2-2012

West Coast Rock Lobster Managed Fishery : Harvest Strategy and Decision Rules Framework Proposals Under a Quota Management System : A DISCUSSION PAPER

Department of Fisheries

WEST COAST ROCK LOBSTER MANAGED FISHERY

HARVEST STRATEGY AND DECISION RULES FRAMEWORK PROPOSALS UNDER A QUOTA MANAGEMENT SYSTEM

A DISCUSSION PAPER

FISHERIES MANAGEMENT PAPER NO. 254

Published by
Department of Fisheries
168 St. Georges Terrace
Perth WA 6000

February 2012

ISSN 0819-4327

West Coast Rock Lobster Managed Fishery
Harvest Strategy and Decision Rules Framework Proposals
Under a Quota Management System

February 2012

Fisheries Management Paper No. 254
ISSN 0819-4327

Citation:

Department of Fisheries 2012. *West Coast Rock Lobster Managed Fishery – Harvest Strategy and Decision Rules Proposals Under a Quota Management System.* Western Australian Department of Fisheries, 3rd Floor The Atrium, 168 St Georges Terrace, Perth, Western Australia, 6000.

Government of **Western Australia**
Department of **Fisheries**

CONTENTS

OPPORTUNITY TO COMMENT

This paper was prepared by the Department of Fisheries and is designed to encourage public involvement in finalizing revisions to the harvest strategy and decision rules, which will be used for the management of the Western Rock Lobster resource under the new quota based management system.

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 received on this draft discussion paper have been considered, a final proposal will be presented to the Minister for Fisheries for his approval.

Although specific issues have been identified for comment, your views are sought on **all** 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 31 March 2012. Please send your submission before this date, along with your full name, address, and association details (if applicable) to:

The Director General
Department of Fisheries
168 St Georges Terrace
Perth Western Australia 6000

Or by email to:
Lobster.Submissions@fish.wa.gov.au

ACKNOWLEDGEMENTS

The input of the following people to the development of this discussion paper is gratefully acknowledged:

Department of Fisheries Research Division:

Dr Rick Fletcher, Dr Nick Caputi, Dr Simon de Lestang and Jason How.

Department of Fisheries Aquatic Management Division:

Rhys Brown, Graeme Baudains, Joanne Kennedy and Kevin Donohue.

Members of the Department of Fisheries' Western Rock Lobster Stakeholder Reference Group

GLOSSARY AND ABBREVIATIONS

Acceptable Performance: the indicator is 'above' and is likely to remain above the threshold level for egg production with an appropriate level of certainty.

Biomass: the total weight estimate of a stock or of a component of a stock.

Breeding Biomass: (also referred to as spawning stock biomass) the total weight estimate of all mature female lobsters in a population.

BSMA: Breeding Stock Management Area.

Decision rules: agreed responses that management would make under pre-defined circumstances regarding stock status and legal proportion harvested.

Egg production index: the estimated relative numbers of eggs that would be generated by a stock for an entire breeding season.

IFM: Integrated Fisheries Management. It is the process used to divide the harvest of a fish resource between different stakeholder groups. See Fisheries Management Paper No. 236 (DoF, 2010).

GPS: global positioning system.

Harvest Strategy: the clear and specific articulation of how the system of management for a fishery will achieve its core sustainability, ecological, social and economic objectives.

HSDR: Harvest Strategy and Decision Rules.

IFM: Integrated Fisheries Management.

Indicator: are used to measure the performance of one or more fishery management objectives e.g. egg production and legal proportion harvested.

ITQ: Individual Transferable Quota

Legal Proportion Harvested (LPH): is the proportion of legal lobsters harvested by the fishery each season: (LPH = Annual Commercial Catch / Estimated legal biomass[1] available for capture over the season).

Limit: an upper or lower boundary of an indicator. If the indicator value is outside the limit it triggers immediate significant management action.

Management strategy assessment: a procedure whereby alternative management strategies are tested and compared.

Maximum Economic Yield (MEY): the catch or effort level for a commercial fishery that maximises average net economic returns over a number of years based on prevailing economic conditions.

Maximum Sustainable Yield (MSY): the maximum sustainable average annual catch that can be removed from a stock over an indefinite period under prevailing environmental conditions.

Objectives: provide the foundation for the overall strategic direction of the harvest strategy for a fishery by documenting the overarching principles and outcomes the fishery should achieve. They often need to be translated into operational / management objectives that have direct and practical application to the management of the fishery and can be measured.

1 This includes the model derived estimates of the legal animals present during the season – including those above any minimum size and below any maximum size and not in spawning condition.

Over fishing: when the level of fishing is too high such that the removal rate from the stock is unsustainable.

Overfished: when a stock has been reduced such that it is currently below its spawning stock limit value.

Quota: the maximum level of catch allowed to be taken.

Recruitment: the entry of a fish or age or size class of fish into the susceptible (legal) component or area of a fishery (i.e. they are able to be caught and kept).

Reference Values: for a harvest strategy to be effective, the level of an indicator (see indicator above) needs to be interpreted in relation to the operational objective (see objective above) by determining what describes the acceptable performance of a fishery compared to unacceptable performance.

Spawning Stock: see Breeding Biomass

Stock: a functionally discrete population that is largely distinct from other populations of the same species. The west coast rock lobster forms a single breeding stock but there are four separate breeding stock management areas (BSMAs).

TAC: Total Allowable Catch

TACC: Total Allowable Commercial Catch

TARC: Total Allowable Recreational Catch

Target: the optimum value for an indicator(s) from a biological and/or economic and/or social perspective.

Threshold: an upper or lower boundary of an indicator, outside of which management action may be required.

Unacceptable performance: The indicator is 'below' the threshold level for egg production.

Uncertainty: the estimated amount or percentage by which an observed or calculated value may differ from the true value

WRLF: Western Rock Lobster Fishery.

WCRLMF: West Coast Rock Lobster Managed Fishery.

EXECUTIVE SUMMARY

This paper outlines a set of updated proposals for use in the Harvest Strategy and Decision Rules framework (referred to as the HSDR) for the West Coast Rock Lobster Managed Fishery (WCRLMF)[2], which have been developed to facilitate implementation of the new quota-based management system. Where relevant, this current document utilises the information and outcomes presented in the previous discussion document on HSDR[3] (Donohue *et al*., 2010) developed for use with the then input (effort) control management system that operated until 2009/10.

The adoption of HSDR for a fishery represents international best practice for fisheries management and is consistent with the Department of Fisheries' initiative to establish a Harvest Strategy Policy to cover all Western Australian fisheries. The concept of introducing uncertainty and the legal proportion harvested into the HSDR for the WCRLMF fishery was proposed by the Department in early 2007 and was endorsed during a review of the stock assessment of the fishery conducted by four international scientists as part of the *Western Rock Lobster Stock Assessment and Harvest Strategy Workshop, 16-20 July 2007* (DoF 2008)[4], in the *Western Rock Lobster International Stock Assessment and Modelling Workshop Report* (DoF 2010)[5] and in the *Review of the Western Australian Rock Lobster Stock Assessment – Report to the Western Australian Department of Fisheries* (DoF 2011)[6]. These concepts were also supported in recommendations of the Marine Stewardship Council's auditors[7]. The inclusion of these additional factors into the HSDR will ensure that future management decisions are more comprehensive, consistent, predictable, transparent and robust.

Following the international review of stock assessment for this fishery (DoF 2010 and 2011), four breeding stock management areas (BSMAs, see Figure 2) are now being used to assess the status of the western rock lobster breeding stock based on the model estimates of egg production, these are:

- Zones A/B northern deepwater area (>20 fm including Big Bank and northern Abrolhos – BSMA 1).
- Zone A/B southern deepwater area (>20 fm including southern Zone B and remainder of Abrolhos deepwater – BSMA 2).
- Abrolhos Is. shallow (immediate area around the Abrolhos Is. – BSMA 3).
- Zone C deepwater (>20 fm – BSMA 4).

The previous discussion paper resulted in formal agreement that the sustainability (biological) objective for the fishery was to not only ensure that the breeding stock levels within each breeding stock management areas (BSMAs) were above their threshold levels but that they will remain above those levels for at least the next five years (Proposal 1).

2 The WCRLMF is also referred to as the Western Rock Lobster Fishery (WRLF).

3 Donohue et al. (2010) "*Western Rock Lobster Fishery Harvest Strategy and Decision Rules Framework Proposal*" at: http://www.fish.wa.gov.au/docs/mp/mp239/index.php?0706

4 The report can be found at: http://www.fish.wa.gov.au/docs/op/op050/index.php?0706

5 The report can be found at http://www.fish.wa.gov.au/docs/op/op081/index.php?0706

6 The report can be found at http://www.fish.wa.gov.au/docs/op/op099/index.php?0706

7 Scientific Certifications Systems performed the reassessment and annual audits on behalf of the MSC. Their reports on the fishery can be found at: http://www.msc.org/track-a-fishery/certified/south-atlantic-indian-ocean/western-australia-rock-lobster/reassessment-downloads-1 In particular see the 2006 and 2011 reassessments and the 2007 – 2010 annual surveillance reports.

The current discussion paper proposes that there should be an additional legal proportion harvested objective designed to achieve relatively high catch rates that will result in higher economic returns from the fishery. This objective would be used as the target within the Total Allowable Commercial Catch (TACC) setting process (Proposal 2). It would be anticipated that the setting of the optimal legal proportion harvested (i.e. to achieve relatively high catch rates) would result in the rock lobster industry effectively achieving high economic returns from the fishery. The reference values used to assess performance within each management Zone or region will therefore not only have a limit/threshold value for egg production (Proposal 1), but also a target range that defines the optimal legal proportion harvested (Proposal 2).

Given these two proposals, the TACC setting processes will be based on (i) the current breeding stock levels; (ii) a legal proportion harvested assessment for each Zone or region and; (iii) the anticipated[8] future recruitment of lobsters into that Zone/region.

It is also proposed that the TACC setting for Zone C will be undertaken independently from Zones A and B because only the current and likely future egg production levels in the Zone C (BSMA 4) are involved (Proposal 3). Given the higher level of lobster movement between Zones A and B (BSMAs 1, 2 and 3), a series of steps have been proposed for determining their TACCs (Proposal 4).

The decision rules used to set the TACC for each Zone would be based on ensuring that the biological objective is being met and then keeping the legal proportion harvested as close to its optimal target range as possible while keeping the change in TACC between years to less than, for example, 20%, unless this would breach one of the biological sustainability reference values (Proposals 5 and 6). This would require the calculation of the TACC for the next season as well as providing indicative TACCs for each Zone for the following four seasons in advance.

The consideration of any social issues, including the recreational catch, that could be impacted by any of the above proposals would be expected to be central to the consultative processes associated with the review and formal establishment of the annual TACC.

Your Views

Your views are sought on all the matters covered in this document, in particular each of the proposals and the comments that are associated with them, and any other issue you or your organisation considers important in developing the HSDR for the fishery.

Following the public comment period, a final proposal for the harvest strategy and decision rules framework will be recommended to the Minister for Fisheries for approval and implementation.

8 That is, predictions based on the level of puerulus settlement.

INTRODUCTION

Purpose

The purpose of this discussion paper is to engage stakeholders in the development of the Harvest Strategy and Decision Rules framework (HSDR) for the West Coast Rock Lobster Managed Fishery (WCRLMF, which is also referred to as the Western Rock Lobster Fishery (WRLF)). The preparation of this paper is consistent with the Department of Fisheries' (DoF's) strategic direction to develop an overall Harvest Strategy Policy for all Western Australian fisheries.

A discussion paper on a harvest strategy for the rock lobster fishery under the previous fishing effort / input control management regime was released for public comment in April 2010 (Donohue *et al*. 2010[9]). This paper outlines a set of updated proposals for use in the HSDR for the WRLF, which have been developed to facilitate implementation of the new quota-based management system.

Background to the Fishery

West Coast Rock Lobster Managed Fishery licensees target the western rock lobster, *Panulirus cygnus*, on the west coast of Western Australia (WA) between Shark Bay and Cape Leeuwin (Figure 1a), using baited pots (traps). The WRLF has long been Australia's most valuable single species fishery. In response to a series of poor puerulus settlements, management changes were introduced to significantly reduce catch levels to appropriately deal with the expected low levels of recruitment entering the fishery.

Figure 1a. Distribution of the Western Rock Lobster, *Panulirus cygnus*.

9 Donohue et al. (2010) "Western Rock Lobster Fishery Harvest Strategy and Decision Rules Framework Proposal" at: http://www.fish.wa.gov.au/docs/mp/mp239/index.php?0706

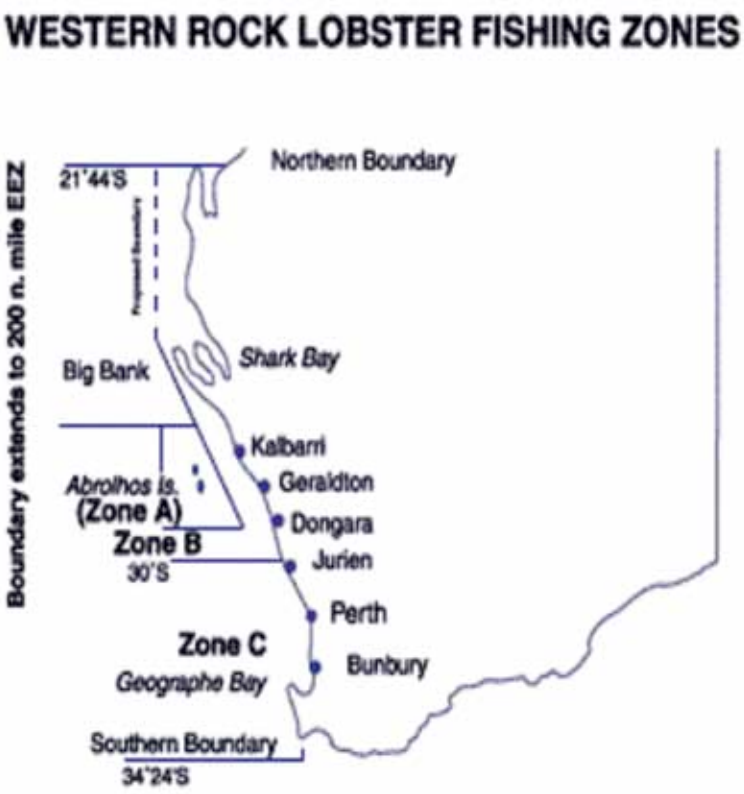

Figure 1b. Boundary of the west coast rock lobster managed fishery and the major management Zones, A, B and C. Big Bank is a separate sub-Zone of Zone B and is currently closed to fishing.

The fishery has recently changed from a total allowable effort (TAE) system, based on a sophisticated set of input controls, to an output-based management system that uses catch limits. It is scheduled to move to full Individual Transferable Quota (ITQ) based management in 2013, while still retaining some necessary input controls. The fishery is divided into three major Zones (A, B and C, Figure 1b), which helps distribute effort across the fishery and allows the implementation of different management controls to address Zone specific issues.

Recreational rock lobster fishers mainly target lobsters in relatively shallow waters with the peak fishing effort being around the coastal urban centres, e.g. Bunbury, Mandurah, Fremantle/Perth, Jurien and Dongara/Geraldton and account on average for about 3-4 percent of the total catch.

Resource Sharing

Integrated Fisheries Management – Recreational Sector

The WRLF was the first fishery where the legal lobster biomass was allocated to user sectors under DoF's Integrated Fisheries Management (IFM) policy. The commercial sector was allocated 95% and the recreational sector was allocated 5%[10], while the customary (indigenous) sector was allocated one tonne. A model for how the sector shares will be managed is set out in *Consideration for the Implementation of Western Rock Lobster Sectoral Allocations*. Fisheries Management Paper 236 (DoF 2010).

The HSDR relates specifically to the commercial sector allocation.

10 The current recreational catch is about 3-4% of the total catch.

For further information about the commercial and recreational fishery see the State of the Fisheries and Aquatic Resources Reports at http://www.fish.wa.gov.au/docs/sof/index.php?0706

Harvest Strategies and Decision Rules

As part of the practical implementation of Ecological Sustainable Development policy (DoF, 2002), which includes adoption of an ecosystem-based approach to the management of fisheries, DoF has recently commenced the development of a state-wide Harvest Strategy Policy that will set out what is considered to be world's best practice for the precautionary management of fisheries. This requires that the management of fish stocks have explicit objectives that reflect scientific knowledge and community values, and there is a clear articulation of how acceptable performance against the objectives will be determined, measured and achieved. This will greatly improve the management decision-making process. The new state-wide policy incorporates ecological, social and economic objectives and therefore recognises that to optimise community benefits, WA's fisheries should be managed to an appropriate target level, rather than just ensuring they remain above a threshold level. The shift to develop management strategies based upon reaching and maintaining a target level is also a more precautionary approach and should, therefore, generally be more cost effective for both DoF and the fishing industry because there should be fewer urgent management interventions.

The core elements of the state-wide Harvest Strategy Policy for fisheries are documentation of:

- objectives,
- indicators used to measure performance against the objectives,
- reference values for indicators that describe what is acceptable and unacceptable performance,
- a target value that optimises the fishery's performance, and
- a predefined set of decision rules to determine the appropriate management actions to assist in reaching target levels and avoid unacceptable performance.

A summary explanation of each of these terms based on the draft state-wide Harvest Strategy Policy is provided below. Their specific application to the western rock lobster fishery is outlined in later sections.

Objectives

Objectives provide the foundation for the overall strategic direction of the harvest strategy by documenting the overarching principles and outcomes the fishery should achieve. They often need to be translated into operational / management objectives that have direct and practical application to the management of the fishery and can be measured using the current or proposed system of data collection.

Indicators

Indicators are used to measure the performance of one or more fishery management objectives. An indicator may be a direct observation (such as catch per unit effort or catch rate of breeding lobsters) or it may be a measure estimated using a stock assessment model. The value of an indicator may be either an absolute measure, e.g. 10,000 tonnes of catch, or a relative measure such as an index, e.g. an egg production index.

Reference Values

For harvest strategies to be effective, the level of an indicator needs to be interpreted in relation to the operational objective by determining what describes acceptable performance compared to unacceptable performance. The reference values can be a target (where you want the indicator to be), a threshold (where you review your position), or a limit (where you don't want the indicator to be), which are used to guide what management actions are required.

Target The target is the level or range of the indicator that the fishery management system aims to either reach or fluctuate within, respectively. It represents the desired or optimal state to best deliver the outcomes that meet the specific objectives of the fishery.

Threshold The threshold is the level at which the indicator for stock status or other relevant objective is no longer considered to be within the range that will achieve optimal outcomes for the fishery and the current management arrangements should be reviewed.

Limit The limit is the level of the indicator below (or above) which the stock abundance for one or more objectives (stock sustainability, legal proportion harvested, etc.) is considered to be unacceptable and a strong set of management actions would need to be implemented immediately to return the fishery/stock to an acceptable level or at least above the threshold level.

Precision and Precaution

The selection of the indicator and performance limits must be done as a package along with the determination of the level of complexity and precaution of the management strategies and responses. The precision of both the indicator and the performance levels that are used in assessments must match the level of precaution used in the management settings.

Decision Rules

The decision rules outline the management strategies or actions (e.g. setting a TACC level) that are predefined to take place based on the current or projected level of an indicator in relation to its limit, threshold and target (performance) levels. The decision rules for a fishery would be developed such that if the indicator is at an acceptable level management actions would be designed keep it there, but if it is at an unacceptable level the management actions would be designed to return it to an acceptable level within an appropriate timeframe. In general, higher levels of precision and certainty in the indicators and performance values enable more prescriptive decision rules and management responses to be developed.

BREEDING STOCK MANAGEMENT AREAS

The review of the stock assessment methods and model (DoF, 2010) has resulted in the assessment of the status of the stock now being undertaken using four Breeding Stock Management Areas (BSMAs, Figure 2). This recognises the more complex nature of the breeding stock within the northern region of the fishery and the need to explicitly protect the important northern breeding stock.

Breeding Stock Management Areas

Four Breeding Stock Management Areas will be used to assess the status of the fishery (see Figure 2).

Northern region (Zones A and B)

BSMA 1 –Deepwater areas (>20 fm) of the fishery north of 28°S. This encompasses the northern Abrolhos and Big Bank regions.

BSMA 2 – Deepwater areas (>20 fm) of the fishery between 28° and 30°S. This encompasses southern Abrolhos and offshore Geraldton and Dongara areas.

BSMA 3 –Shallow Abrolhos Islands (<20 fm around the Abrolhos Is.)

Southern region (Zone C)

BSMA 4 – Deepwater areas (>20 fm) of the fishery south of 30°S. This encompasses all C Zone deepwater.

Note: Zones A+B are sometimes referred to as the northern region and Zone C as the southern region.

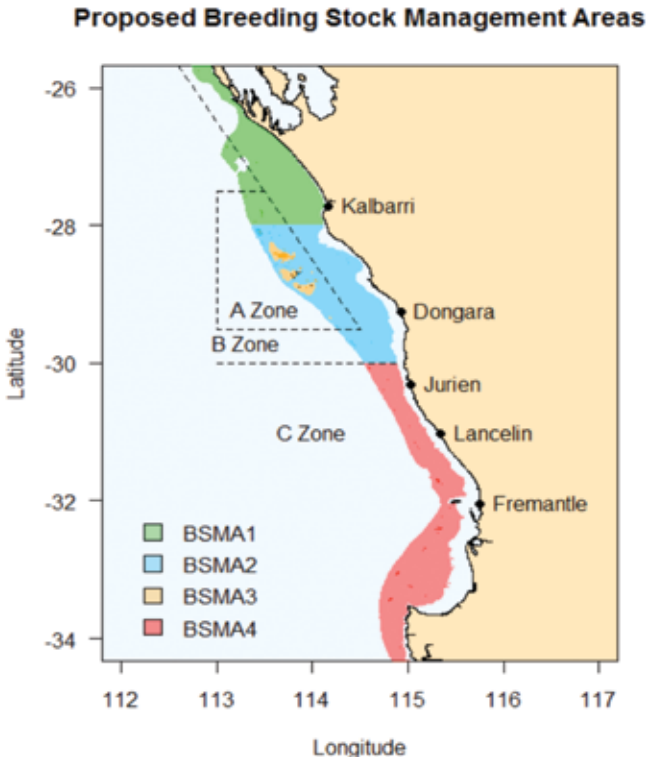

Figure 2. Four Breeding Stock Management Areas covering areas of significant egg production throughout the fishery. Note two areas, BMSA1 and BMSA2 cross the border between Zones A and B.

Previous Decision Rules for the Western Rock Lobster Fishery

The history of decision rules that have been used for the WRLF was outlined in the previous discussion document (Donohue *et al*., 2010). In summary, the first formalised decision-making framework for maintaining the sustainability of the fishery was established in 1993 (RLIAC, 1993) with the adoption of the following management objective:

> *That management arrangements maintain, or restore as the case may be, the abundance of breeding lobsters at or above the levels in 1980.*

Until recently, the management of the fishery was essentially based on the objective of ensuring the coastal breeding stock was above this level. A *Decision Rules Framework* was developed in 2004 to enable management decisions to be made using more explicit, clear and targeted objectives (Bray 2004). While this framework was a significant advance on the 1993 version it still did not include:

- uncertainty in estimates of the performance indicators;
- explicit consideration of the legal proportion harvested objectives ;
- projected trends in recruitment to the fishery and future breeding stock levels extending to a five year time horizon; and
- explicit target levels.

Expanding the *Decision Rules Framework* to include consideration of legal proportion harvested target levels, was proposed by DoF in 2007 and supported by international fisheries experts who took part in the *Western Rock Lobster Stock Assessment and Harvest Strategy Workshop, 16-20 July 2007* (DoF 2008)[11], the *Western Rock Lobster International Stock Assessment and Modelling Workshop Report* (DoF 2010)[12] and the *Review of the Western Australian Rock Lobster Stock Assessment – Report to the Western Australian Department of Fisheries* (DoF 2011)[13]. Explicitly introducing uncertainty into the harvest strategy/decision-making framework was also recommended by the workshops, the reviews and the Marine Stewardship Council's stock assessment auditors[14], and was supported by DoF.

Under DoF's IFM policy, the decision rules framework and the stock assessment model will be updated to include the catch share of the fishery's other stakeholders, i.e. recreational and indigenous sectors, as well as the commercial sector.

11 The report can be found at http://www.fish.wa.gov.au/docs/op/op050/index.php?0706

12 The report can be found at http://www.fish.wa.gov.au/docs/op/op081/index.php?0706

13 The report can be found at http://www.fish.wa.gov.au/docs/op/op099/index.php?0706

14 Scientific Certifications Systems perform the reassessment and annual audits on behalf of the MSC. Their reports on the fishery can be found at: http://www.msc.org/track-a-fishery/certified/south-atlantic-indian-ocean/western-australia-rock-lobster/reassessment-downloads-1 In particular see the 2006 and 2010 reassessment and the 2007 to 2010 annual surveillance reports.

Management Objectives

An essential component of the HSDR is the specification of the management objectives for the fishery, as this enables the selection of the appropriate indicators and reference levels.

Section 3(1)(a) and (b) of the *Fish Resources Management Act 1994* (FRMA) specifies the objects of the FRMA which are:

(a) to develop and manage fisheries and aquaculture in a sustainable way; and

(b) to share and conserve the State's fish and other aquatic resources and their habitats for the benefit of present and future generations.

Key Principles

The following Key Principles underpin the Harvest Strategy and Decision Rules:

1. The TACCs will be set to ensure the sustainability objective of maintaining acceptable egg production levels in each of the four Breeding Stock Management Areas is met and, where appropriate, set an optimal legal proportion harvested that is based on achieving relatively high catch rates and hence higher economic returns for each Zone or region of the fishery.
2. Given the differences in recruitment patterns among Zones and regions plus the requirement to ensure the egg production is spread appropriately across the entire distribution of the stock, annual quotas will be set on a Zone basis.
3. The TACC for each Zone will, to the extent feasible, be based on the current breeding stock levels in the Breeding Stock Management Areas associated with each Zone, the anticipated[15] future recruitment of adults into that Zone and the optimal legal proportion harvested that provides relatively high catch rates and hence higher economic returns for the Zone or region.
4. To provide stability in the catch between years, the TACCs should not change by more than 20%, unless, by not doing so, they would breach the biological sustainability reference values.
5. The TACCs for each upcoming season to be reviewed prior to the start of the season to ensure that any unexpected changes in the stock status, economics or social aspects of the fishery could be considered.
6. In addition to calculating the upcoming season's TACCs for each Zone (i.e. one season in advance), an estimated TACC (or range) would also be provided for the following four seasons to optimise the likelihood that the egg production in the BSMAs would reach, or remain above, their threshold value and that the legal proportion harvested was within the target range that produces high catch rates and hence higher economic returns for the Zone or region.

15 Using the puerulus counts

Proposals

In line with the objects of the FRMA, from which the management proposals for the HSDR are formulated, DoF proposes two key objectives for use in developing advice on future management arrangements for the WRLF. These objectives are:

- Sustainability Objective (Proposal 1); and
- Legal Proportion Harvested[16] Objective (Proposal 2).

Sustainability Objective

The proposed sustainability objective requires that egg production be above its threshold value, and likely to remain above it in the short to medium term with a reasonable level of certainty. In practice this means that unless there was some externally driven, catastrophic event that decimated the breeding stock, the threshold level should not be breached.[17]

Sustainability Indicator for Egg Production

The previous discussion paper (Donohue *et al*., 2010) discussed the relative strengths and weaknesses of three different ways of measuring the breeding stock and hence calculating egg production. It was decided that the egg production indices for the four BSMAs calculated using the spatial population dynamic stock assessment model (the model) would be used as the indicator representing the breeding capacity of the rock lobster stocks. It is proposed that these indices would continue to be used to assess the sustainability objective.

Sustainability Reference Values – Egg Production Thresholds and Limits

Threshold and limit reference values[18] for egg production have been derived from the Sustainability Objective of the fishery (see Proposal 1 below) and apply to each of the four BSMAs.

Firm threshold and limit reference values have not been determined for BSMA 1 (Figure 2). Unlike BSMAs 2, 3 and 4, BSMA 1 is relatively isolated and the Big Bank component of this area was not heavily fished until the early 1990s. As such little data is available pre 1990 and, because of low fishing effort, for a number of years after this. In February 2009 a significant proportion of the fishing grounds that comprise BSMA 1 were closed to lobster fishing as anecdotal information indicated a marked reduction in residual (particularly breeding) stock had occurred. To understand the recovery and produce a time series of data to aid in the modelling of this area, annual independent stock surveys were initiated in October 2009. This time series currently stands at three years and it will be integrated into the stock assessment model over the coming year(s). Once a better understanding of the biomass recovery in this area has been obtained and there is agreement between the model and observed data for BSMA 1, firm threshold and limit values will be set. In the interim an indicative threshold value has been set based on the current model-estimated average egg production of the mid 1990s, and an indicative limit value has also been set, which is 20% below the threshold value. The mid 1990s period has been chosen as it was shortly after fishing began in this area and was well before the abnormally low puerulus settlements were recorded in the fishery (i.e. between 2007/08 and 2011/12). The main management focus in BSMA 1 at this stage is to increase the

16 The legal proportion harvested affects catch rates. Generally the lower the legal proportion harvested the higher the catch rate.

17 In this respect the threshold level is similar to a limit level and is therefore very precautionary.

18 A target reference value is not calculated for egg production because all values above the threshold are considered equally acceptable.

level of the breeding stock using an area closure and to monitor the recovery. BSMA 1 reference values will not be used for harvest strategy decisions until they have been determined more accurately.

For Breeding Stock Management Areas 2, 3 and 4 (Figure 2), it is proposed that the threshold value for egg production be based on the mid-1980s level (Table 1). This period is considered to be a period of relatively lower exploitation in the fishery (particularly in the deeper water breeding stock areas) that preceded the general uptake of major innovations in technology, such as GPS, high definition colour echo sounders and computers.

Unlike the breeding females in the coastal areas of Zones B and C, most females in BSMA 3 commence breeding below legal size and hence the breeding stock in BSMA 3 is not depleted by fishing to the same extent as in the other BSMAs.

Limit values for the fishery have been set at 20% below the threshold values for each of the BSMAs. Given the proposed sustainability objective is to maintain egg production above the threshold level at all times, it is most unlikely, barring some catastrophic event, that egg production would breach the limit level. However, if it did, it would result in significant and rapid management intervention.

Table 1. Threshold reference years for each of the four breeding stock management areas. Note that egg production limit values are set 20% below the threshold values.

	Description	Threshold reference years	
BSMA1	Deepwater areas north of 28° S	Preliminary estimate only mid 1990s, but will be revised as more years of survey data become available	1994 – 1995
BSMA2	Deepwater areas between 28° and 30°S	Mid 80s	1984 – 1986
BSMA3	Shallow Abrolhos Islands areas	Mid 80s	1984 – 1986
BSMA4	Deepwater areas south of 30° S	Mid 80s	1984 – 1986

Taking Account of Uncertainty

The harvest strategy and decision rules can incorporate uncertainty by expressing the rules in terms of the probability of the indicators (in this case, estimated relative egg production) being above or below their reference values. For example, if the estimated egg production were equal to its threshold value this would be equivalent to stating that there is a 50% probability that the actual egg production is above the threshold value.

Stock assessment reviewers[19] have recommended that the decision rules associated with sustainability should be more precautionary by accounting for uncertainty and that there should be a greater than 50% probability that the indicator value is above the egg production threshold value. This has been incorporated into the framework by providing the 75% probability level associated with the egg production indicator values over time, as shown in the example in Figure 3. That is, if the estimated egg production at the 75% probability level were equal to its threshold value it would be equivalent to stating that there was a 75% probability that the actual egg production was above the threshold value

19 See the report of *Western Rock Lobster Stock Assessment and Harvest Strategy Workshop 16 – 20 July 2007* (DoF 2008) at: http://www.fish.wa.gov.au/docs/op/op050/index.php?0706, the *Western Rock Lobster International Stock Assessment and Modelling Workshop Report* (DoF 2010) at: http://www.fish.wa.gov.au/docs/op/op081/index.php?0706 and the *Review of the Western Australian Rock Lobster Stock Assessment – Report to the Western Australian Department of Fisheries* (DoF 2011) at: http://www.fish.wa.gov.au/docs/op/op099/index.php?0706

Proposal 1
Sustainability Objective

Ensure that the egg production in Breeding Stock Management Areas (2-4) of the fishery (see Figure 2) remains above its threshold value for the next 5 years with a confidence level of 75%.

Comments:

- *If the egg production in any BSMA is predicted to fall below the threshold value, management action would be taken to ensure it does not.*
- *The limit level for each BSMA is 20% below the threshold level. A breach of the limit value in any BSMA will result in significant and immediate management action.*

Stock Status and Fishery Performance

The stock status and fishery performance is evaluated from where an indicator value (e.g. level of egg production) is located in relation to one or more of the reference values. For the WRLF, based on the above proposals, the level of egg production would be classified as:

Acceptable – Mean value is above the threshold level, with greater than 75% certainty for each of the five years. Given this precautionary approach, the stock and the fishery is therefore in an acceptable state by meeting the sustainability objective (Figure 3).

Unacceptable – Mean value is below the threshold or is above the threshold, but with less than 75% certainty in any one or more of the five years. The fishery would be considered to be in an 'unacceptable' state, as it would not be meeting its sustainability objective (Figure 3).

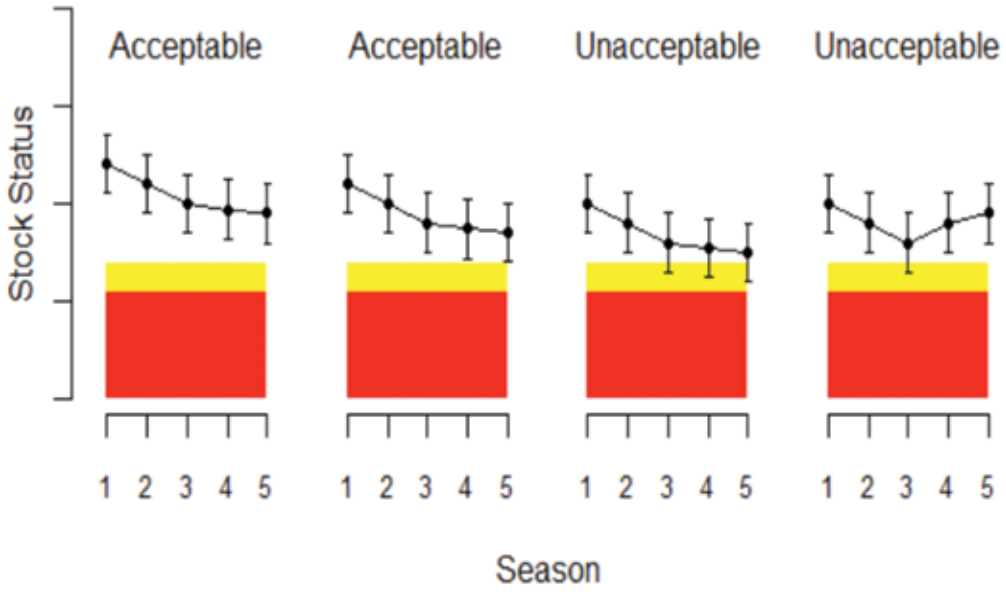

Figure 3. Example of how the stock status indicator showing a 75% confidence level relative to a threshold/limit reference values could generate acceptable or unacceptable levels of stock status. The upper lines of the yellow and red areas are the threshold and limit values, respectively.

Legal Proportion Harvested Objective

The proposed legal proportion harvested objective for the fishery is aimed at delivering relatively high catch rates and hence higher economic returns. This is in line with the objects of the FRMA and is consistent with the Key Principles of the HSDR. Having an explicit objective based on the legal proportion harvested[20] was presented in the previous discussion paper (Donohue *et al*., 2010) and adopted in principle, however, the details of how it would be applied in practice were not determined. The target range of the legal proportion harvested may vary over the years as it takes into account the fluctuations in lobster abundance and changes in lobster prices and cost of fishing.

An assessment of the fishery undertaken in 2008 showed that the level of effort required to achieve relatively high catch rates and higher economic returns was about 50-70% lower than the fishing effort in 2007/08. The subsequent effort reductions in 2008/09 and 2009/10 (44 and 73%), that were undertaken due to very low puerulus settlements, were at a level similar to that required to achieve higher economic returns. The significant effort reductions resulted in a reduction of the legal proportion harvested and significant increases in catch rates (kgs of lobsters per pot lift), which reduced the cost of fishing and hence produced greater net profits.

Legal Proportion Harvested Indicator

The legal proportion harvested for the purposes of the HSDR will need to provide a measure of the proportion of legal animals that are harvested annually by the rock lobster fleet. The legal proportion harvested measure is given as:

Legal Proportion Harvested = Catch / (Total Legal Biomass[21])

Using a biomass of lobsters that can be legally taken provides the most appropriate input to calculate the legal proportion harvested because it is based on the current management rules (e.g. minimum, maximum sizes, etc) and therefore reflects the proportion of legal-stock available that are landed during that season. This legal proportion harvested should better reflect the legal catch rates observed by industry. Higher catch rates are an important factor contributing to maximising industry profitability.

Reference Values – Legal Proportion Harvested Target Range

Target reference values for the legal proportion harvested (LPH) are based on the legal proportion harvested objective of the fishery in Proposal 2. It is proposed that the target LPH will initially be set at 0.5, which is very similar to the average LPH estimated for the 2009/10 and 2010/11 seasons in each zone, when the catch was restricted to approximately 5,500 t. These seasons produced high catch rates and relatively good economic returns given the lobster abundance available at that time. They also produced significant increases in breeding stock abundance.

Given that it is difficult to maintain a specific harvest value, it is proposed that a legal proportion harvested range for each region (rather than a single value) be set at ±0.05 of the target mean proportion of animals exploited (e.g. the green area in Figure 4).

20 Note that the level of the legal proportion harvested affects legal catch rates.

21 This includes the model-derived estimates of the legal animals present during the season – including those above any minimum size and below any maximum size and not in spawning condition.

Proposal 2
Legal Proportion Harvested Objective

In addition to meeting the sustainability objective, TACCs set for the fishery should target an optimal legal proportion harvested range that would produce catch rates that would provide high economic returns from the fishery.

The target legal proportion harvested range will initially be set at the level of 0.5, and the range will be set at ±0.05 of the mean proportion of legal animals harvested (e.g. the green area in Figure 4).

Comments:

- *The TACCs set to achieve the target legal proportion harvested (i.e. within the range) would usually be below that required for sustainability; however, where there is any conflict, the sustainability objective must first be met.*
- *The level of variability in TACCs between years in each Zone should be minimized (e.g. vary by less than 20%) to assist economic performance.*

Legal Proportion Harvested and Fishery Performance

Based on the above proposal, the legal proportion harvested of the WRLF would be classified as:

Optimal – If the mean legal proportion harvested was within the target range over the subsequent five years, the fishery is in optimal state by meeting the legal proportion harvested objective (Figure 4).

Not Optimal – If the mean is outside the target range in any of the projected five years, the fishery would be considered to be in a 'not optimal' state, as it would not be meeting its legal proportion harvested objective (Figure 4).

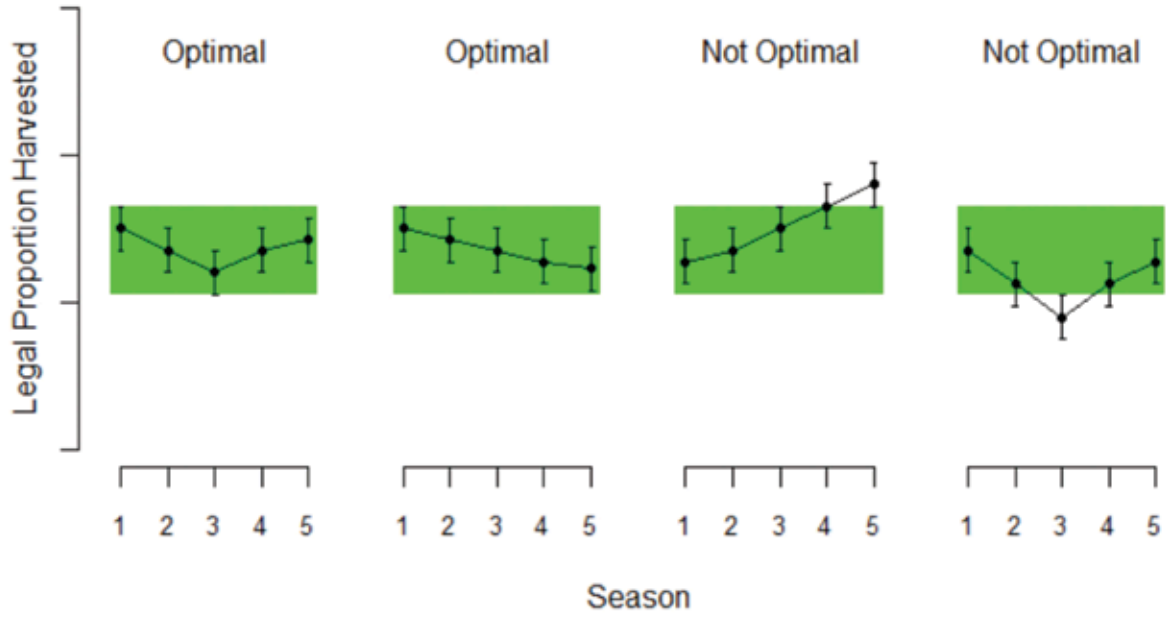

Figure 4. Examples of how the legal proportion harvested indicator in relation to the target reference range (green) would generate Optimal and Not Optimal levels over the next five years.

Note: Generally, if the legal proportion harvested is relatively low more lobsters would be left on the grounds each year and hence their abundance would increase, including the abundance of the breeding stock. The higher the abundance of lobsters, the higher the catch rate, which usually results in higher economic returns from the fishery. The higher catch rates would also be beneficial to recreational fishers and provide a more satisfying recreational fishing experience (i.e. participants would be more likely to catch a lobster when the abundance is higher). By comparison a high legal proportion harvested usually results in fewer lobster being left on the grounds at the end of the year and hence the abundance declines, including the abundance of the breeding stock. The lower the abundance of lobsters the lower the catch rate, which usually results in lower economic returns from the fishery and lower catch rates for recreational fishers.

DECISION RULES FOR TACC SETTING

TACCs for Zones A, B and C will be set on an annual basis. Meeting the sustainability objective for each of the BSMAs would be the first priority. The TACC setting processes will be based on:

- the current breeding stock levels in the BSMA(s) that are associated with each Zone (see Proposal 1),
- the anticipated[22] future recruitment into that Zone, and
- producing a legal proportion harvested equivalent to 0.5 ± 0.05 for each Zone or region (see Proposal 2).

Determination of the TACC for a Zone will be an iterative process that will try to optimise the likelihood that the legal proportion harvested indicator value for the Zone or region will reach or remain within the optimal target range (see Figure 4) for the subsequent five years while attempting to keep the level of change in the TACC between years to less than 20%.

Achieving this condition would require the calculation of the anticipated TACCs or likely TACC ranges for each Zone for both the upcoming season and at least the following four seasons (see Principles 5 and 6).

An annual review process would formally provide advice on the annual TACC and this would take into account any updates or unexpected changes in the stock status, economics or social aspects of the fishery before the TACC was finalised.

Stock interactions between zones

The only BSMA that directly relates to one Zone of the fishery is BSMA 4 (Figure 2) which represents the breeding stock for Zone C. This is a reflection of the relatively low level of stock and direct fisher interactions between Zone C and the two northern Zones (A and B). By contrast, there is a high level of both stock and fisher interactions between Zones A and B, which is overlayed with the requirement to independently maintain the three BSMAs (i.e. BSMA 1, 2 and 3) that occur across the northern half of the fishery. The interactions between Zones A and B and the requirement to manage three BSMAs will result in the TACC setting process for Zones A and B being more complicated than for Zone C.

It is therefore proposed that the TACC for Zone C be set independently to the TACCs for Zones A and B but the process for Zones A and B would need to be coordinated.

Proposal 3
Separate TACC Setting For Zone C And Northern Zones (A And B)

The TACC setting process for Zone C can be undertaken independently from Zones A and B because only the current and likely future egg production levels in the Zone C, (i.e. Breeding Stock Management Area 4, Figure 2) are involved.

Comments:

While there are some stock interactions between Zone C and Zones A and B, these are unidirectional – it is estimated that only a relatively small proportion of the total stock of lobsters migrate from Zone C to Zones B and A.

22 Using the puerulus counts

Zone C TACC Setting

Proposal 4
TACC Setting for Zone C

The TACC set for Zone C must comply with the fishery's two key objectives, being the:

- sustainability objective that ensures that the egg production index for BSMA 4 is above its threshold value with 75% confidence, and
- legal proportion harvested objective that the legal proportion harvested is within the target range for Zone C.

Comments:

The upcoming year's TACC and the four future years' indicative TACCs will be calculated to optimise the likelihood that the legal proportion harvested will reach, or remain close to the target range (i.e. within ± 0.05) while attempting to maintain the change in TACCs between years to less than 20%.

Fixed proportional TACC between Zones A and B

Given the level of stock interaction between Zones A and B, it is likely that fishing to a lower target legal proportion harvested will result in a significant increase in the amount of migration between the two Zones. This migration will predominantly be from Zone B into Zone A, but then, back into Zone B in the Big Bank area. There is also significant interaction between the fishers in this region, as the Zone A fishers fish in Zone B for part of their quota and fish the rest in Zone A.

If the TACCs for Zones A and B were set independently, it is highly likely that a conservative harvest strategy would incrementally change the relative abundance in the Zones, which would then effect the level of TACC that could be set. As a consequence, it is proposed that, for the purposes of TACC setting, the proportional allocation of catch between Zones A and B be fixed at the historic 10-year average, 1998/99 to 2007/08. This approach is consistent with that taken in the last two seasons of fixing the proportion of the TACC in Zone B before and after the 15th March, as both Zone A and B fishers have fished in Zone B before and only Zone B fishers fish after that date.

Fixing the "A/B" Zone share of the TACC significantly simplifies the process for determining the TACC for these Zones and allows each Zone to share the benefits equally of any improvement of abundance in stock.

Proposal 5
TACC Setting for Zones A & B

Given that the rock lobster stock and fisher interactions between the Zone A and B are more complex than between Zones C and A/B (e.g. whites migration, breeding stock, fishers fishing the same area for part of the season, etc), it is proposed that, for the purposes of TACC setting, the proportional allocation of catch between Zones A and B be fixed at the historical 10 year average, 1998/99 to 2007/08.

TACC setting for Zones A and b

The next step is to allocate the total amount of Zone B catch that can be taken by Zone A licence holders whilst fishing in the waters of Zone B (i.e. the period from 15 November to 14 March the following year). The approach adopted for the last two seasons has been to fix the proportion of the TACC in Zone B before and after the 15 March based on the historic 10 year average, 1998/99 to 2007/08. It is proposed that this would continue.

Proposal 6
TACC Setting for Zones A & B

The TACC set for Zones A and B must comply with the fishery's two key objectives, being the:

- sustainability objective that ensures that the egg production indexes for BSMAs 1, 2 and 3 are above their threshold values with 75% confidence, and
- legal proportion harvested objective that the legal proportion harvested is within the target range for Zones A and B.

The proposed method for the setting of the TACCs for Zones A and B involves the following steps:

- Determine the combined TACC for Zones A and B that can be taken and still maintain the sustainability objective for BSMAs 1, 2 and 3.
- Determine the combined TACC for Zones A and B that can be taken and still remain within the combined target legal proportion harvested range for Zones A and B.
- Proportion the combined TACC for Zones A and B based the historical average catch share between Zones A and B using the average of the 10 years 1998/99 to 2007/08.
- Proportion the TACC for Zone B between Zone A and B licence holders based the historic average catch share for the period before and after the 15 March, for the 10 years 1998/99 to 2007/08.

Comment:

The upcoming seasons TACCs and the four future seasons' indicative TACCs will be calculated to optimise the likelihood that the legal proportion harvested within Zone A and B will reach, or remain close to, the target range (i.e. within ± 0.05), while attempting to maintain the change in quota between years to less than 20%.

DECISION RULES FOR TACC ADJUSTMENT

Proposed Guidelines for Decision Rules

A critical element of this proposed harvest strategy is that fishery managers, in consultation with stakeholders, will, under normal circumstances, be in a position to take management actions prior to any egg production or legal proportion harvested indicator breaching its reference value, threshold, limit and target respectively. For example:

- if puerulus settlement and model outputs predict that the egg production is likely to breach (go below) the threshold value over the next five years; or
- if the legal proportion harvested assessment predicts that it is projected to fall outside the target range;

then corrective management action may commence immediately to ensure it does not.

If an egg production indicator value was predicted to breach the threshold over the next five years, it would trigger a management response to correct it. The management response to increase the egg production (i.e. rebuild a breeding stock in a particular BSMA) could involve cuts to a Zone's TACC by more than 20% (if necessary) and/or the introduction of other management measures. If a breach is predicted to be in the short term (one or two years), it would trigger an immediate management response to correct it, compared to if the breach was predicted to occur in four or five years time. A breach or projected breach of a limit value in any BSMA would trigger significant and immediate management intervention, such as large-scale area / zone closures or significant TACC reductions or both.

Assuming there are no stock sustainability issues, where a legal proportion harvested indicator value was in breach of its target range, or was predicted to be at some stage over the next five years, the management responses to correct it (i.e. to take a Zone or region back to its target range) would not involve changes in the TACC of more than 20% in any one year.

In practice the decision rules for TACC setting will operate by firstly determining whether the projected legal proportion harvested indicator falls within the legal proportion harvested range. It is expected that once a TACC has been set so that the indicator falls within the legal proportion harvested range, further adjustments to the TACC to ensure that the egg production indicator is above the threshold would generally not be necessary. A flow diagram which outlines how the TACC setting decision rules would work in practice is at Figure 5.

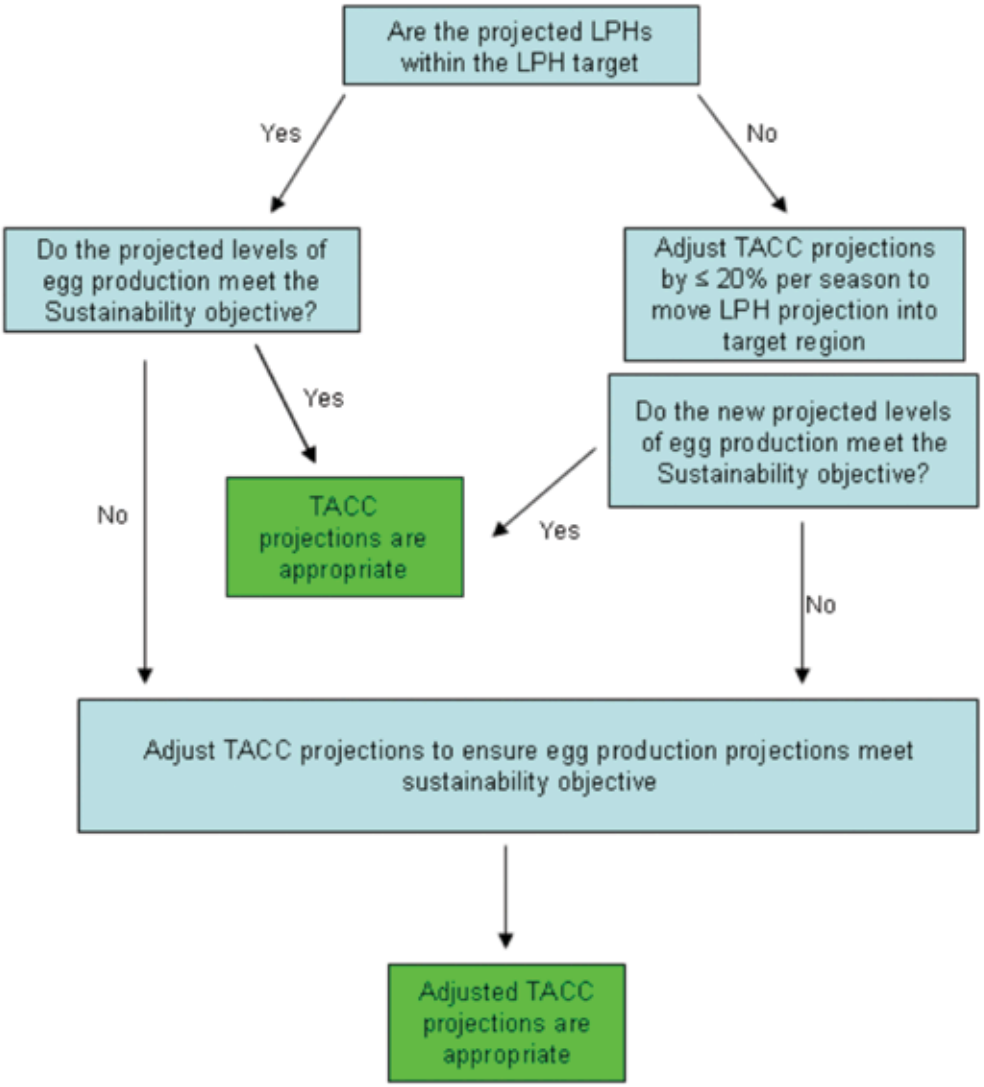

Figure 5. Flow diagram outlining how the TACC setting decision rules would work in practice. LPH = legal proportion harvested, TACC = Total Allowable Commercial Catch.

Zone C Decision Rules

Proposal 7 **Sustainability Decision Rules** **Zone C – BSMA 4**	
Indicator Value - egg production	**Management Response**
Likely to remain above the threshold value for the next five years with 75% confidence.	Quota can be set based on the legal proportion harvested objective.
Less than 75% probability that the indicator will be above the threshold value.	Immediately adjust one or more of the future five year indicative TACCs down in the Zone C five-year package and, if necessary, take other management action to bring the egg production indicator above the threshold value with a 75% probability.
Less than 75% probability that the indicator is above the limit value.	Significantly reduce the TACC and/or implement large-scale area/Zone closures until the egg production indicator is projected to be back above the threshold value with a 75% probability.
Comments: • *Any management decision/action required to return projected egg production to above the threshold value would occur over a time period (less than five years) that would ensure that it did not actually go below its threshold.* • *If a catastrophic event took the actual or projected egg production below the limit value, immediate management decisions/actions would be taken to return it to above the threshold.*	

Proposal 8 **Legal Proportion Harvested Decision Rules** **Zone C**	
Indicator Value – Legal Proportion Harvested	**Management Response**
Likely to remain within the target range for the future projected five years.	No change.
Likely to fall above or below the target range in the future projected five years.	Increase or reduce the TACC by increments ≤20% to bring the legal proportion harvested back within the target range.

Zones A and B Decision Rules

Proposal 9 **Sustainability Decision Rules** **Zones A and B – BSMA 1, 2 and 3**	
Indicator Value - egg production	**Management Response**
Likely to remain above the threshold value for the next five years with 75% confidence.	TACC can be set based on legal proportion harvested objectives.
Less than 75% probability that the indicator will be above the threshold value in BSMA 2 or 3.	Immediately adjust one or more of the future five year indicative TACCs down in the combined Zones A and B five year package and, if necessary, take other management action to bring the egg production indicator above the threshold value with a 75% probability.
Less than 75% probability that the indicator is above the limit value in BSMA 2 or 3.	Significantly reduce the combined Zones A and B quota and/or implement large scale area/Zone closures until the egg production indicator is projected to be back above the threshold value with a 75% probability.
Comments: • *Any management decision/action required to return projected egg production to above the threshold value would occur over a time period (less than five years) that would ensure that it did not actually go below its threshold.* • *If a catastrophic event took the actual or projected egg production below the limit value, immediate management decisions/actions would be taken to return it to above the threshold.* • *At this stage, the main management focus in BSMA 1 is to increase the level of the breeding stock using an area closure and to monitor the recovery. BSMA 1 reference values will not be used for harvest strategy decisions until they have been determined more accurately.*	

Proposal 9 **Legal Proportion Harvested Decision Rules** **Zones A and B**	
Indicator Value – Legal Proportion Harvested	**Management Response**
Likely to remain within the target range for the future projected 5 years.	No change.
Likely to fall above or below the target range for the future projected 5 years.	Increase or reduce the TACC by increments ≤20% to bring the legal proportion harvested back within the target range.

FUTURE DIRECTIONS

Bio-economic Modelling

A three-year bio-economic project to develop better economic information for the rock lobster industry to help optimise the rock lobster harvest is currently underway. A summary of the project can be found at Appendix 1.

Stock Assessment Model Improvements

Improvements to the stock assessment model will continue to be made including:

- Examination and incorporation of density-dependent mortality.
- Jitter analysis, parameter sensitivity and Management Strategy Evaluations are currently being undertaken to determine the robustness of the model and its projections.

Stock and Recruitment Relationship and Environment Effects

A number of research projects are currently investigating aspects of the rock lobster stock and recruitment relationship and the influences of environmental factors on the levels of puerulus settlement (Caputi *et al*., 2010). The results of these projects, amongst other things, will enable a review of the appropriateness of the threshold egg production levels based on the:

- mid 1980s level for deepwater BSMA 4 in Zone C,
- mid 1980s level for southern deepwater BSMAs 2 in Zones A &B,
- mid 1990s for northern deepwater BSMA 1 in Zones A & B, and
- mid 1980s level for shallow water BSMA 3 in Zone A.

Integrated Fisheries Management – Recreational Sector

Under the Department's IFM policy, the decision rules framework and the stock assessment model will be updated to include the catch share of the fishery's other stakeholders (e.g. recreational and indigenous sectors), as well as the commercial sector[23].

23 The current recreational catch is about 3-4% of the total catch.

REFERENCES

Bowen, B K, (1994). Long term management strategies for the western rock lobster fishery – Evaluation of management options. Volume 1. Fisheries Management Paper No. 55 (October 1994). Fisheries Department of Western Australia.

Bray, T, 2004, 'Rock Lobster Decision Rules: Breeding Stock Report 21 September 2004', Department of Fisheries Publication.

Brown, R (2009). *Western Rock Lobster Low Puerulus Settlement Risk Assessment Workshop Held 1 and 2 April 2009* at http://www.fish.wa.gov.au/docs/op/op071/index.php?0706

Caputi N, Melville-Smith R, de Lestang S, How J, Thomson A, Stephenson P, Wright I, Donohue K, 2008. *Stock Assessment for the West Coast Rock Lobster Fishery (Draft)*. Fisheries Research Report. http://www.fish.wa.gov.au/docs/frr/frr180/index.php?0401 (the report is currently being updated).

Caputi, N., Melville-Smith, R., de Lestang, S., Pearce, A. and M. Feng 2010. The effect of climate change on the western rock lobster (*Panulirus cygnus*) fishery of Western Australia. *Can. J. Fish. Aquat. Sci*. 67(1): 85–96

Chubb, C F, 1991, *Measurement of spawning stock levels for the western rock lobster, Panulirus cygnus.* Revista de Investigaciones Marinas 12: 223-233.

Department of Agriculture, Fisheries & Forestry, 2007, *Commonwealth Fisheries Harvest Strategy Policy & Guidelines*, Department of Agriculture, Fisheries and Forestry, http://www.daff.gov.au/fisheries/domestic/harvest_strategy_policy

Department of Fisheries 2002. Policy for the implementation of Ecologically Sustainable Development for Fisheries and Aquaculture within Western Australia. *Fisheries Management Paper*, No. 157; 70pp. Department of Fisheries, Perth , Western Australia.

Department of Fisheries 2006. Assessment of Western Rock Lobster Strategic Management Options (4 volumes). An Overview of Bio-economic, Social and Comparative Analyses, Volume 1. Fisheries Management Paper No. 209, January 2006. http://www.fish.wa.gov.au/docs/mp/mp209/index.php?0706

Department of Fisheries 2008. 'Western Rock Lobster Stock Assessment and Harvest Strategy Workshop: http://www.fish.wa.gov.au/docs/op/op050/index.php?0706.

Department of Fisheries 2010. Consideration for the Implementation of Western Rock Lobster Sectoral Allocations. *Fisheries Management Paper 236*. Department of Fisheries, Perth, Western Australia. http://www.fish.wa.gov.au/docs/mp/mp236/index.php?0706

Department of Fisheries 2010. Western Rock Lobster International Stock Assessment

and Modelling Workshop Report 20 to 24 May 2010. *Fisheries Occasional Publication* No 81. Department of Fisheries, Perth, Western Australia.

Department of Fisheries 2011. Review of the Western Australian Rock Lobster Stock Assessment – Report to the Western Australian Department of Fisheries. *Occasional Publication No.99.* Department of Fisheries, Perth, Western Australia.

Department of Fisheries 2011. Harvest Strategy Policy and Guidelines for Fisheries in Western Australia. *Fisheries Management Paper* (in press)

Donohue, K., Caputi, C., de Lestang, S., Brown, R. and W. Fletcher. 2010. Western Rock Lobster Fishery – Harvest Strategy and Decision Rules Proposals. *Fisheries Management Paper No. 239*. Department of Fisheries, Perth, Western Australia.

Marine Stewardship Council, 2006, *Western Rock Lobster Fishery, MSC Re-Certification November 2006*, Marine Stewardship Council: http://www.msc.org/track-a-fishery/certified/south-atlantic-indian-ocean/western-australia-rock-lobster/reassessment-downloads-1

Rock Lobster Industry Advisory Committee (1993). *Chairman's Report to the Minister for Fisheries on the Management Recommendations for 1993/94 and 1994/95 Western Rock Lobster Seasons*. Fisheries Management Paper No. 55. Fisheries Department of Western Australia.

APPENDICES

Appendix 1 Bio-economic Modelling Project Progress Summary

Background

Historically the main focus of the assessment of the western rock lobster fishery (WRLF) has been on the status of the stock to ensure biological sustainability. More recently the economic performance of the fishery has been examined (Cameron-Bird, Julian Morrison FRDC 2007/052) and a comparison of the economic effects of the different management strategies proposed for 2005/06 was undertaken (Thompson and Caputi 2006). In 2008, a preliminary assessment of the maximum economic yield (MEY) was undertaken by the Department of Fisheries' economist to demonstrate that there were alternative management options to optimize profits (Reid 2009). However there is a need for further assessment of the MEY analysis to take into account variability associated with the parameters assumed and alternative management approaches. This includes examination of inter-annual patterns of the fishery (because economic traits of peak catches are different to other periods) and in catch composition effects on price, as stock rebuilding will lead to a greater range of size grades being landed. This assessment would take into account the outputs from the WAFIC IDU 08/07 project that is updating the financial data collection for the WRLF as well as information from the processing sector on prices of rock lobsters under different management arrangements.

The western rock lobster fishery is facing significant economic pressure from the cost-price squeeze as well as reduced catches due to low puerulus settlement and resultant management changes. It is therefore important to undertake a bio-economic assessment of the management strategies to ensure economic optimization of the fishery. As a result of the low puerulus settlement there have been significant reductions in nominal fishing effort (ca. 50-70% in 2008/09 and 2009/10) that are taking into account the economic aspects of the fishery e.g. higher catch rates, reducing the peak catches in March-April. In 2010/11 individual catch limits were introduced which has changed the pattern of fishing as well as the costs associated with fishing and the prices obtained for lobsters. It is important that an economic assessment is undertaken of these strategies.

Objectives

- To estimate the annual catch and effort to achieve optimum economic yield
- To evaluate intra-annual market-based management strategies.
- To evaluate the economic effect of current and proposed management changes.

Planned Outcomes

- Determination of annual catch and effort to achieve optimum economic yield taking into account net present value.
- Assessment of the impact of effort reduction implemented in the 2008/09 and 2009/10 seasons.
- Evaluation of intra-annual market-based management strategies to assess within year economic performance of different management strategies of fishing the whites (December) and reds (March-April) peak catches.

Progress

An evaluation of the effort reduction in 2008/09 and 2009/10 (and preliminary evaluation for 2010/11) has been undertaken to assess how the changes compare to the MEY assessment undertaken after the 2007/08 season. This assessment takes into account the catch, effort, lobster prices and costs of fishing for these two years.

This project is being undertaken with funding assistance from the Australian Seafood Cooperative Research Centre.