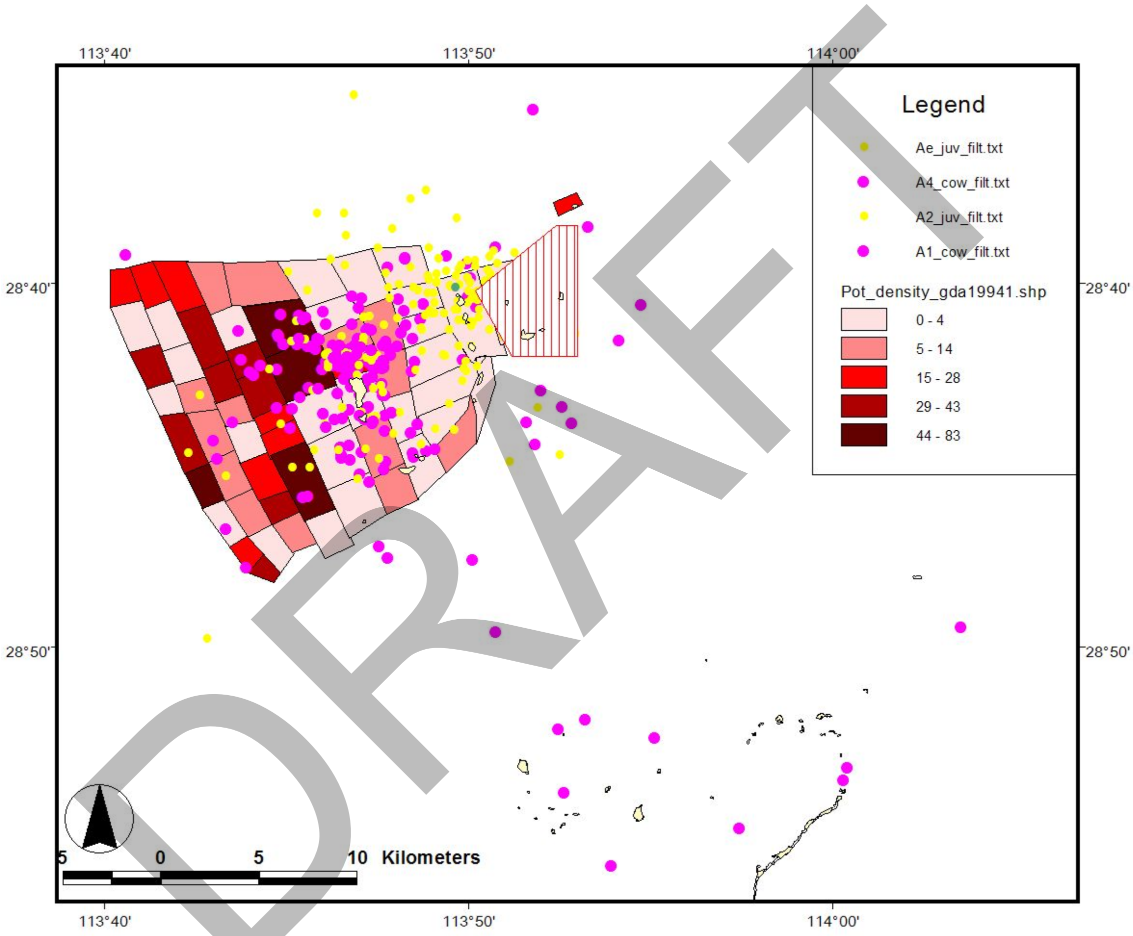

Figure 2. Overlap of rock lobster fishing effort and Australian sea lion foraging effort in the Easter Group, Abrolhos Islands. Both juvenile and adult female cohorts overlapped with the relatively high density of fishing effort

Based on these data, video trials of sea lion-rock lobster pot interactions were conducted at the Abrolhos Islands over a period of years to determine whether there was a considerable risk of ASL drowning in pots at the Abrolhos. Two independent trials found limited interaction, though there was limited activity of ASLs in the water during these trial periods. The animals remained on the islands/haulouts on most occasions and did not enter the water to confirm either way if there was an interaction in this area. At the last SL SRG meeting it was discussed that these data were still equivocal and that further trials should be conducted to determine the extent of the issue.

The latest trials were conducted during 25th June 2008 at a site just to the north of Rat Is near the haulout site of Little White Is. A single lobster pot with approximately 15 lobsters was set in approximately 1.5metres of water adjacent to the haulout. Approximately 10 sea lions were present on the island but only two juvenile animals entered the water and approached the experimental site. One particular animal immediately began to dive on the pot and forage from it. It succeeded in removing nine lobsters over a period of about 90 minutes from 41 attempts. A second animal made one attempt to forage from the pots. This rate of depredation was similar to that seen during experiments in the mid-west coast near North Fisherman Island (SRG 2005). (A supplementary video file of the Abrolhos interaction will be available shortly on dvd.)

Recent video trials to investigate the nature of the interaction between ASL and lobster pots in South Australia discovered similar rates of interaction and depredation with 1800 pot entries recorded over a 12 day period (Goldsworthy et al. 2010). This suggests that ASLs are at risk of drowning in lobster pots throughout their range.

Based on these results it would appear that ASL are at risk of drowning in lobster pots at the Abrolhos Islands, as they are on the mid-west coast. Whilst there have been no reported interactions at the Abrolhos, a single dead sea lion was found placed on the Fisheries Jetty on Rat Island in the 2007/08 fishing season and post-mortem examination showed that the animal had drowned. There was no way of telling how or why the animal had drowned.

Given the small size of the ASL population at the Abrolhos Islands, this population is at even greater potential risk of extinction and population decline than the mid-west coast population. Based on the satellite tracking data, it is supposed that the area of risk for ASL at the Abrolhos Islands would concur with that defined in the mid-west coast (i.e. waters less than 20 metres). All waters less than 20 metres in the Easter and Southern Groups would be within the foraging range of vulnerable sized pup and juvenile Australian sea lions. Any management response, such as the introduction of SLEDs should incorporate these areas as shown in Figs. 3a & 3b. There is no suggestion that sea lions in the Wallabi Group are vulnerable to capture and young sea lions appear to stay within their respective island groups. However, the dataset is limited to only a few animals and this pattern may not be a true indication of the foraging range and risk of incidental capture of ASL at the Abrolhos Islands.

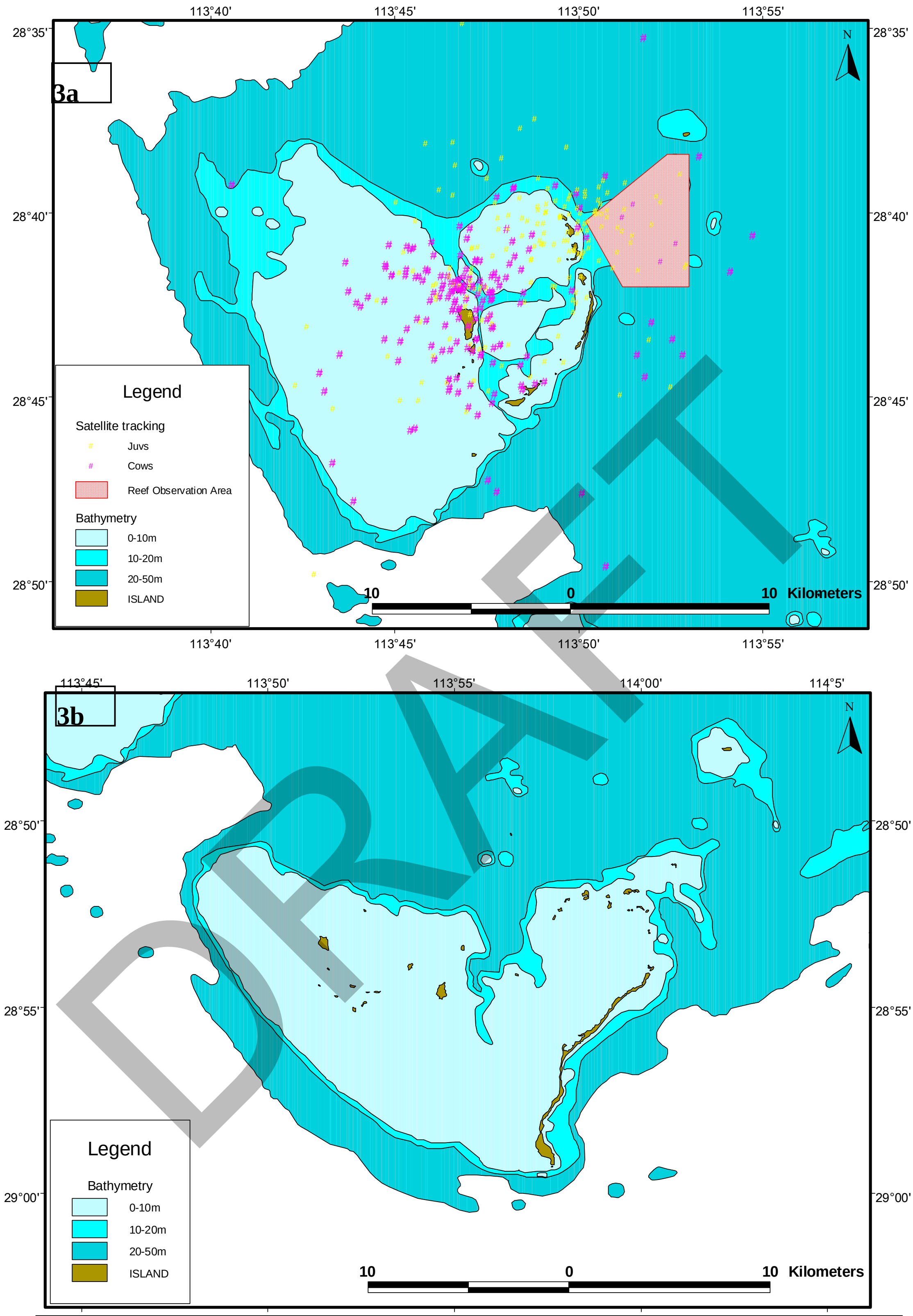

Figure 3. Bathymetry patterns around the Easter and Southern Groups, where seasonal breeding activity of ASL has been reported. Satellite tagging of ASL in the Easter Group demonstrated the patterns of habitat use by adult female and juvenile sea lions within the island group.

Appendix 5 – Australian Sea Lions and SLEDs at the Abrolhos Islands Meeting Report

10 am FRIDAY 1 OCTOBER 2010

DEPARTMENT OF FISHERIES CONFERENCE ROOM

LEVEL 3, 168 ST GEORGE'S TERRACE, PERTH

Attendees:

Rhys Brown (Chair) (DoF)

Peter Mawson (DEC)

Richard Campbell (DEC)

Nic Sofoulis (WRLC)

Simon de LeStange (DoF)

Nick Gales (teleconference connection) (Aust. Antarctic Division)

Sascha Brand-Gardner (DoF)

Eileen Ferguson (Minute Secretary)

Apologies:

Kane Moyle (Recfishwest)

Guy Leyland (WAFIC)

Paul Gamblin (WWF)

Rhys Brown advised attendees that the purpose of the meeting was to decide the coordinates for the Sea Lion Exclusion Devices (SLEDs) in the Abrolhos Islands.

There was a requirement under EPBC and the Marine Stewardship Council to address issues relating to Australian sea lion (ASL) interaction with rock lobster pots.

Background (Richard Campbell)

SLEDs were introduced for the Central West Coast region for the 2006/2007 season for both commercial and recreational fishers, to address the issue of sea lion interactions within the rock lobster fishery. At the time of introduction no interaction had been recorded within the Abrolhos Islands, however research carried out in the area has now identified some interaction. Most of the interaction was in depths of less than 20 metres. The animals have a restricted range and indications are that within the Abrolhos they return to the particular island group where they were born.

The largest population is found in the Easter Group of islands, where pups and juveniles move between the islands. Pups and juveniles are also found in the Southern Group of islands, however there is a much smaller population, with an estimated three or four pups born over the breeding season.

Given that the sea lion population in the Abrolhos Islands is very small, it was considered that any interaction (mortality) posed a risk to the population's survival. Sea lion pups and juveniles are particularly vulnerable to rock lobster pots. Indications are that only about 20 pups are born in an 18 month period in the region.

Other issues impacting on the pups and juveniles include being entangled in trawl netting and fishing lines, plus other environmental risks. By introducing SLEDs to the Abrolhos Is, one of the possible sources of mortality will be eliminated, which would significantly benefit the sea lion population.

Nic Souflis advised that several fishermen claim that the rock lobster catches are higher in the pots fitted with SLEDs.

Wallabi Group

Population appear to be mainly sub adult males, with no pups or juveniles sighted in the area.

Easter Group

Largest population which includes males, cows, juveniles and pups. There is a need to address interaction, as most of the rock lobster fishing is within the 20 metre depth range, which is where most of the pups and juveniles forage. Sea lions sighted outside the 20 metre range still dived to the ocean floor. Nick Gales noted that the tracking data is for one season only and there may be different foraging activity during another season.

It was agreed that the maps for this group would be redrawn with the boundary line for the area of the SLEDs 'zone' to be made larger by extending the line further out to the east, and extending to the north by making the line straight across to include all the area less than 20 m in depth and encompassing all recorded juvenile dive locations.

Southern (Pelsaert) Group

Fishermen have reported that there are pups and juveniles in this group. ASLs have been seen on Stick Island.

It was agreed that the boundary line for the SLED's zone would be drawn straight across the top of the zone, and the line to be straight on the east side, from the north-east corner to the southern point to encompass the area less than 20 m in depth.

Rhys Brown indicated that by adopting a precautionary approach, the proposed SLED zone should meet the Marine Stewardship Council and EPBC Act requirements.

Action: Maps to be redrawn and circulated to attendees (and others who could not make the meeting) for approval and for them to sign off on the boundaries.

Once the boundaries are approved, the Department will commence the legislative processes required, including relevant consultation, for the introduction of the SLEDs in the Abrolhos Islands for the 2011 season (commencing 15 March 2011).

A communication strategy will be developed to advise both commercial and recreational fishers of the need to fit the SLEDs to their rock lobster pots.

Note: It was recommended that the rock lobster fishery consider making a submission to the Government Awards (State and Commonwealth), including environmental awards, to show how the fishery has addressed issues of sea lion interaction, in order to protect the sea lion population on the Central West Coast, including the Abrolhos Islands. Listing the actions they have taken, including the introduction of the SLEDs.

Meeting closed at 11.05am.

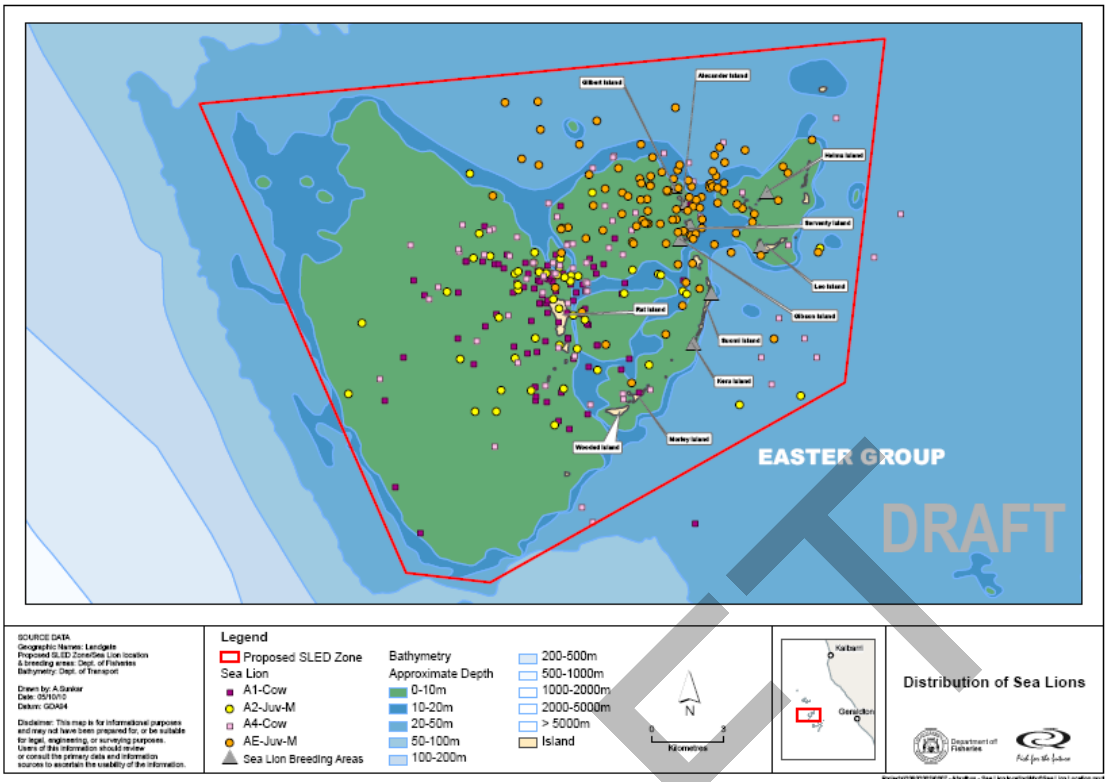

Figure A3.1 – Draft proposed SLED zone for the Easter Group of the Houtman Abrolhos Islands

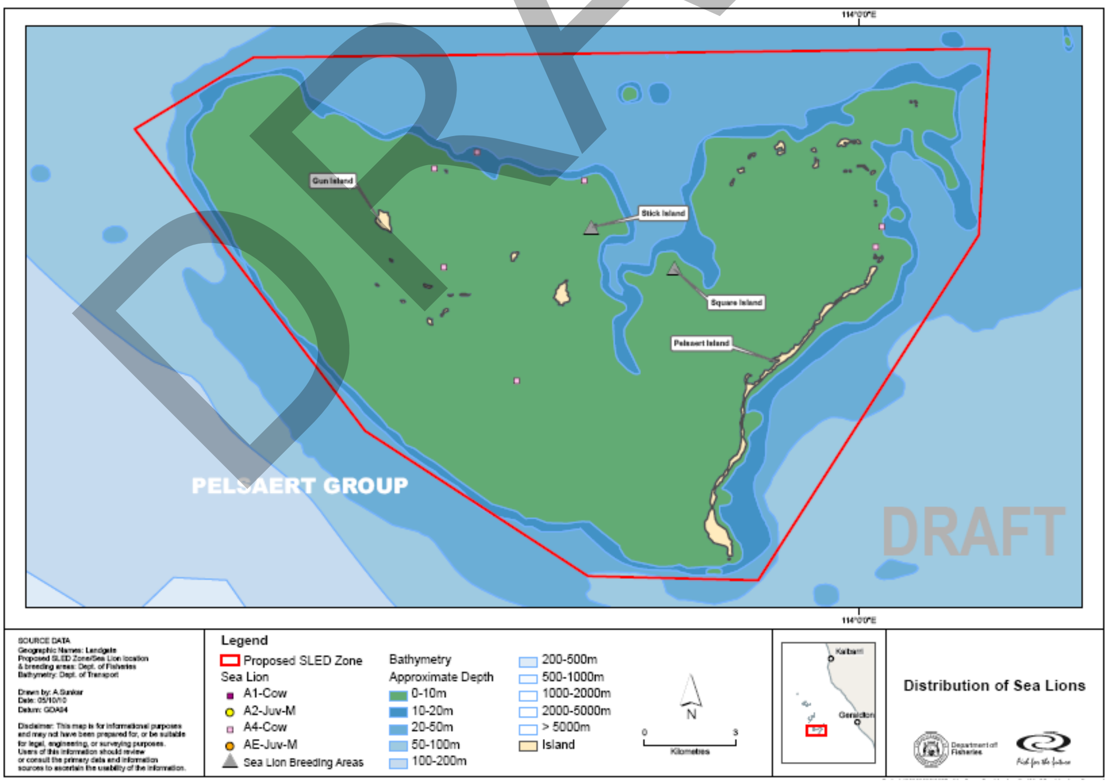

Figure A3.2 – Draft proposed SLED zone for the Pelsaert Group of the Houtman Abrolhos Islands

Appendix 6 – Summary report on the public consultation submissions for the draft western rock lobster environmental management strategy (to be completed once comments have been received)

New EMS to be put out for public comment, feedback will be entered once received.

Appendix 7 - Department of Fisheries responses to public comments received on the draft WRL Environmental Management Strategy (to be completed once comments have be received)

Section	From	Recommendations/comments	Response

Appendix 8: Table of Acronyms

ACRONYM	MEANING
AFMA	Australian Fisheries Management Authority
AIMAC	Abrolhos Islands Management Advisory Committee
CALM	(WA) Department of Conservation and Land Management now the Department of Environment and Conservation (DEC)
DEC	Department of Environment and Conservation
DEW	Department of the Environment and Water Resources
DoF	(WA) Department of Fisheries
DOLA	(WA) Department of Land Administration
EBM	Ecosystem Based Management
EMS	(Western Rock Lobster) Environmental Management Strategy
ERA	Ecological Risk Assessment
ERAEF	Ecological Risk Assessment for Effect of Fishing
ESD	Ecologically Sustainable Development
FAO	Food and Agriculture Organisation (of the United Nations)
FRDC	Fisheries Research and Development Corporation
FRMA	Fish Resources Management Act (1994)
GIS	Geographic Information System
IBSS	Independent Breeding Stock Survey (for western rock lobster)
JBMP	Jurien Bay Marine Park
MS	(The Western Rock Lobster) Management System
MSC	Marine Stewardship Council
PBR	Potential Biological Removal
PSA	Productivity/Susceptibility Analysis
RLIAC	Rock Lobster Industry Advisory Committee
ROV	Remotely Operated Vehicle (usually for underwater video filming)
SICA	Scale, Intensity and Consequence Analysis
SCS	Scientific Certification Systems (auditors for MSC certification)
SED or SLED	Sea-lion Exclusion Device
SLSRG	Sea Lion Scientific Reference Group
SRG	Scientific Reference Group

TEP	Threatened, Endangered and Protected (species)
WAFIC	WA Fishing Industry Council
WRL	Western Rock Lobster
WRLC	Western Rock Lobster Council
WRLF	Western Rock Lobster Fishery
WWF	World Wide Fund for Nature (formerly World Wildlife Fund)