WEST COAST ROCK LOBSTER HARVEST STRATEGY AND CONTROL RULES 2015 – 2019

A DISCUSSION PAPER

FISHERIES MANAGEMENT PAPER NO. 263

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OPPORTUNITY TO COMMENT

The Harvest Strategy and Control Rules (HSCR) discussion paper has been prepared to invite further informed comment on a variety of matters in relation to setting the Total Allowable Catch (TAC) for the western rock lobster resource as well as the Total Allowable Commercial Catch (TACC) for the West Coast Rock Lobster Managed Fishery.

Interested persons are strongly encouraged to provide a written submission on any aspect of the discussion paper. Representations will be accepted until 4.30 pm, Monday 17 March 2014.

Submissions may be forwarded to:

Director General
Department of Fisheries
Locked Bag 39, Cloisters Square
WA 6850

or:

lobster.submissions@fish.wa.gov.au

In order to assist industry members in preparing submissions, consultation meetings will be conducted by the Department of Fisheries (the Department) in early 2014. Further information on dates and venues for these meetings will be provided in January 2014.

At the conclusion of the submission period the Department will provide a copy of the submissions to the Western Rock Lobster Council (WRLC) and Recfishwest. The Department will finalise the HSCR by preparing a short document that briefly outlines the outcomes of the consultation on this discussion paper, as well as a flow chart that will be used to guide future TACC setting processes. The HSCR document will then be provided to the WRLC and Recfishwest along with the submissions on this paper for their consideration and advice, prior to seeking final approval of the HSCR from the Minister.

INTRODUCTION

The purpose of this discussion paper is to update and to complement Fisheries Management Paper 254 'West Coast Rock Lobster Managed Fishery Harvest Strategy and Control Rules Framework Under a Quota Management System - A Discussion Paper' (FMP 254) with a view to finalising the harvest strategy for the West Coast Rock Lobster Managed Fishery (fishery). It has also been the Department's intention to develop a paper that is easily understood and provides further information on matters that arose from the consultation process around FMP 254 and the subsequent quota setting for the 2013 season of the fishery.

This document describes two proposed objectives that would underpin the Harvest Strategy and Control Rules (HSCR) framework and discuss the pros and cons of a number of principles that could be employed for setting Total Allowable Commercial Catches (TACCs) for the fishery. It also provides industry with the opportunity to have input and to comment on the various options that are discussed.

Lastly, the Department's Research Division has modelled a number of harvest strategy scenarios, based on the principles discussed in this paper, that illustrate the effects of various factors on TACCs, breeding stock levels and catch rates for 2014 through to 2018.

Why do we need an HSCR?

The clear and immediate need for developing an HSCR for the fishery is to provide a set of principles to guide the TACC setting process. These principles will make the TACC setting process more transparent and understandable to fishers and other stakeholders.

Having an HSCR in place for the fishery also represents international best practice for fisheries management and is consistent with the Department's initiative to establish a Harvest Strategy Policy for all Western Australian fisheries. The Marine Stewardship Council (MSC) has also made it a condition of the fishery's continued certification that it develops and implements a HSCR

To assist with the implementation of the HSCR, it is proposed that the Department will prepare a short HSCR document based on the outcomes of the consultation process on this discussion paper. Once approved, the final HSCR will become a "TACC setting rulebook" that will guide the TACC setting process in future seasons.

Integrated Fisheries Management Considerations

The western rock lobster 'resource' was the first fishery where the legal lobster catch was allocated to user sectors under the Integrated Fisheries Management (IFM) policy. Through this process the commercial sector was allocated 95% and the recreational sector was allocated 5% of the Allowable Harvest Level (AHL).

Under the principles of IFM[1], the AHL is based on the biologically acceptable catch that can be taken in a fishery. Catch levels may be set lower than the AHL due to a desire to have a larger biomass for the purposes of sustainability (rebuilding stocks), economic maximisation (commercial), or amenity optimisation (recreational). The process for setting the AHL and

[1] see *Consideration for the Implementation of Western Rock Lobster Sectoral Allocations*. Fisheries Management Paper 236 at http://www.fish.wa.gov.au/About-Us/Publications/Pages/Fisheries-Management-Papers.aspx

how the allowable take for each sector is determined under the principles of IFM is illustrated in Figure 1.

While the HSCR relates specifically to the commercial sector allocation (i.e. 95% of AHL), it is important to note that the Department intends to use the HSCR to set the recreational sectors "*Total Allowable Recreational Catch*" (TARC) for that season. In the case of the western rock lobster 'resource', and in accordance with the principles of IFM and past practice, the AHL will be calculated from the upper limit of the recommended TACC range as an outcome of the HSCR.

This means that should the commercial sector decide to take less than the AHL (i.e. less than the TACC at the upper range recommended by the HSCR), the recreational sector allocation would still be based on the AHL, not on the TACC that is implemented for the commercial sector. This is consistent with the way the TARC has been calculated in recent years.

For example in mid-2013 when determining the TACC for the 2014 season, the Department advised industry that the maximum allowable commercial catch (based on FMP254) was 7,370 tonnes. While industry advised the Minister that it wanted a significantly lower TACC, the recreational catch for the purposes of IFM (i.e. the TARC) was based on the following calculation:

TACC Range = 5,783 to 7,370 tonnes

AHL = 7,370 / 0.95 = 7,758 tonnes

TARC = 7,758 x 0.05 = 388 tonnes

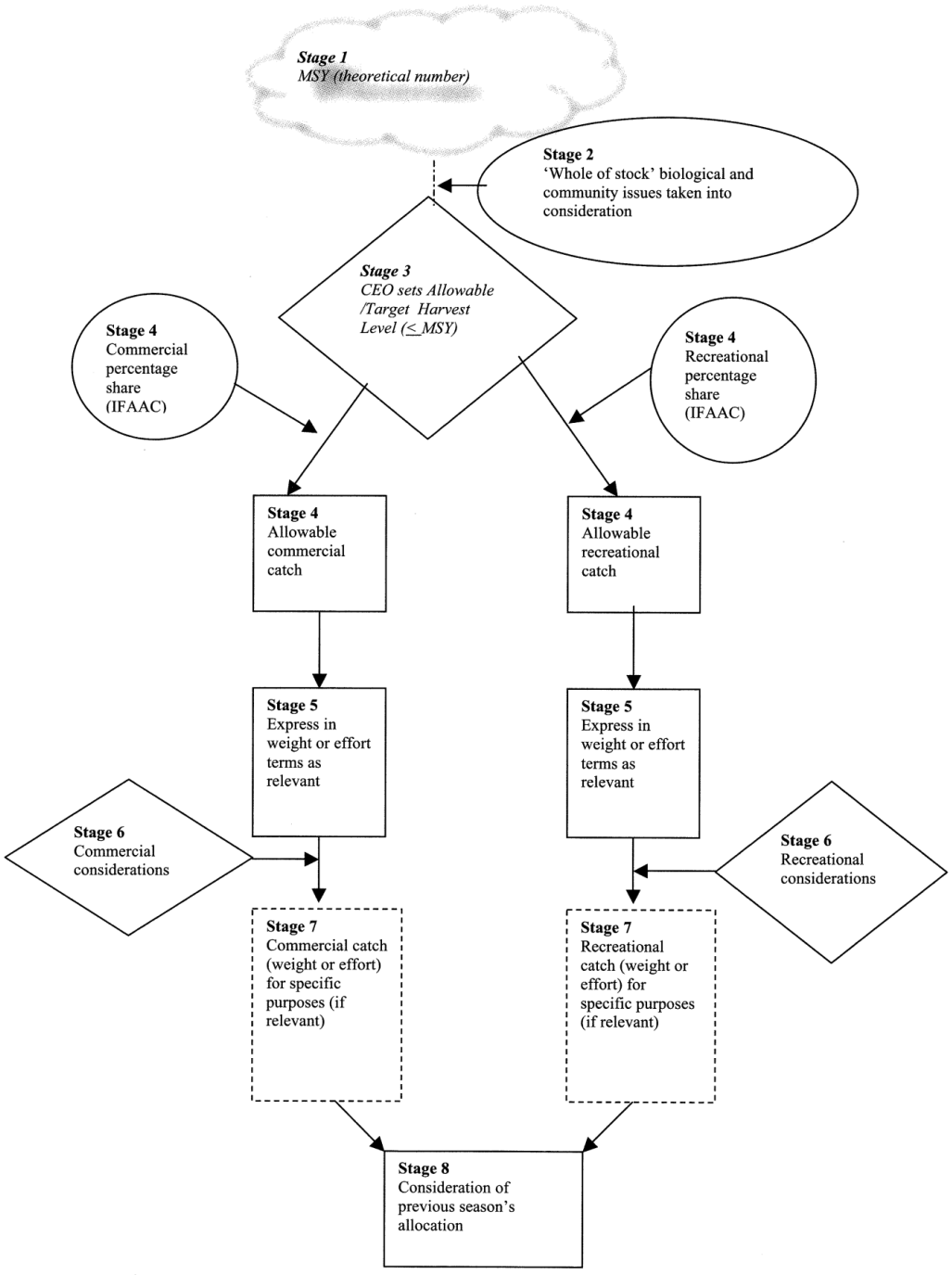


Figure 1. Extract from *Consideration for the Implementation of Western Rock Lobster Sectoral Allocations*. Fisheries Management Paper 236.

SUSTAINABILITY OBJECTIVE

The Sustainability Objective is the primary objective of the HSCR, and must be met irrespective of other principles or objectives in the HSCR. A full description as to how the Sustainability Objective is to be measured, and how the level of uncertainty around the estimates of egg production is to be taken into account, can be found in Appendix 1.

The Sustainability Objective for the fishery is:

"To ensure that the egg production in Breeding Stock Management Areas of the fishery (see Figure 2) *remains above its threshold value for the next five years with a probability greater than 75%"*

There are now four Breeding Stock Management Areas (BSMAs) which will be used to assess the status of the fishery (see **Figure 2**). This is a change from the three BSMAs which were previously assessed in the fishery, which were based on the breeding stocks in Zones A, B and C. The new BSMAs, as summarised below, are more aligned with the biological characteristics and differing habitats:

Northern region (Zones A and B)

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

BSMA 2 – Deepwater areas (>20 fm) of the fishery between 28° and 30°S. This encompasses southern Abrolhos Is. 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 Zone C deepwater.

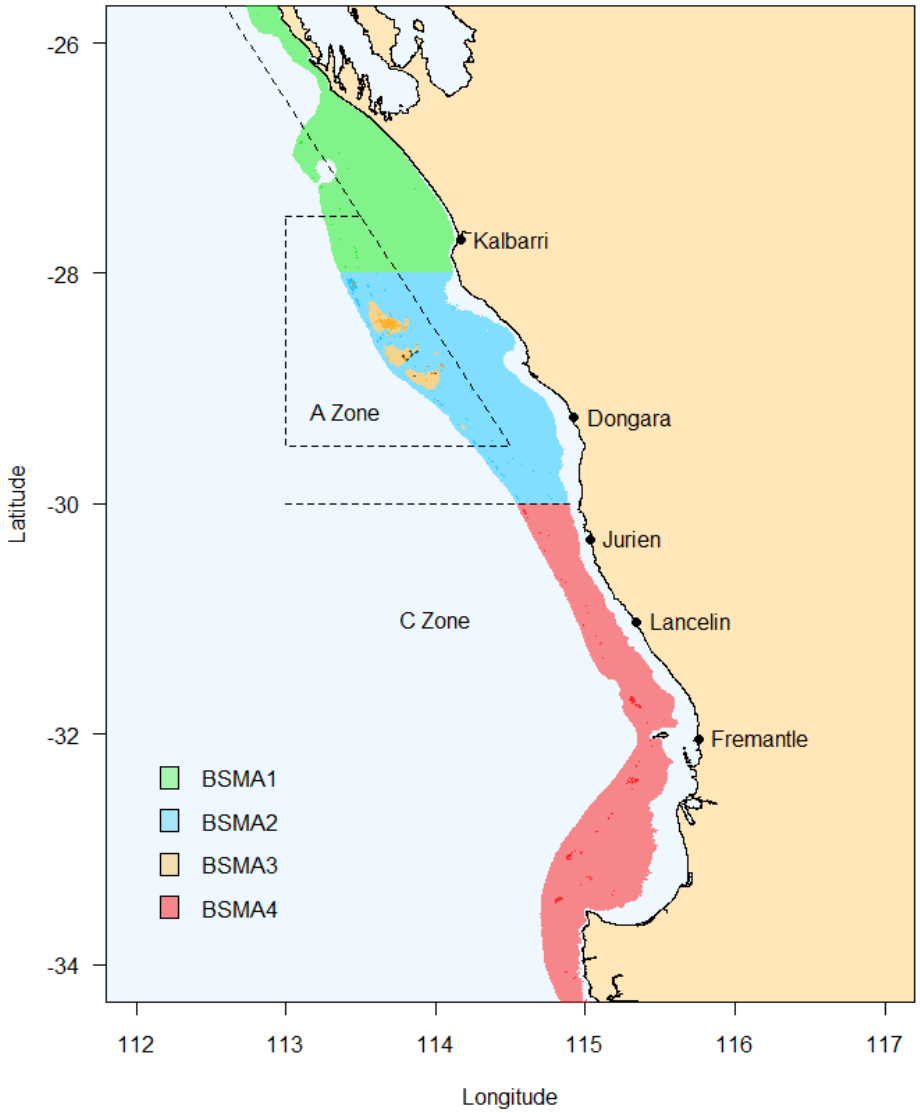


Figure 2. Four Breeding Stock Management Areas (BSMA) covering areas of significant egg production throughout the fishery.

Should modelling indicate that the threshold level in any one of the BSMAs may be breached within the five year projected time period, management action would be required to ensure that there is no breach of the threshold level. This would include a reduction in TACC for the relevant zone(s) or change in biological controls.

In general, the purpose of the Sustainability Objective is to ensure that egg production in all areas of the fishery does not fall below the levels that were observed prior to the increase in fishing effort and efficiency through technology uptake that occurred around the mid-1980s throughout much of the fishery (BSMA 2 – 4). In BSMA 1 the mid-1990s period is used as this area was only lightly exploited prior to this. These levels are known as the "threshold values". To ensure long term sustainability, egg production is projected out five years into the future and takes into account both puerulus settlement and future catch setting arrangements.

It is important to note that preliminary threshold and limit reference points for BSMA 1 have been determined and will be reviewed in the next 3-5 years as additional data is collected in

this region. Despite these reference points being preliminary for BSMA 1, a breach of the reference points would still necessitate management action.

Application of the Sustainability Objective
Appendix 1 outlines in detail how the Sustainability Objective is to be applied in the fishery. In particular **Table 1** (**Appendix 1**) summarises the threshold and limit values for each of the BSMAs.

Given there is some uncertainty regarding the preliminary threshold and limits that have been set for BSMA1, the Department recommends that in the event the Big Bank area of the fishery is reopened, the abundance of lobsters in that area not contribute to the TACC setting for Zone B (as is the current practice). This would ensure that a precautionary approach to managing breeding stocks in the northern part of the fishery is maintained, while allowing some spread of fishing effort into the Big Bank area should it be reopened.

GENERAL PRINCIPLES FOR TACC SETTING

This section describes a number of proposals that, if adopted, would become principles of the final HSCR and would be used to inform the TACC setting process each year. Once adopted, these principles would not be debated annually. They would remain in place for the life of the HSCR (e.g. 5 years).

Fixing TACCs to increase lobster abundance

With the move to quota and the recent period of low recruitment and catches, the main focus of the fishery has been to rebuild breeding stocks and at the same time maximise its profitability by fishing closely to market requirements and reducing operating costs. This has been achieved through conservative TACCs set at or about 5,500 tonnes since the 2009/10 season (or the equivalent pro-rata for the 2011/13 season).

To enable fishers to take maximum advantage of these often short periods of high beach price, it is necessary to build up stock abundance to ensure that catch rates are very high.

One way of doing this is to fix TACCs at a conservative level for a period of time (e.g. three years). This is the "Harvest Strategy" that has been successfully employed by the New Zealand Southern Rock Lobster CRA8 Fishery, which is showcased as a model quota-based southern rock lobster fishery. In the case of CRA8, the management arrangements were designed to build catch rates to a target level by fixing TACCs at a conservative level. Once that level was achieved, the CRA8 decision rules afford a maximum 5% increase in TACC, provided the target catch rate was not compromised.[2]

A conservative fixed TACC over a period of time would provide a level of certainty and financial stability for fishers as well as financiers and investors and assist the industry with it future business planning

Fixing the TACC for a number of years (e.g. three) would also require fixing the catch proportions between Zones A and B, as explained below. In addition, due to the variable recruitment patterns across the Fishery, it is likely that lobster abundance would build up at different rates in some zones compared to others. For example, we know abundance in Zone A has already increased more rapidly than Zone B.

If a fixed TACC was adopted, it would be possible, if industry considered there could be benefits, to factor in a small incremental increase in catch each year to "test" the market's ability to absorb additional product, while still maintaining the highest beach price possible.

Fixed proportions between Zone A and Zone B

There is considerable stock interaction between Zones A and B and it is likely that fishing to a lower target of LPH will result in a significant increase in the amount of lobsters migrating between these two Zones. This migration is from Zone B northward into Zone A and the currently closed Big Bank area and out of Zone A into Zone B, mainly to Big Bank and the deeper water banks to the north of Geraldton and offshore from Kalbarri. There is also significant interaction between the fishers in this region, with many fishers holding quota in both Zones A and B of the fishery.

[2] http://nzsportfishing.org.nz/userfiles/file/CRA-IPP-Dec12.pdf

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 of lobster in the zones, which would then affect future levels of TACC that could be set. This would be particularly evident if the TACC for the Fishery was fixed at a conservative level to increase lobster abundance.

As a consequence, it is proposed that, for the purposes of TACC setting, the proportional allocation of catch between Zones A and B continue to be fixed at the ratio of 0.36 to Zone A and 0.64 to Zone B. This is consistent with the historic 10-year average of 1998/99 to 2007/08 as illustrated in **Figure 3**. This approach is consistent with that adopted in the previous three seasons of quota setting up to and including the 2014 season.

Fixing the proportions between Zones A and B would significantly simplify the process for determining the TACC for these zones and allows them to share the benefits of any improvement in the abundance of stock. Similarly, the fixed proportions would require each zone to share the responsibility for rebuilding northern breeding stocks in BSMA 1, 2 and 3 (**Figure 1**). As a consequence, the Department supports maintaining fixed proportions between Zones A and B at this time, rather than setting their TACCs independently.

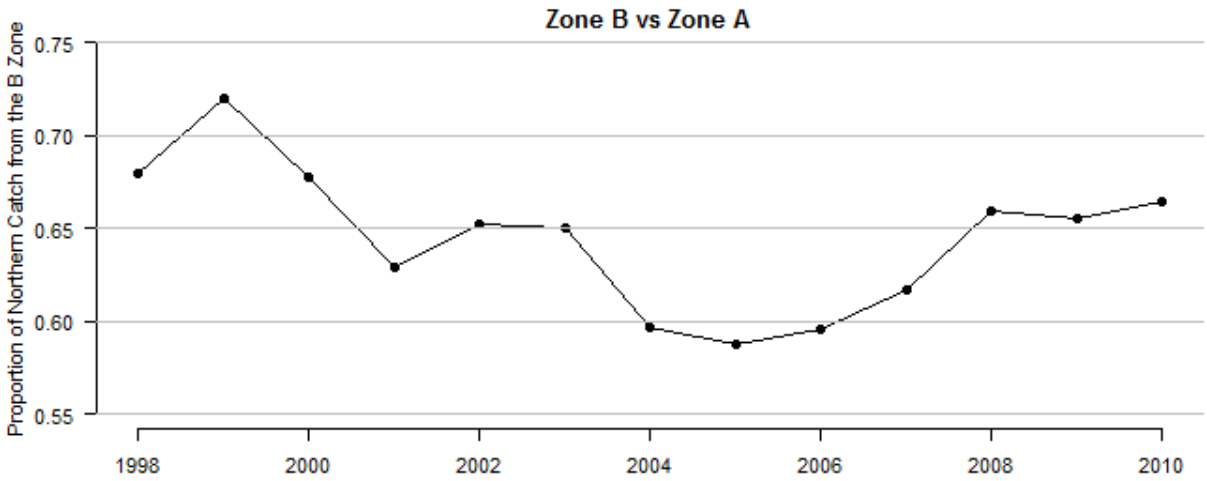


Figure 3. Proportion of the northern catch (combined Zones A and B) landed by Zone B.

Fixed proportions between the northern (Zones A and B) and southern (Zone C) regions

The long-term historical average proportions of catch landed between the northern (Zones A and B) and southern (Zone C) regions is about 50/50; however in any given year it can vary from up to 60/40 in either direction (see **Figure 4**). This is primarily due to differences in recruitment patterns between the north and south of the Fishery, but is also influenced by TACC setting processes and the level of "carry-over" or unfished stock remaining at the end of a given season.

Under the principles outlined in FMP 254 the proportions between the northern region and the southern region were not fixed when setting the TACCs for the 2013 and 2014 seasons, nor were they fixed in the three preceding years where the TACCs were fixed by the Government at (or about) 5,500 tonnes. The independent allocation between the northern and southern regions was permitted simply because of the differing recruitment patterns and level carry-over stock in each region. In addition, the level of stock movement between these the northern and southern regions are relatively limited in comparison to the movement of lobsters between Zones A and B.

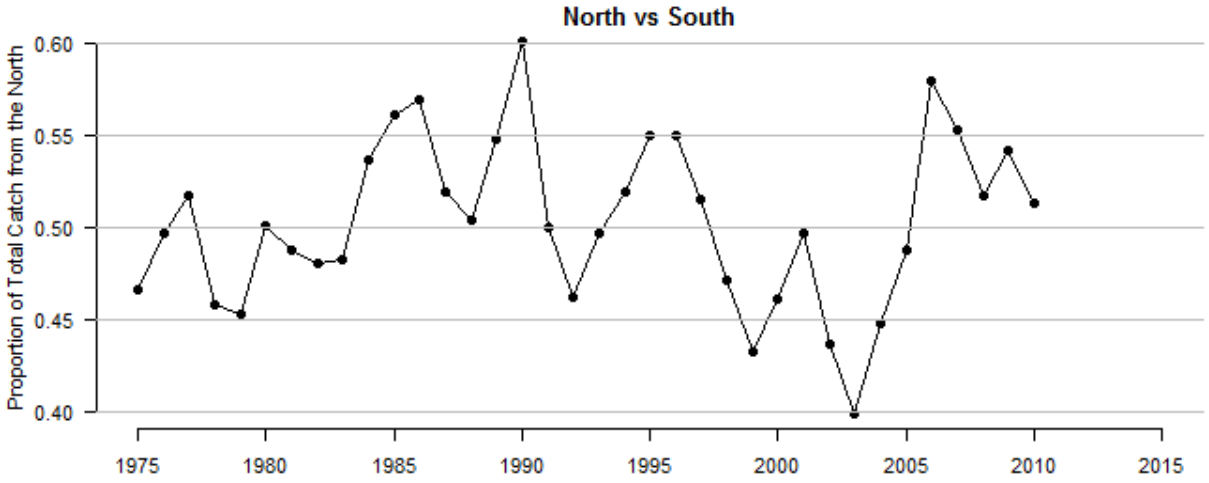


Figure 4. Proportion of the total catch landed by Zones A and B (north) since 1975.

The relatively limited movement between southern and northern zones is supported by tag-recapture information which is incorporated into the Rock Lobster Stock Assessment Model and used to estimate the movement of the stock between areas. Model estimates based on historical tagging data indicate that in Zone C, 30 – 50% of migrating whites move from shallow waters (< 40 m depth) directly offshore into deeper waters (> 40 m depth) over the course of a migration season. Approximately 1% of the migrating whites in deeper waters (> 40 m depth) off Lancelin and Fremantle move north into the 30 – 31°S latitudinal band (i.e. offshore from Jurien). Of the migrating whites initially located in the Jurien latitudinal band (30 – 31°S), only about 2% move further north over latitude 30°S latitude into Zone B.

In contrast the Stock Assessment Model estimates that 10% of the migrating white lobsters in deep-water Dongara move into the Abrolhos Islands and 9% of those in deep water Abrolhos move into northern and north eastern Zone B, including Big Bank. A tagging research program has been proposed to gain more information about biological parameters and to assess any changes in migration rates that may occur with the current low exploitation rates than as occurred during the historical tagging programs. If this tagging project is funded and

further increases the Department's understanding of the movement of lobsters within the fishery, then this information would be incorporated into the Stock Assessment Model and may influence future TACC setting processes.

Despite this limited interaction between southern and northern zones compared to those between zones A and B, it would be possible to fix the proportion of the TACC taken by the northern and southern regions as a principle of the HSCR. Provided the Sustainability Objective is met, the fixed TACC proportion of 50/50 could be achieved by either:

1. determining an equal TACC within the range provided from the outcome of the Harvest Objective (discussed further in this paper); or
2. reducing the LPH of one zone (or zones) to the below the range determined by the Harvest Objective to the extent that the TACCs are equal.

While either scenario would provide TACC equality between the northern and southern regions in relation to zone TACCs, the effect is likely to result in a further separation in terms of catch rates and breeding stock indices between the zones. For example, increasing the LPH in one zone to match the TACC of another could result in a decrease in the overall abundance of lobsters in that zone, reduced catch rates and breeding stock. The reduced abundance would impact on the relative profitability of fishers in that zone. In contrast, reducing the LPH in one zone to match the TACC of another could result in an increased abundance of lobsters, catch rates and breeding stock in relation to the other zone to the extent that the forgone catch may artificially restrict the overall value of the fishery and the return to the community from the resource would not be maximised.

The MEY assessment undertaken for the next five years and the TACC range provided for 2014 for the northern and southern regions shows a considerable level of overlap in the ranges that enables a 50/50 allocation.

Allocation of quota to the Western Rock Lobster Council

The western rock lobster industry has many issues to address that require funding, but it is not always available from third parties such as Government or the Fisheries Research and Development Corporation (FRDC).

Some projects need to be funded on a one-off basis; others as continuing programs. Some projects identified by the WRLC include:

- continuation of the tag program to collect more data on movement of lobster;
- additional breeding stock analysis; extra puerulus monitoring;
- gear modifications for whale entanglement minimisation;
- investigating marketing issues;
- industry representative staff and director training (e.g. corporate governance);
- legal advice/representation;
- MSC certification cost.

One method of raising capital to finance these projects is by way of a compulsory unit levy. This has been done in the past, however, it is not popular and requires Ministerial approval. As part of this process, the Minister must consider the opinion of the Regulatory Gatekeeping Unit (Western Australian Department of Finance), which aims to reduce the regulatory burden on business. The Regulatory Gatekeeping Unit has previously questioned why Government should impose a compulsory levy on industry to fund industry-led projects.

An alternate method of raising funds for important industry initiatives could be through an allocation of a small percentage of lobster quota (by allocating additional units of entitlement) to the WRLC. The WRLC has suggested that it be allocated 0.5% of the quota in each zone above the usual allocation. This would provide the WRLC with an independent reliable source of revenue via leasing the quota to fishers. The WRLC has proposed that monies generated from leasing quota would go into a trust fund administered by the Council's Board of Directors.

To facilitate the WRLC's proposal, it would be necessary to allocate units to the WRLC under the West Coast Rock Lobster Managed Fishery Management Plan 2012 (management plan). As the commercial fishery's share of the western rock lobster resource is fully allocated, an increase in the number of units in each zone would result in a very small reduction in kg/unit compared to what would have been the case if units had not been allocated to the WRLC.

The WRLC has indicated that it would be willing to investigate mechanisms to reduce the small financial impact on fishers (e.g. over the course of time the WRLC could utilise a portion of the revenue raised each year to actually buy units. The units allocated to the WRLC could then be surrendered meaning that over time, the units held by the WRLC would no longer have any impact on unit values).

HARVEST OBJECTIVE

When the fishery was managed under input (effort) controls, the commercial catch was generally based on a principle of Maximum Sustainable Yield (MSY). Fishing effort restrictions ensured that the breeding stock threshold in each zone of the fishery was not breached. This was consistent with the Control rules for the fishery (Bray 2004) and led to the development of a Sustainability Objective for the fishery.

In response to the very low puerulus settlement in 2008/09, the fishery began to move away from MSY, with the goal of providing a carry-over of stock into the subsequent years of predicted poor recruitment as well as protection of breeding stocks. This was achieved by reducing fishing effort to target a TACC for the fishery of 5,500 tonnes for the 2009/10 and 2010/11 seasons as well as the equivalent pro-rata for the 2011/13 season (14 months), of 6,938 tonnes. This was approximately half of the fishery's long-term average catch.

Restricting the catch to relatively low levels in response to low puerulus settlement resulted in industry taking a greater interest in how to make the most of the available catch, particularly in terms of optimising profitability. This indicates that there would be benefit in establishing a Harvest Objective with a catch that is below the limit provided for by the Sustainability Objective. The main reason to have a Harvest Objective is to provide a catch target, or a target range within which the catch will be maintained, to enable the fishery to be managed in a way that achieves benefits of importance to stakeholders. A catch target or catch limit that is set by the Harvest Objective should result in TACCs that produce good catch rates and high profitability for the fishery, while at the same time protecting the breeding stocks. The development of a catch target reference point has also become an MSC condition for ongoing certification of the fishery.

In 2012, FMP 254 introduced the concept of using a Harvest Objective to inform the TACC setting process. It also introduced the concept of Legal Proportion Harvested (LPH), which is a measure of the fishery's performance against the Harvest Objective. FMP 254 proposed that the Harvest Objective be based on an optimal LPH range that would result in profitable catch rates for the fishery (i.e. provide high economic returns). The 'optimal LPH' range at that time was based on observed LPHs from the 2009/10 and 2010/11 seasons, which were acknowledged by industry as providing good economic returns. The target range of LPH was also informed by a preliminary Maximum Economic Yield (MEY) analysis conducted by the Department (Reid 2009; Reid et al. 2013).

In considering further research conducted by the Department on MEY, an Industry Reference Group (in collaboration with the Department and the WRLC) has recommended that MEY be incorporated into the Harvest Objective, to provide a target range of LPH for the fishery.

Proposed Harvest Objective:

Once the Sustainability Objective has been satisfied TACCs set for the fishery should use Maximum Economic Yield to determine an optimal range of legal proportion harvested that would optimise the economic value of the fishery by increasing stock abundance and catch rates and thereby providing high economic returns and greater amenity to the fishery and the WA community.

In the event that the egg production is below or predicted to fall below the threshold levels in one or more of the BSMA's, then the LPH for zones A and B (BSMA 1,2, or 3) or for Zone C (BSMA 4) is reduced until the Sustainability Objective is met. In this instance the Harvest Objective would not be used for determining TACCs for the affected Zone(s).

It should be noted that the MEY estimate that would be used under the proposed Harvest Objective would be a guide as to the optimum LPH for the fishery as a whole and may not represent the highest economic yield for individual fishers or processors.

A further explanation of the terms LPH and MEY is provided below.

Legal Proportion Harvested

LPH represents the percentage of the total amount of legal lobsters that are taken by the fishery (this is also referred to as "harvest rate"). Currently in the 2013/14 season "legal lobsters" do not include undersize, oversize, setose, tarspot or berried females. They do include the female lobsters that moult out of setose for a period during the year and undersize lobsters that become legal (by moulting) during the season. Under FMP 254, the maximum LPH for the 2014 season was 0.55 meaning that 55% of the total number of legal lobsters available in that season could be harvested. This is illustrated in **Figure 5** below.

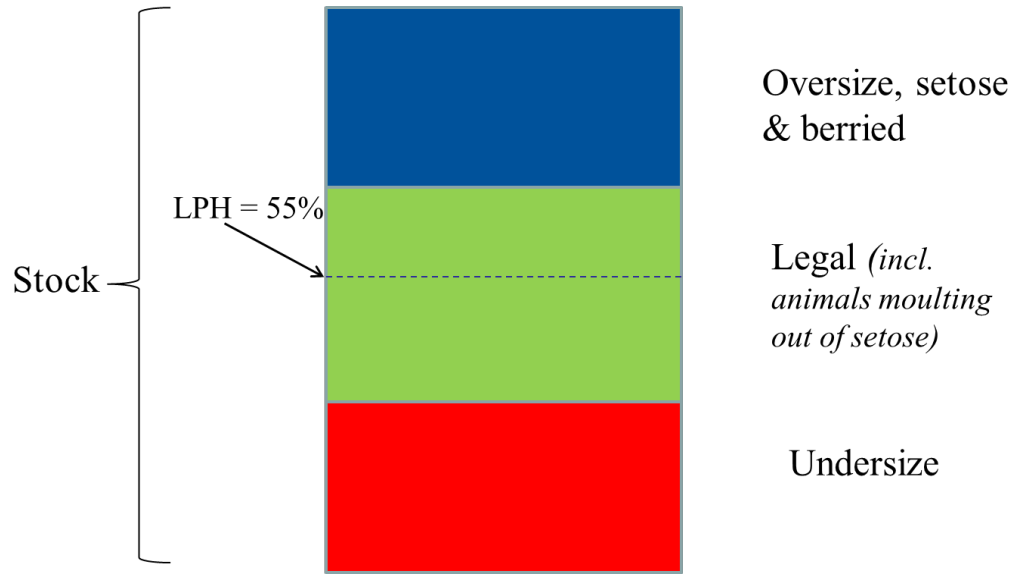


Figure 5. Illustrative example showing LPH on current management arrangements with an LPH of 55% of the legal lobsters.

The legal proportion harvested is determined using estimates from the Rock Lobster Stock Assessment Model (Del Lestang et al. 2012) and is explained in more detail at Appendix 2.

If the LPH is relatively low, more lobsters are left in the water each year and hence their abundance increases together with the abundance of the breeding stock. A high abundance of lobsters results in higher catch rates, which allows industry to catch their quota with less effort. By comparison a high LPH usually results in fewer lobsters being left in the water at the end of the year and hence the abundance declines, including the abundance of the breeding stock. A low abundance of lobsters results in lower catch rates and results in both sectors being able to take their allocation more efficiently.

It should be noted that any given LPH only relates to biological controls that are current in the fishery. For example if the prohibition on oversize and/or setose females was removed, then the total number of "legal lobsters" in the fishery would increase. An LPH of 0.50 with these controls removed would therefore represent a significantly higher TACC and TARC than the equivalent LPH with the oversize/setose rules in place. Therefore the effect of any rule change on the abundance of the breeding stock would also have to be taken into account.

Maximum Economic Yield

There are a number of definitions for Maximum Economic Yield (MEY). The one favoured by the Department is:

> *MEY is the value of the largest positive difference between total revenues and total costs of fishing (including the cost of labour and capital) with all inputs valued at their opportunity costs.*[3]

The Department's MEY analysis simply examines the income of the fishery as a whole (total catch x beach price) and the costs of operating (vessels, fuel, bait and wages) to determine a level of catch that would provide the most profit. This assessment has been undertaken over five years with the profits in future years discounted in calculating the net present value (NPV) of profits. In determining income it is essential to incorporate a realistic supply and demand relationship, which in this case was derived from industry data relating to beach price, catch, exchange rate and management system.

The following assumptions were made in the economic assessment:

- The number of vessels operating was dependent on changes in pot lifts, taking into account the number of vessels and pot lifts during two recent seasons;

[3] Other, more technical definitions include:
"*the catch or effort level for a commercial fishery that maximises average net economic returns over a number of years. Fishing to MEY will usually result in the equilibrium stock (biomass) of fish being greater than that associated with MSY*"; or
When relating total revenues from fishing to total fishing effort in a surplus production model, the value of the largest positive difference between total revenues and total costs of fishing (including the cost of labour and capital) with all inputs valued at their opportunity costs is the MEY".

- Beach price - catch relationship to determine expected change in the annual beach price due to changes in catch after taking into account the price premium estimated to be associated with the move to ITQ and exchange rate;
- Costs were similar to 2007/08 with an estimated reduction for movement to quota due to lower bait and fuel costs as obtained from some preliminary estimates;
- There were three components to costs: (a) fixed annual costs including vessel depreciation ($85,000 per year); (b) operating costs including bait and fuel of $7 per pot lift; and (c) wages based on 30% of the value of catch.
- Discount rate of 5 and 10% per annum for future profits.

It is also important to note that the calculations for MEY by the Department are based on the fishery as whole, i.e. as if the fishery was a single company and unit holders owned shares in the company. MEY does not represent the myriad of different fishing operations and individual financial circumstances in the fishery. Therefore, while the current calculation of MEY provides an indication of the level of catch that is most profitable for the fishery as a whole, it is unlikely to fully represent MEY for an individual fisher or fishing business. Furthermore, the analysis of MEY is at a preliminary stage and should only be used as a guide as the fishing arrangements such as season duration have changed in recent years. Scope exists for a far more detailed analysis of MEY that would encompass longer periods of data, updating economic data and greater input from industry. These opportunities may be pursued by industry and government over coming seasons.

The harvest rates associated with MEY can encompass a wide range of LPH values to provide the highest Net Present Value (NPV), or profit for the whole fishery. The range can vary depending on how close to the estimate of MEY industry may wish to be. For example, 100% MEY would be the exact top of the highest NPV point on the curve, whereas 95% MEY is 2.5% either side of the highest NPV, as shown in **Figure 6**.

Under the Harvest Objective, the range of LPH values at 95% MEY (shaded green) will provide a corresponding range of TACCs for the fishery that would result in good economic returns (**Figure 6**). Marketing issues aside, catching below MEY would result in the fishery as a whole experiencing very good catch rates but reduced income as more catch could be taken to offset fixed costs such as capital investments (e.g. boats, pen fees, insurance and pots etc.). Catching above MEY would result in the fishery experiencing larger overall revenue but poorer catch rates; so that the cost of catching lobsters would begin to significantly erode profits.

The optimal LPH range of 0.28 to 0.47, arising from the MEY analysis (as seen at **Figure 6**) results in a very large variation in TACCs for the fishery i.e. from 4,365 to 7,370 tonnes for 2014. Using the MEY analysis in the Harvest Objective provides industry with a broad range of TACCs from which to choose, while ensuring that the Sustainability Objective is met in each BSMA. The LPHs chosen within this range by industry may vary from year to year, and would be influenced by the principles for TACC setting that are discussed later in this document.

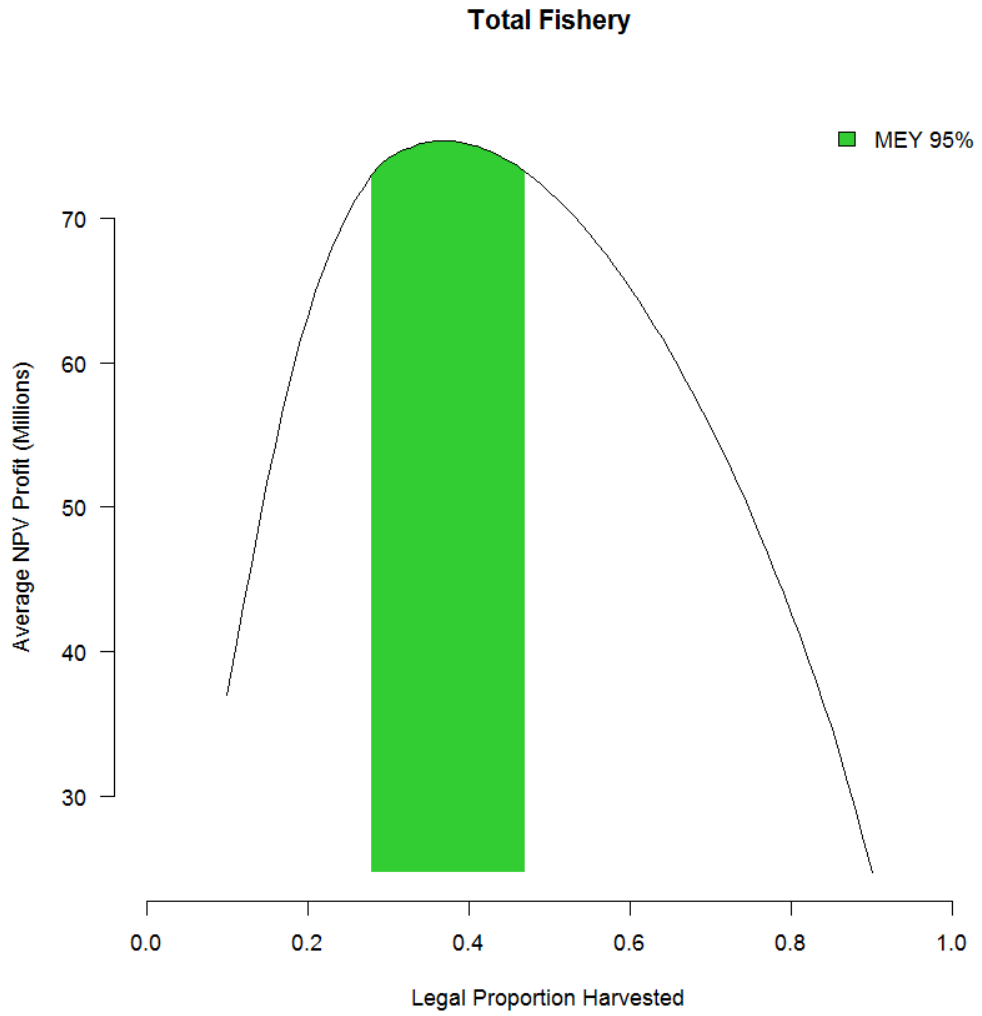


Figure 6. Example of MEY assessment showing the LPH range (green), based on a 12 month fishing season and existing biological controls, which results in 95% of the maximum NPV for the West Coast Rock Lobster Fishery over the next 5 years.

As the MEY analysis makes a number of assumptions concerning future beach prices and operating costs, a sensitivity analysis of these variables was conducted to determine what effect changing these would have on the overall MEY assessment. The results of this analysis showed that, while the overall profitability does move up and down when costs and beach price are varied, the range of LPH under MEY (i.e. about 0.4) does not markedly change. This demonstrates the robustness of the LPH values within the shaded area to changes in inputs within this analysis.

Narrowing the Range of TACCs

While the analysis of the 95% MEY provides a broad scope for the selection of TACCs under the Harvest Objective, some initial comments from the 2013 consultation suggest that there would be merit in narrowing the TACC range in order to provide a better indication on what level of catch should provide the greatest profitability for industry as a whole.

In order to provide a more focused range of TACCs, the MEY analysis has been narrowed to 99%, which provides a range that would is focussed on the centre, or the upper-most region, of the MEY curve (**Figure 7**).

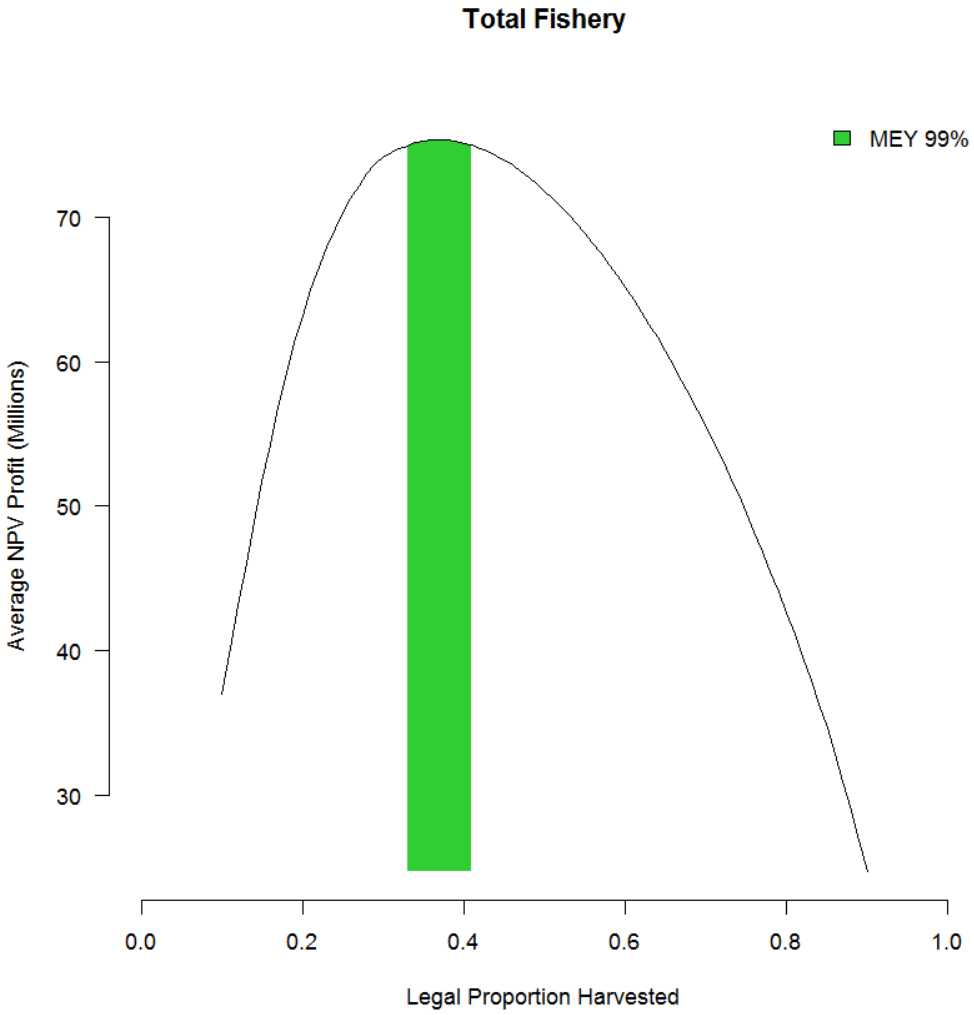


Figure 7. Example of MEY assessment showing the LPH range (green), based on a 12 month season and existing biological controls, which results in 99% of the maximum NPV for the West Coast Rock Lobster Fishery over the next 5 years.

The optimal LPH range, arising from the 99% MEY analysis (**Figure 7**) is 0.33 to 0.41, which results in a much narrower variation in TACCs for the fishery, i.e. from 5,152 to 6,417 tonnes for the 2014 season.

This method provides for a more focused approach to TACC setting under the Harvest Objective and is more in line with the approach taken by industry when providing its recommendations on the TACCs for the 2014 season.

Another way of narrowing the TACC range as discussed during the 2013 Annual Management Meetings, was to combine the MEY analysis with an assessment of the Gross Value of Production (GVP) for the fishery (total catch x estimated beach price). This method is discussed in more detail in Appendix 3.

Further research on MEY

It is recognised that the Department's initial research on MEY is preliminary. Further to this research (e.g. Reid, 2009; Reid et al. 2013), the Department has undertaken a three year research project to develop a bio-economic model for the fishery (Seafood CRC project 2009/714.10). This study uses available economic and catch data supplied by fishers to develop estimates of MEY. The preliminary results from this work have been incorporated into the current MEY analysis presented above.

In the longer-term, it will need to be determined whether more research on MEY is carried out and where responsibility for this lies (industry or Government).

RESEARCH MODELLING OF BIOLOGICAL CONTOLS

Assessment under current controls

An assessment using fixed levels of LPH from 0.1 to 0.9 was undertaken for the five seasons, 2014 to 2019. The stock assessment model produced outputs of catch, effort (pot lifts), and egg production by northern (Zones A and B combined) and southern (Zone C) regions for the five seasons for the different levels of LPH. This assessment assumed that current regulations on female maximum size, setose and minimum size were maintained (**Appendix 4**).

The assessments showed that for northern and southern regions low levels of LPH (0.1 to 0.3) resulted in relatively high catch rates with low catches increasing over the five years. At high levels of LPH (0.6 to 0.9) catches were far higher in the first year but then decreased with catch rates being relatively low and declining over the five years. At the intermediate levels of LPH (0.3 to 0.5) the catches and catch rates were relatively stable over the five years (**Appendix 4**).

Current estimated levels of egg production are at very high levels throughout the fishery (**Appendix 4**) and this is supported by fishery-independent surveys that have been undertaken since the early 1990s. Future projections of egg production indicate that they are likely to increase at LPH levels below 0.4 and decrease at levels above 0.6. Relatively stable levels of egg production are maintained at intermediate levels of LPH between 0.4 and 0.6. Given the current high levels of egg production, LPH levels between 0.4 and 0.6 are not likely to breach the threshold levels of any of the BSMAs over the next five years.

Varying the biological controls

At the request of industry, the Department has repeated the above analysis using a number of different scenarios, involving the removal of some of the key biological controls[4] (**Figure 8**). The MEY analysis included as a part of this assessment has been set at 99% of NPV, as discussed previously. The scenarios that were assessed against the current biological rules (Appendix 4) were the removal of the following prohibitions:

1.	maximum female size	Appendix 5
2.	setose lobsters	Appendix 6
3.	maximum female size and setose	Appendix 7
4.	maximum female size and setose and decreasing the minimum size from 77mm to 76mm	Appendix 8

The relaxation of any of these rules would result in higher catch rates (**Figure 8**) and thereby improve the profitability of the fishery. It would also provide the industry with a greater choice of size grade classes to target to maximise the value of the catch.

[4] These rules were implemented when the fishery was operating under input controls and the exploitation rate was greater than 80%; much higher than it is today.

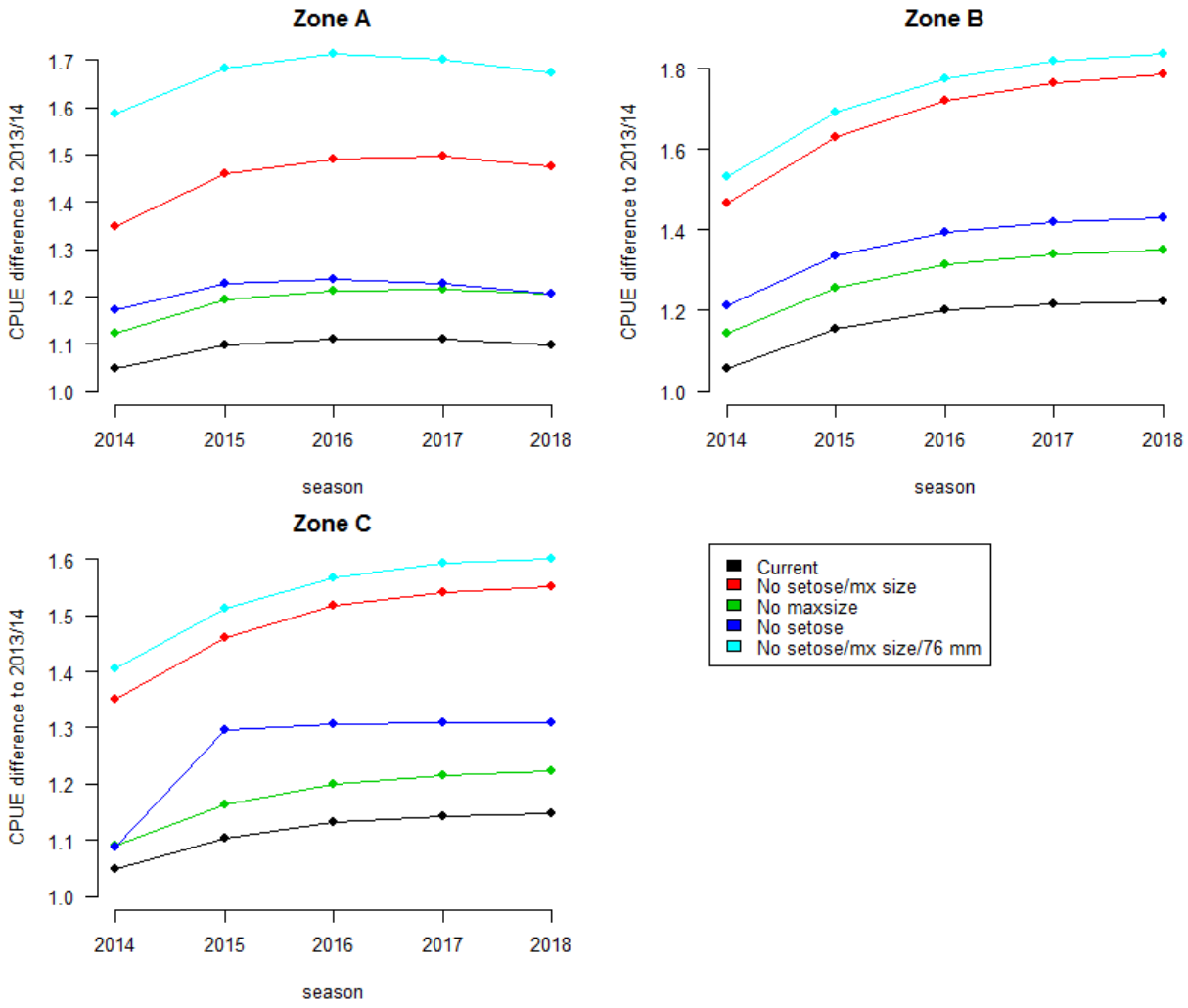


Figure 8. Comparison of the expected relative change in catch rates (kg/pot lift) from those experienced during the 2013 season as a result of changing biological controls.

POT USAGE

Clause 68 of the West Coast Rock Lobster Management Plan provides for the following arrangements regarding the number of pots that may be used in each zone of the Fishery:

> *"(1) The maximum number of pots that may be operated under the authority of a licence is -*
>
> *(a) in Zone A, the sum of -*
>
> *(i) the current entitlement of Zone A units multiplied by 0.05;*
> *(ii) the current entitlement of Zone B units multiplied by 0; and*
> *(iii) the current entitlement of Zone C units multiplied by 0;*
>
> *(b) in Zone B, the sum of -*
>
> *(i) the current entitlement of Zone A units multiplied by 0.028;*
> *(ii) the current entitlement of Zone B units multiplied by 0.05; and*
> *(iii) the current entitlement of Zone C units multiplied by 0;*
>
> *(c) in Zone C, the sum of -*
>
> *(i) the current entitlement of Zone A units multiplied by 0;*
> *(ii) the current entitlement of Zone B units multiplied by 0; and*
> *(iii) the current entitlement of Zone C units multiplied by 0.05."*

These arrangements maintain the same level of permitted pot usage as under the previous management plan. This is despite the changes to the number of units held by fishers and the grant of discrete Zone B units to Zone A fishers.

With fishers rapidly adapting to the management arrangements under quota, there has been some interest in re-examining the pot usage for the fishery.

Although pot usage does not impact on how the TACC is set, it can impact on fishing efficiency. It is understood that this is an important issue for industry and therefore submissions on pot usage are invited. Some options include:

- unlimited pots, reverting to current usage during the whale migration period;
- all fishers permitted a minimum pots then 0.05 pots per unit extra, once a certain number of units are held;
- limit of 0.05 pots for **all units** on the licence (i.e. combined A, B and C); or
- limit of 0.05 (or another ratio) pots for the **units in the zone** that is being fished.

TACC SETTING PROCESS

It is intended that in 2014, the TACC setting process for 2015 and the respective timelines will be linked to the adoption of the HSCR. It is expected that this process will be as follows:

Month	Action
December/March	Consultation.
March	Department of Fisheries to draft a HSCR "rulebook" outlining objectives and principles based on outcomes of consultation.
April	WRLC meeting to provide advice on final HSCR.
April	Ministerial approval of final HSCR.
June	Commence consultation on 2015 TACCs using approved HSCR (linked with the Annual Management Meetings).
August	WRLC final recommendations to the Minister on 2015 TACCs.

These timeframes should allow adequate time for the relevant legislation to be drafted in order for industry and the Department to be aware of approved TACCs well ahead of the coming licensing period.

The process would be similar in future years, but in keeping with the development of the HSCR, there would be no need to consult on the objectives and principles behind TACC setting, meaning that the process would commence in May with presentation of the latest research data and discussions on the TACC based on the approved HSCR.

An alternative process to set the TACCs could be the use of an independent committee to develop advice for the Minister's consideration rather than advice coming via the WRLC. This type of arrangement is in place in New South Wales where the TACC setting committee seeks submissions from stakeholders, examines the Government's scientific advice and recommendations and then provides their "independent" advice to the Minister[5]. Adoption of this model in WA would require Ministerial approval noting both the current provisions of the Management Plan with regard to consultation prior to amendment and as he/she is the decision maker in terms of TACCs.

[5] http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0019/400717/Rock-Lobster-Total-Allowable-Catch-Committee-Report-and-Determination-for-2011-12.pdf

REVIEW PERIOD/LIFE OF DOCUMENT

The benefit of having an HSCR in place for the fishery is that the general principles and processes around TACC setting do not need to be debated each year, thereby providing increased stability and certainty for industry. However, it is recognised that the fishery does change over time and that a review period should be built into the HSCR to ensure that it remains relevant.

It is recommended that once the HSCR has been approved by the Minister, it will remain in place for a period of five years, after which time it will be fully reviewed. However, should a situation arise that may require changes to the HSCR, then a review could be initiated sooner.

Determining the effectiveness of the Harvest Objective
In order to be consistent with the Harvest Strategy Policy, it is necessary to provide two checks in HSCR. If either of these checks fail without a satisfactory explanation, then a review of the Stock Assessment Model and/or the HSCR may be necessary. The checks are:

1. **That the fishery achieves at least a certain proportion of its quota each year**. If the quota is not achieved, then an explanation would be required to ensure that the reason is not due to a lack of lobster abundance. It will be necessary to determine what the acceptable level of uncaught quota should be.
2. **That the quota is achieved within a specified effort level**. The quota should be achieved at or above a specified catch rate. If this is not achieved then an evaluation may be required as this result could reflect a lower abundance of legal size than predicted by the Stock Assessment Model. The catch rate threshold will be determined in a few years when more information on effort distribution for a 12 month season is available.

REFERENCES

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

de Lestang, S., Caputi, N., How, J., Melville-Smith, R., Thomson, A. and Stephenson, P. 2012. Stock Assessment for the West Coast Rock Lobster Fishery. Fisheries Research Report No. 217. Department of Fisheries Publication

Reid, C, 2009, 'An analysis of Maximum Economic Yield in the Western Rock Lobster Fishery'. Department of Fisheries Publication

Reid, C., Caputi, N., de Lestang, S., Stephenson, P. 2013. Assessing the effects of moving to maximum economic yield effort level in the western rock lobster fishery of Western Australia. *Marine Policy* (39) 303-313

APPENDICES

APPENDIX 1.

MEASURING THE SUSTAINABILITY OBJECTIVE

Sustainability Reference Values – Egg Production Thresholds and Limits

Threshold and limit reference values[6] for egg production have been established for the four Breeding Stock Management Areas (BSMAs) such that the Sustainability Objective of the fishery can be applied 1 to 4.

Thresholds
For BSMAs 2, 3 and 4 (**Figure 1**), the threshold value for egg production be based on the mid-1980s level (Appendix 1, **Table 1**). This is considered as 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 the Abrolhos shallow water 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.

Limits
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.

Proposed threshold and limit reference values have also been determined for BSMA 1 (**Figure 1**). 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 monitor the recovery of the population/breeding stock 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 four years and has now been integrated into the stock assessment model. Once a better understanding of the population recovery in BSMA1 has been obtained and there is agreement between the model and observed data for this area, 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. An indicative limit value has also been set, which is 20% below the threshold value. The mid-1990s period has been chosen for BSMA 1 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. since 2007/08).

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

Appendix 1, Table 1. Description and 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	
BSMA 1	**Deep water areas north of 28°S**	**Preliminary estimate only mid-1990s, but will be revised as more years of survey data become available**	**1994-1996**
BSMA 2	**Deep water areas between 28° and 30°S**	**Mid-1980s**	**1984–1986**
BSMA 3	**Shallow Abrolhos Islands areas**	**Mid-1980s**	**1984–1986**
BSMA 4	**Deep water areas south of 30°S**	**Mid-1980s**	**1984–1986**

Taking Account of Uncertainty

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

Stock assessment reviewers[7] have recommended that the Control rules associated with sustainability should be more precautionary by accounting for uncertainty and that there should be a greater than 50% probability that the egg production indicator value is above the threshold value. This has been incorporated into the Control rules by requiring a 75% probability level that the egg production indicator values are above their threshold values five years into the future (Appendix 1, **Table 1**). This is equivalent to stating that there is a 75% probability that the actual egg production is, and will continue to be, above its threshold value five years into the future.

Stock Status and Fishery Performance

The stock status and fishery performance is evaluated by estimating where an indicator value (e.g. level of egg production) is located in relation to one or more of the reference values.

[7] See: the report of *Western Rock Lobster Stock Assessment and Harvest Strategy Workshop 16 – 20 July 2007* (Department of Fisheries 2008); the *Western Rock Lobster International Stock Assessment and Modelling Workshop Report* (Department of Fisheries 2010) and the *Review of the Western Australian Rock Lobster Stock Assessment – Report to the Western Australian Department of Fisheries* (Department of Fisheries 2008) at: http://www.fish.wa.gov.au/About-Us/Publications/Pages/Fisheries-Occasional-Publications.aspx

Based on the thresholds and limits, the level of egg production for the fishery would be classified as:

Acceptable – Mean value is above the threshold level, with greater than 75% probability for each of the five years. Given this precautionary approach, the stock and the fishery are therefore in an acceptable state by meeting the Sustainability Objective (**Figure A**).

Unacceptable – Mean value is below the threshold or is above the threshold, but with less than 75% probability in 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 A**).

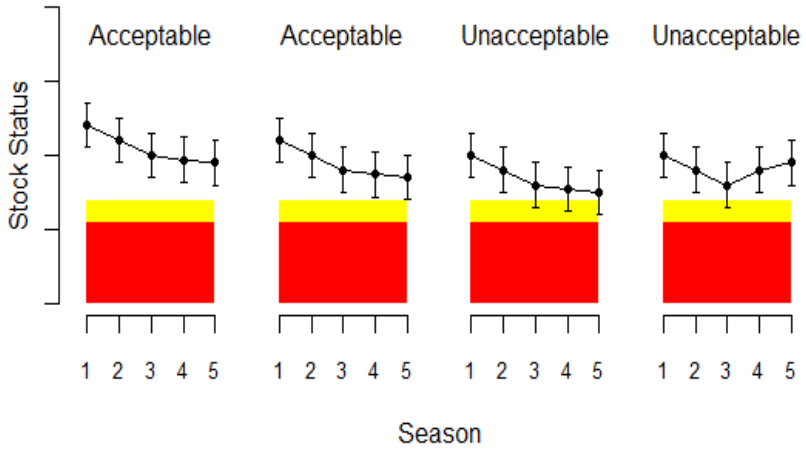


Figure A. Example of how a stock status indicator (showing a 75% probability level) is performing relative to a threshold/limit reference values could generate acceptable or unacceptable levels of stock status. The upper lines of the yellow and red areas are the threshold and limit values, respectively.

APPENDIX 2

EXPLANATION OF LEGAL PROPORTION HARVESTED

The Legal Portion Harvested (LPH) is represented by the equation:

$$LPH_s = \frac{C_s}{B_s},$$

where C_s is the commercial catch in season s and B_s is the average legal biomass if the fishery were to remain unfished for season *s*. Since the average unfished legal biomass over a season is derived only from the time-steps when fishing occurs, the magnitude of B_s can change if the number of time-steps that encompass a season changes (as was the case when the fishing season was increased from 7 ½, to 9 ½ and then to 12 months). As a season becomes longer more lobsters can moult into legal size and the average legal biomass over that season can therefore increase. Thus if the catch from a season remains the same while the average legal biomass is determined over two different periods the LPH value will change. This has been the case between determining LPH levels for setting the 2013 and 2014 seasons. The average unfished legal biomass over a season is currently based on every time-step in the Model since the season has now been extended to cover 12 months of the year.

APPENDIX 3

GVP AS A POSSIBLE TACC SETTING INPUT

Definition: Gross Value of Production (GVP) in the context of the HSCR for the western rock lobster fishery is measured as the total dollar return to all fishers in the fishery.

The wide range of TACCs from the MEY analysis (**Figure 5** in the main text) corresponds with a wide range of GVP values of between AUD$180 to $240 million that has important socio-economic implications for the fishery. Fishing at the lower end of the MEY (and hence GVP) range would result in a loss of AU$60 million in GVP. A smaller number of boats would be likely to operate to achieve the catch and hence there would be a lower level of employment in the fishery, however, there would be a relatively high profit per boat. In contrast at the upper end of the MEY (GVP) range, the TACCs and GVPs would be significantly higher, with a relatively larger number of boats likely to operate and hence a higher level of employment. However, the profitability per boat may be lower.

GVP could be used to narrow the target LPH range to select a level of catch that would provide a higher GVP (total dollar return) to achieve a socio-economic goal, if that was thought to be desirable. For example, selecting the LPH range that provides for at least 80% of the maximum GVP coincides with the top half of the MEY range, with LPH values of approximately 0.37 to 0.47 (**Figure B** below). This would result in catches in the range of 5,783 to 7,370 tonnes for 2014/15, with a corresponding GVPs of AUD$200 to $230 million. The corresponding TACC ranges for the zones would be:

A. 1,089 - 1,390 tonnes
B. 1,944 - 2,481 tonnes
C. 2,750 - 3,499 tonnes

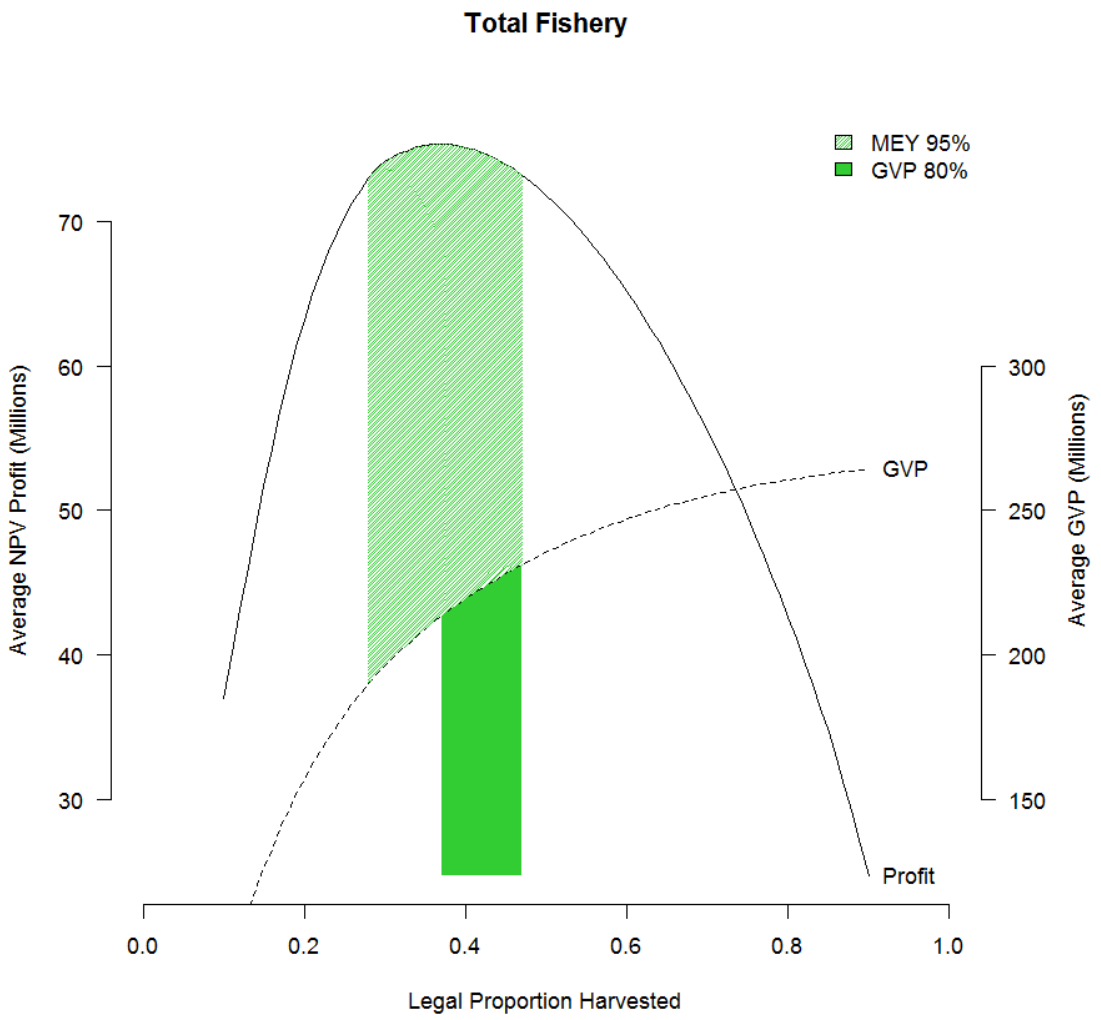


Figure B. Example of MEY based on 95% of the maximum NPV, and GVP based on a minimum of 80% of maximum GVP in the West Coast Rock Lobster Fishery

APPENDIX 4

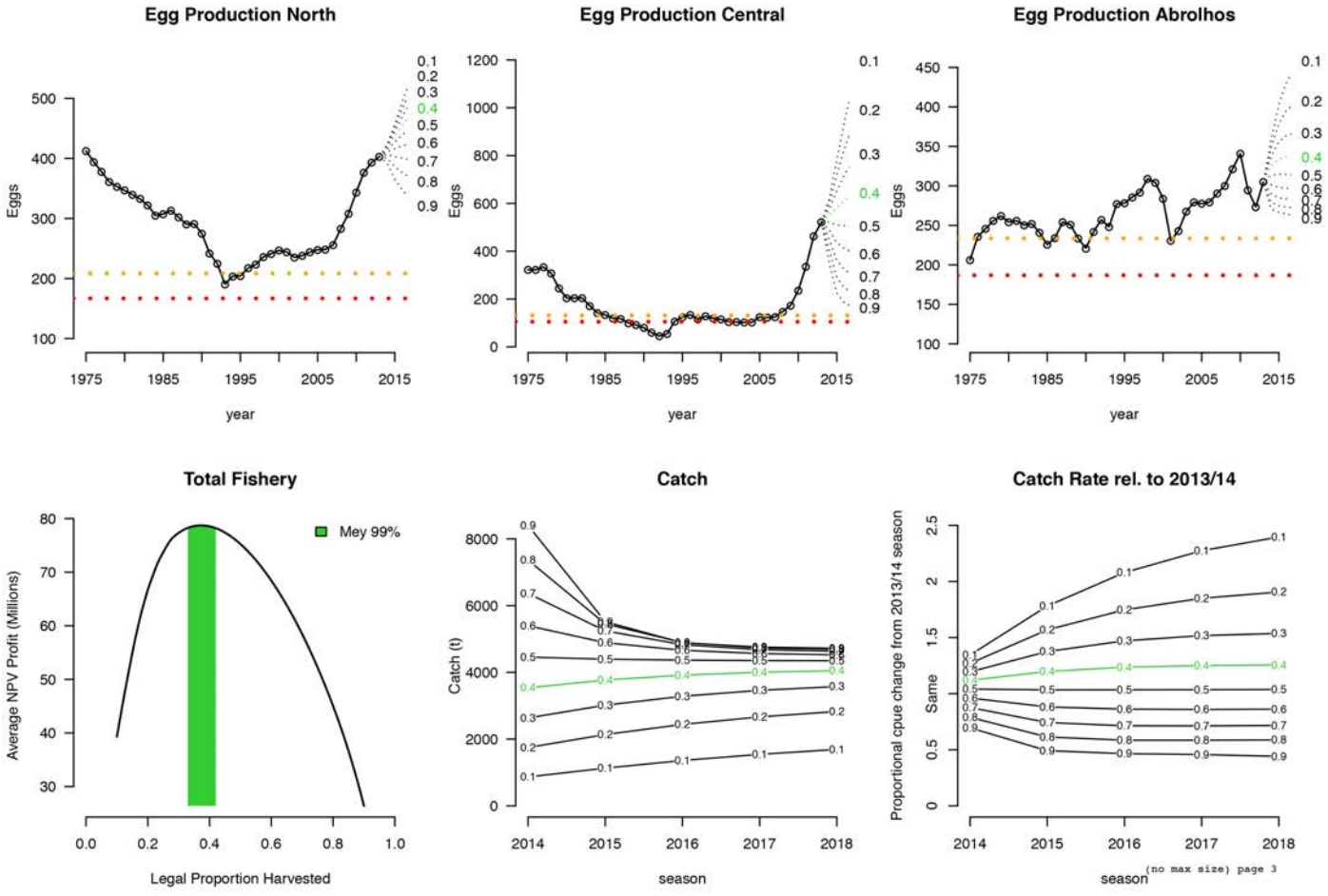
ASSESEMENT UNDER CURRENT BIOLOGICAL CONTROLS

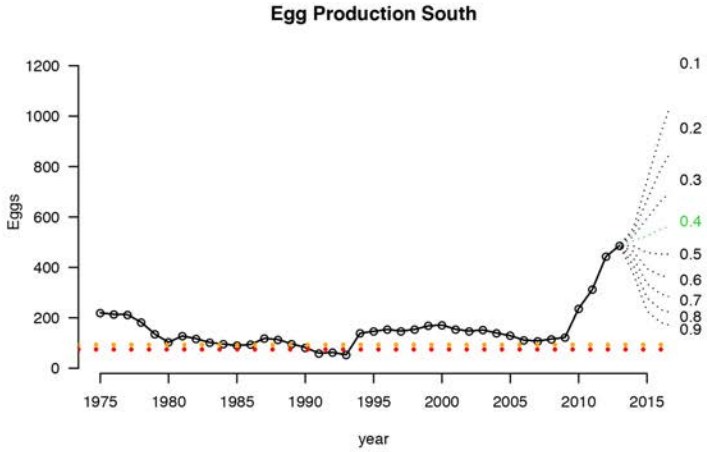
At the request of industry, the Department has repeated the above analysis using a number of different scenarios, involving the removal of some of the key biological controls. The MEY analysis included as a part of this assessment has been set at 99% of NPV, as discussed previously. The scenarios that were assessed against the current biological rules include the removal of the following prohibitions:

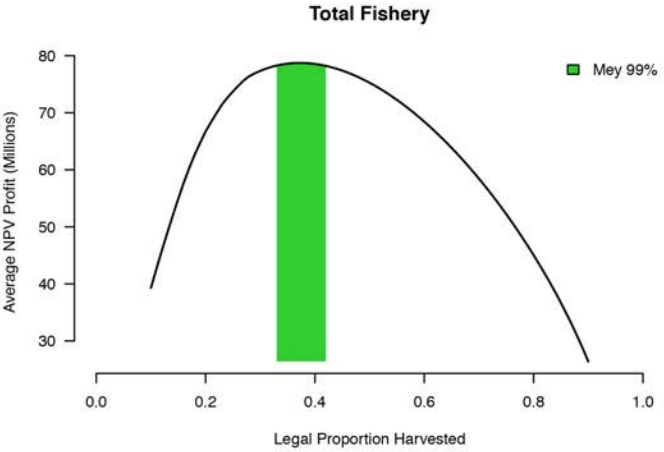
1. maximum female size **Appendix 5**
2. setose lobsters **Appendix 6**
3. maximum female size and setose **Appendix 7**
4. maximum female size and setose and decreasing the minimum size from 77mm to 76mm **Appendix 8**

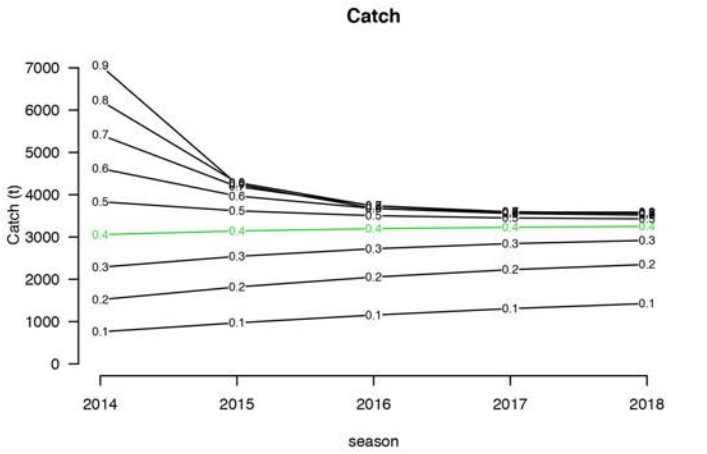
APPENDIX 5

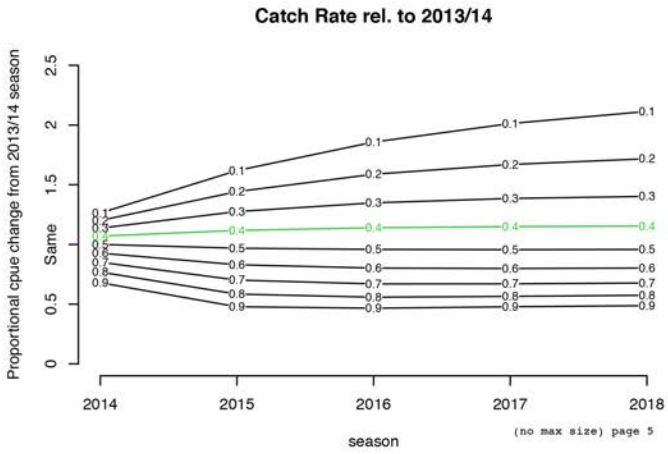
REMOVAL OF MAXIMUM FEMALE SIZE RULE




Egg Production South
Eggs
year
Average NPV Profit (Millions)


Total Fishery
Mey 99%
Legal Proportion Harvested


Catch
Catch (t)
season


Catch Rate rel. to 2013/14
Proportional cpue change from 2013/14 season
Same
season
(no max size) page 5

TACCs (2014/15 season)

	Cth. North	Cth. South	Total	Delta_cpue_AB	Delta_cpue_C
0.21	1833	1595	3428	1.26	1.19
0.22	1922	1672	3594	1.25	1.19
0.23	2010	1748	3758	1.25	1.18
0.24	2099	1825	3924	1.24	1.17
0.25	2188	1901	4089	1.23	1.17
0.26	2277	1978	4255	1.22	1.16
0.27	2366	2055	4421	1.22	1.15
0.28	2455	2131	4586	1.21	1.15
0.29	2544	2208	4752	1.2	1.14
0.3	2634	2285	4919	1.2	1.13
0.31	2724	2362	5086	1.19	1.13
0.32	2813	2439	5252	1.18	1.13
0.33	2903	2516	5419	1.17	1.12
0.34	2993	2593	5586	1.16	1.11
0.35	3083	2670	5753	1.16	1.11
0.36	3174	2747	5921	1.15	1.1
0.37	3264	2824	6088	1.14	1.09
0.38	3355	2901	6256	1.13	1.09
0.39	3446	2979	6425	1.13	1.08
0.4	3537	3056	6593	1.12	1.07
0.41	3628	3134	6762	1.11	1.06
0.42	3720	3211	6931	1.1	1.06
0.43	3811	3289	7100	1.09	1.05
0.44	3903	3367	7270	1.09	1.04
0.45	3995	3444	7439	1.08	1.03
0.46	4087	3522	7609	1.07	1.03
0.47	4179	3600	7779	1.06	1.02
0.48	4272	3678	7950	1.06	1.01
0.49	4364	3756	8120	1.05	1.01
0.5	4457	3834	8291	1.04	1
0.51	4550	3913	8463	1.03	0.99
0.52	4644	3991	8635	1.02	0.98
0.53	4737	4069	8806	1.02	0.98
0.54	4831	4148	8979	1.01	0.97
0.55	4925	4226	9151	1	0.96
0.56	5019	4305	9324	0.99	0.96
0.57	5114	4384	9498	0.99	0.95
0.58	5208	4462	9670	0.97	0.95
0.59	5303	4541	9844	0.97	0.94
0.6	5399	4621	10020	0.96	0.93
0.61	5494	4700	10194	0.95	0.92
0.62	5590	4779	10369	0.94	0.92
0.63	5686	4858	10544	0.94	0.91
0.64	5782	4938	10720	0.93	0.9
0.65	5878	5017	10895	0.92	0.89
0.66	5975	5097	11072	0.91	0.88
0.67	6072	5177	11249	0.9	0.87
0.68	6170	5257	11427	0.89	0.87
0.69	6267	5337	11604	0.88	0.86

Green = 99% MEY target, Orange = Egg Production reduction >20% over 5 yrs
Delta cpue = Proportional change from 2013/14 season

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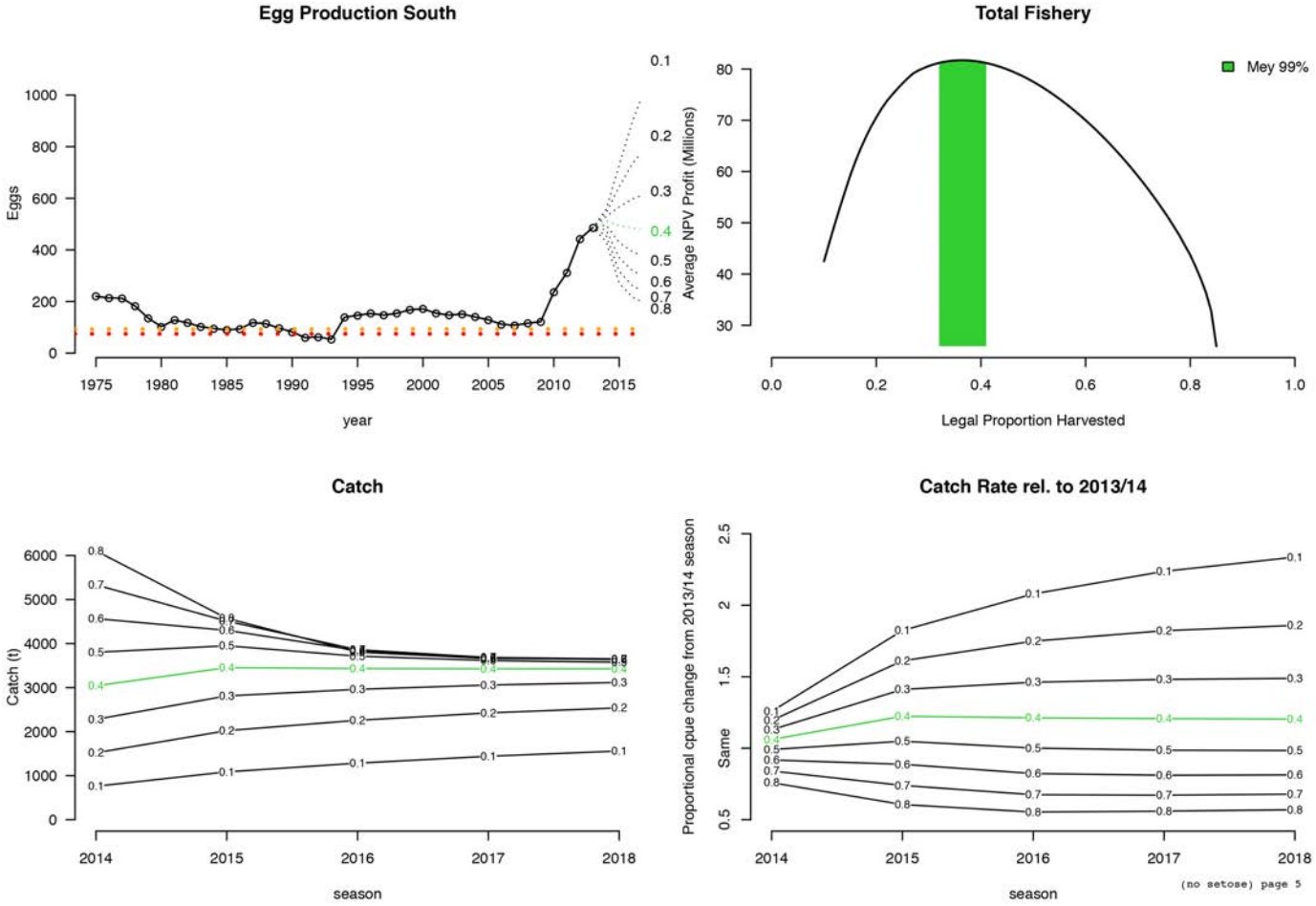
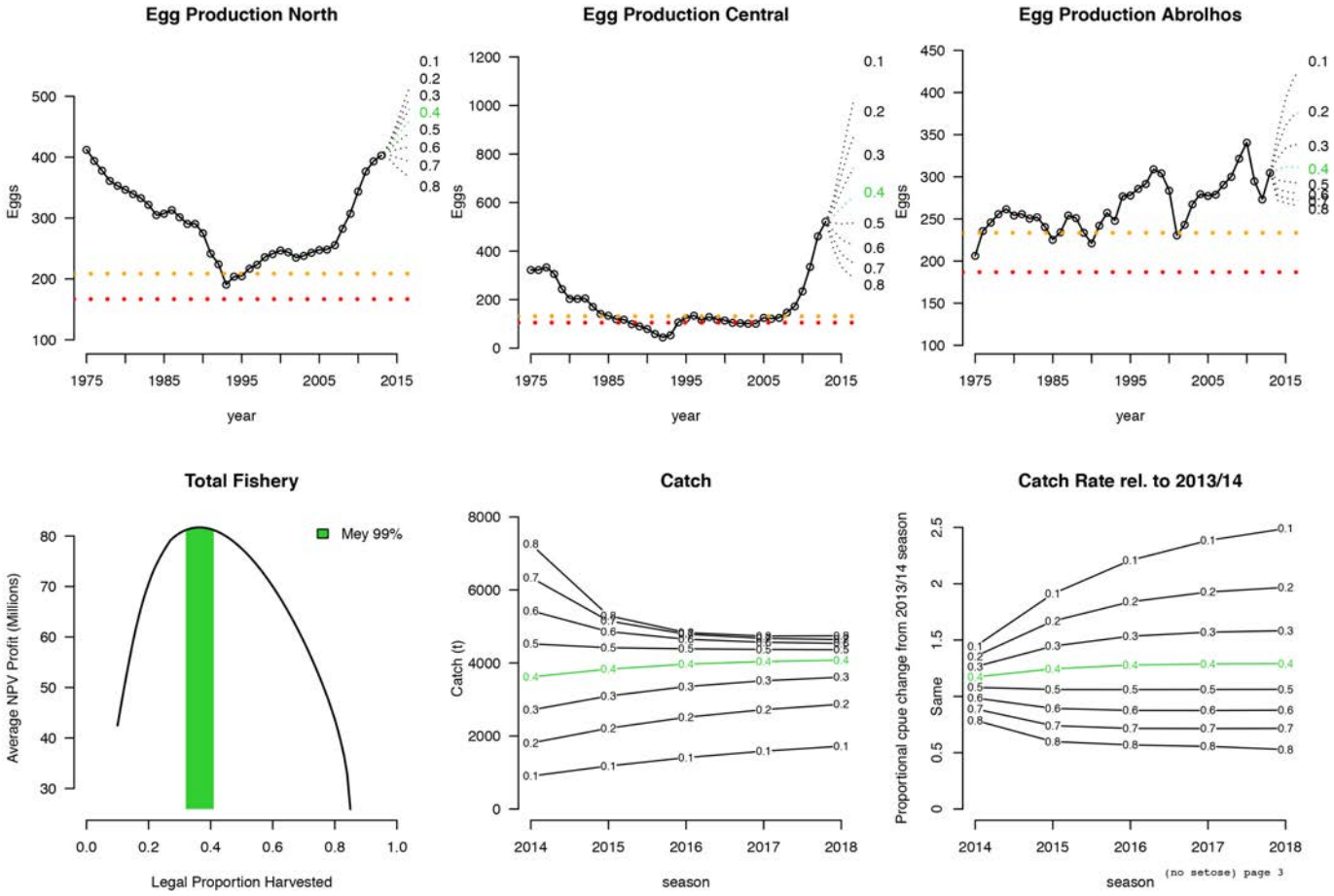
APPENDIX 6

REMOVAL OF SETOSE RULE




Egg Production North
Egg Production Central
Egg Production Abrolhos
Eggs
year
Total Fishery
Mey 99%
Average NPV Profit (Millions)
Legal Proportion Harvested
Catch
Catch (t)
season
Catch Rate rel. to 2013/14
Proportional cpue change from 2013/14 season
Same
season
(no setose) page 3

TACCs (2014/15 season)

	Cth. North	Cth. South	Total	Delta_cpue_AB	Delta_cpue_C
0.21	1897	1595	3492	1.34	1.19
0.22	1987	1671	3658	1.34	1.18
0.23	2077	1747	3824	1.32	1.17
0.24	2168	1823	3991	1.32	1.17
0.25	2258	1899	4157	1.31	1.16
0.26	2349	1975	4324	1.3	1.15
0.27	2439	2051	4490	1.29	1.14
0.28	2530	2127	4657	1.28	1.14
0.29	2620	2203	4823	1.27	1.13
0.3	2710	2279	4989	1.26	1.13
0.31	2801	2355	5156	1.25	1.13
0.32	2892	2431	5323	1.25	1.12
0.33	2982	2507	5489	1.24	1.11
0.34	3073	2583	5656	1.23	1.11
0.35	3163	2660	5823	1.22	1.1
0.36	3254	2736	5990	1.21	1.09
0.37	3344	2812	6156	1.2	1.08
0.38	3435	2888	6323	1.19	1.08
0.39	3525	2964	6489	1.18	1.07
0.4	3616	3040	6656	1.17	1.06
0.41	3706	3116	6822	1.16	1.05
0.42	3797	3192	6989	1.15	1.05
0.43	3888	3269	7157	1.15	1.04
0.44	3978	3345	7323	1.14	1.03
0.45	4069	3421	7490	1.13	1.03
0.46	4160	3497	7657	1.12	1.02
0.47	4250	3574	7824	1.11	1.01
0.48	4341	3650	7991	1.1	1
0.49	4432	3726	8158	1.09	1
0.5	4523	3803	8326	1.08	0.99
0.51	4613	3879	8492	1.07	0.98
0.52	4704	3955	8659	1.06	0.97
0.53	4795	4032	8827	1.05	0.97
0.54	4886	4108	8994	1.04	0.96
0.55	4976	4184	9160	1.03	0.96
0.56	5067	4261	9328	1.02	0.95
0.57	5158	4337	9495	1.02	0.94
0.58	5249	4414	9663	1	0.94
0.59	5340	4490	9830	1	0.93
0.6	5431	4567	9998	0.98	0.92
0.61	5522	4643	10165	0.98	0.91
0.62	5613	4720	10333	0.96	0.9
0.63	5704	4797	10501	0.96	0.9
0.64	5795	4873	10668	0.95	0.89
0.65	5886	4950	10836	0.94	0.88
0.66	5977	5027	11004	0.93	0.87
0.67	6068	5104	11172	0.92	0.86
0.68	6159	5180	11339	0.91	0.86
0.69	6250	5257	11507	0.9	0.85

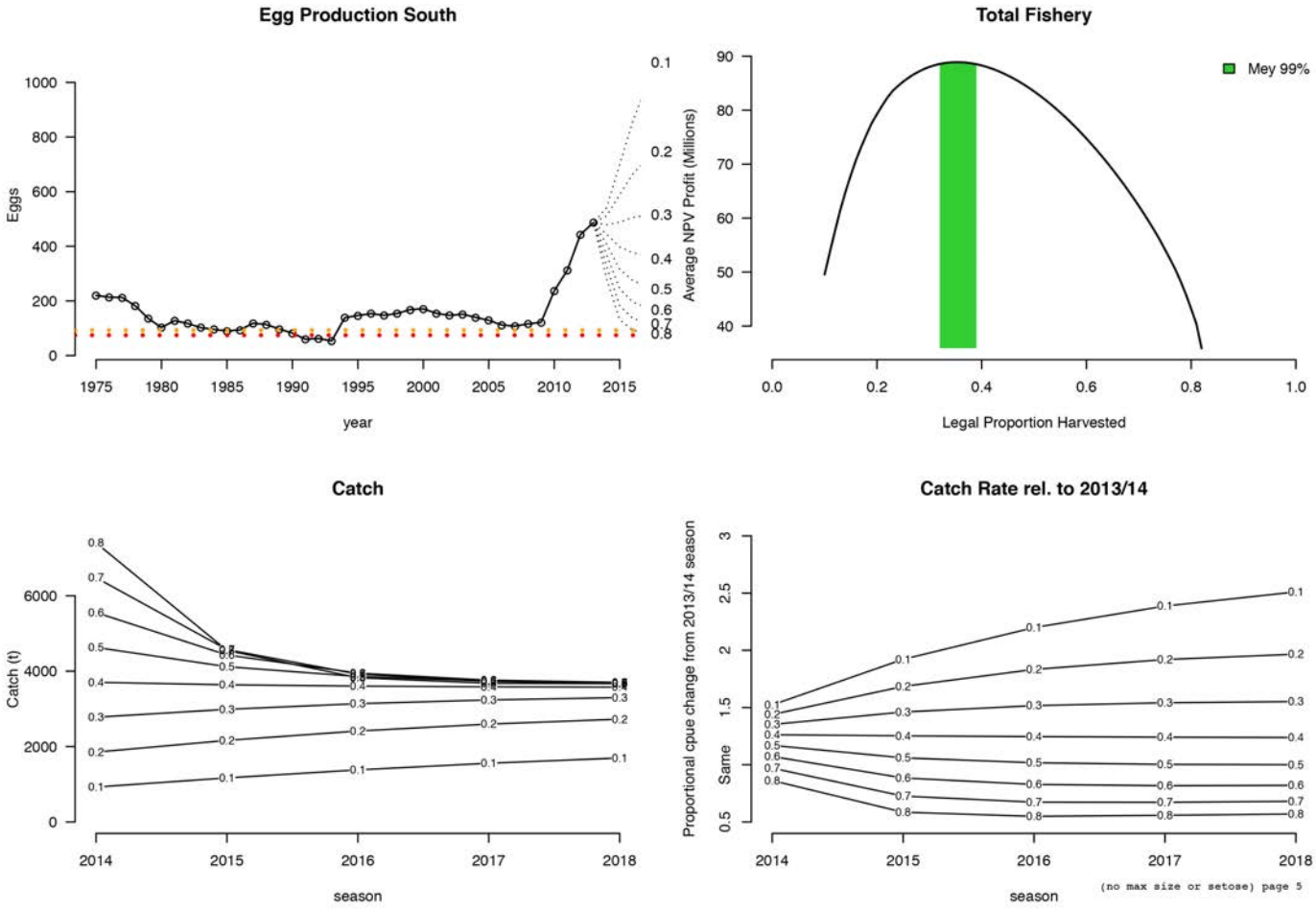
Green = 99% MEY target, Orange = Egg Production reduction >20% over 5 yrs

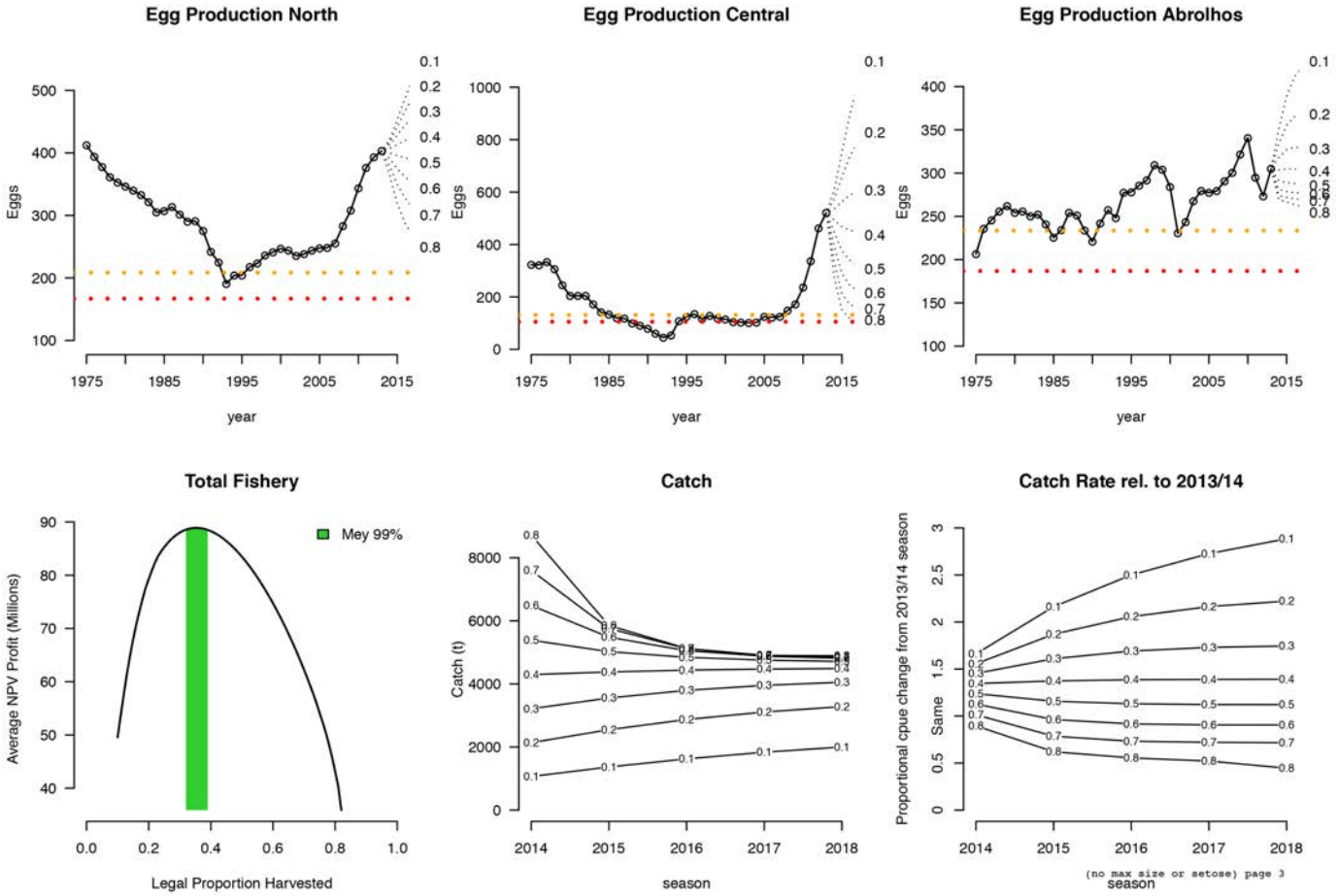
Delta cpue = Proportional change from 2013/14 season

(no setose) page 6

APPENDIX 7

REMOVAL OF MAXIMUM FEMALE AND SETOSE RULES




Egg Production North
Egg Production Central
Egg Production Abrolhos
Eggs
year
Total Fishery
Mey 99%
Average NPV Profit (Millions)
Legal Proportion Harvested
Catch
Catch (t)
season
Catch Rate rel. to 2013/14
Proportional cpue change from 2013/14 season
Same

TACCs (2014/15 season)

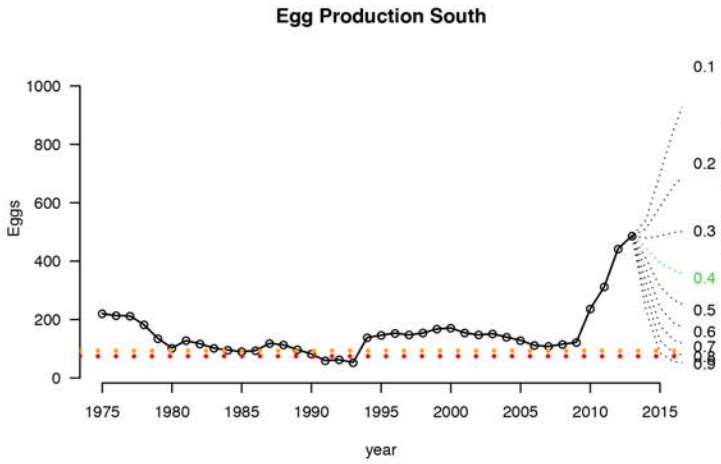
	Cth. North	Cth. South	Total	Delta_cpue_AB	Delta_cpue_C
0.21	2245	1945	4190	1.55	1.43
0.22	2353	2037	4390	1.54	1.42
0.23	2460	2130	4590	1.53	1.41
0.24	2568	2222	4790	1.52	1.41
0.25	2675	2315	4990	1.5	1.4
0.26	2783	2408	5191	1.49	1.39
0.27	2891	2500	5391	1.48	1.38
0.28	2998	2593	5591	1.47	1.37
0.29	3106	2685	5791	1.47	1.36
0.3	3214	2778	5992	1.45	1.35
0.31	3322	2871	6193	1.44	1.34
0.32	3430	2963	6393	1.43	1.33
0.33	3539	3056	6595	1.42	1.32
0.34	3647	3148	6795	1.41	1.31
0.35	3755	3241	6996	1.4	1.31
0.36	3863	3334	7197	1.39	1.3
0.37	3972	3426	7398	1.38	1.29
0.38	4080	3519	7599	1.37	1.28
0.39	4189	3611	7800	1.36	1.27
0.4	4297	3704	8001	1.34	1.26
0.41	4406	3797	8203	1.34	1.26
0.42	4515	3889	8404	1.33	1.25
0.43	4624	3982	8606	1.31	1.24
0.44	4733	4074	8807	1.3	1.23
0.45	4842	4167	9009	1.29	1.22
0.46	4951	4259	9210	1.28	1.21
0.47	5060	4352	9412	1.27	1.2
0.48	5169	4445	9614	1.26	1.19
0.49	5278	4537	9815	1.25	1.18
0.5	5388	4630	10018	1.24	1.17
0.51	5497	4722	10219	1.23	1.16
0.52	5607	4815	10422	1.22	1.15
0.53	5717	4907	10624	1.2	1.14
0.54	5827	5000	10827	1.19	1.13
0.55	5936	5092	11028	1.19	1.13
0.56	6046	5185	11231	1.17	1.12
0.57	6156	5278	11434	1.16	1.11
0.58	6267	5370	11637	1.15	1.09
0.59	6377	5463	11840	1.14	1.08
0.6	6487	5555	12042	1.13	1.07
0.61	6598	5648	12246	1.12	1.06
0.62	6709	5740	12449	1.1	1.05
0.63	6819	5833	12652	1.1	1.04
0.64	6930	5925	12855	1.08	1.03
0.65	7041	6018	13059	1.07	1.02
0.66	7152	6110	13262	1.06	1.01
0.67	7263	6203	13466	1.05	1
0.68	7375	6295	13670	1.04	0.99
0.69	7486	6387	13873	1.03	0.98

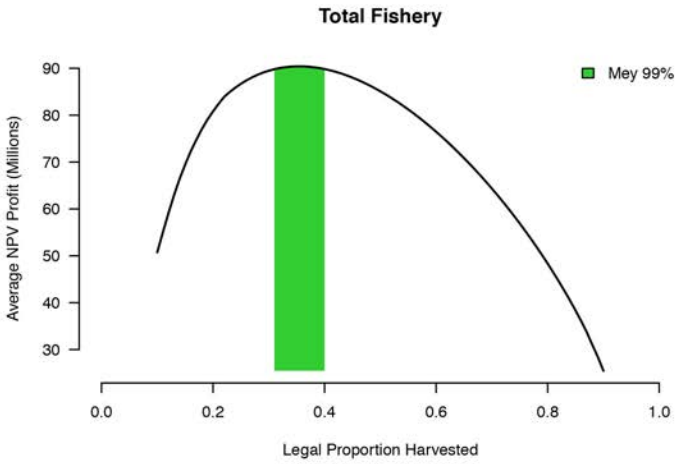
Green = 99% MEY target, Orange = Egg Production reduction >20% over 5 yrs
Delta cpue = Proportional change from 2013/14 season

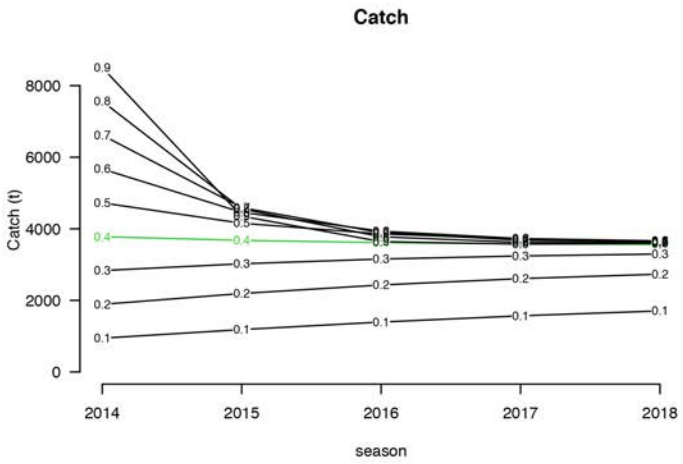
(no max size or setose) page 6

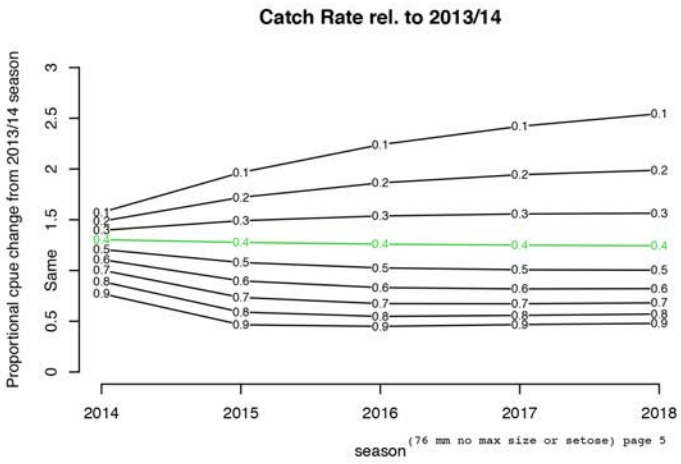
APPENDIX 8

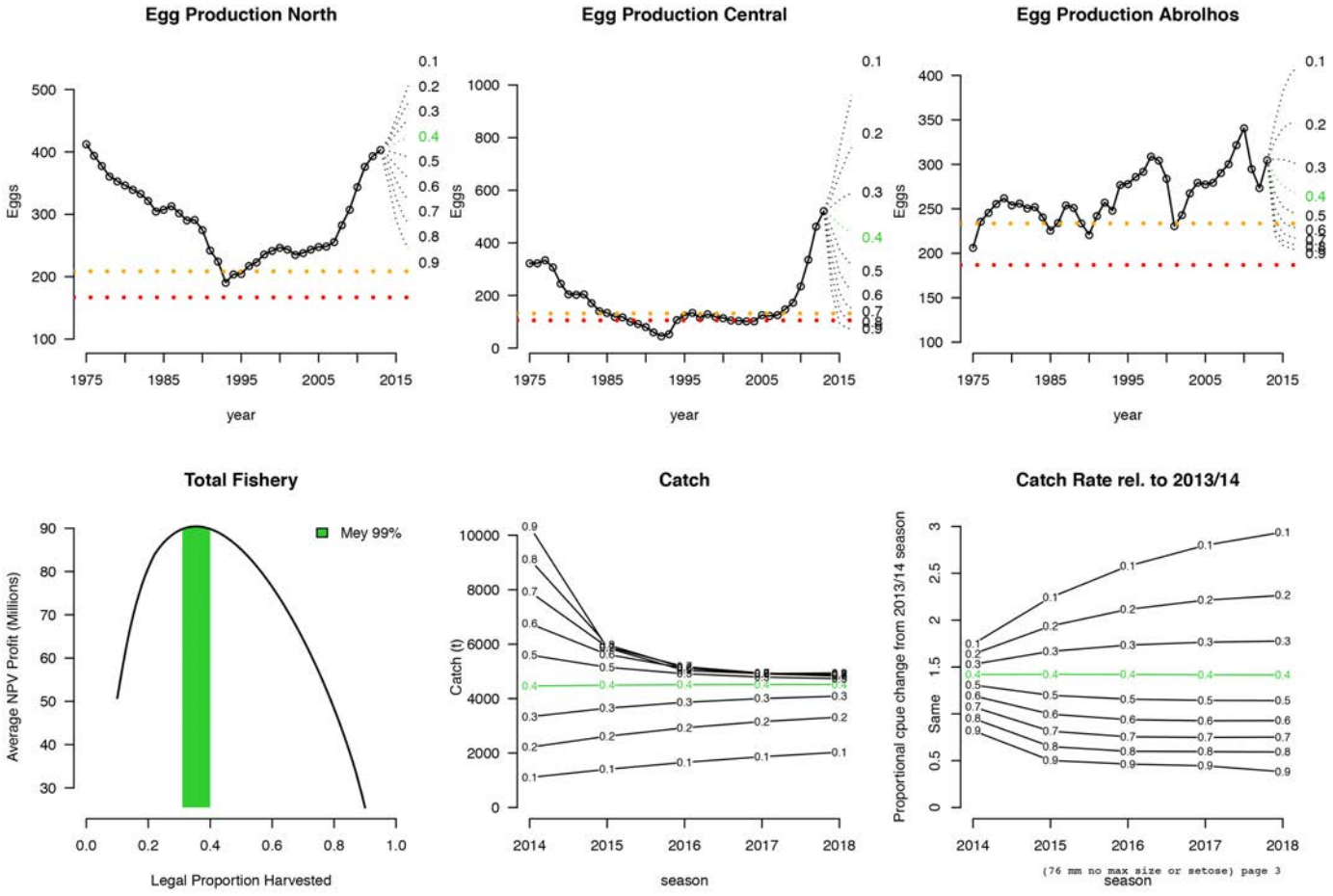
REMOVAL OF MAXIMUM FEMALE AND SETOSE RULES AND REDUCING THE MINIMUM SIZE TO 76mm










Egg Production North
Egg Production Central
Egg Production Abrolhos
Eggs
year
Total Fishery
Mey 99%
Average NPV Profit (Millions)
Legal Proportion Harvested
Catch
Catch (t)
season
Catch Rate rel. to 2013/14
Proportional cpue change from 2013/14 season
Same
season

TACCs (2014/15 season)

	Cth. North	Cth. South	Total	Delta_cpue_AB	Delta_cpue_C
0.21	2326	1983	4309	1.63	1.48
0.22	2438	2078	4516	1.61	1.47
0.23	2550	2172	4722	1.61	1.46
0.24	2662	2267	4929	1.59	1.45
0.25	2773	2361	5134	1.58	1.44
0.26	2885	2456	5341	1.57	1.43
0.27	2997	2550	5547	1.56	1.42
0.28	3109	2644	5753	1.55	1.41
0.29	3222	2739	5961	1.54	1.41
0.3	3334	2833	6167	1.53	1.4
0.31	3447	2928	6375	1.52	1.39
0.32	3559	3023	6582	1.5	1.38
0.33	3672	3117	6789	1.5	1.37
0.34	3784	3212	6996	1.48	1.36
0.35	3897	3306	7203	1.47	1.35
0.36	4010	3401	7411	1.47	1.34
0.37	4123	3495	7618	1.45	1.33
0.38	4236	3590	7826	1.44	1.32
0.39	4349	3684	8033	1.43	1.31
0.4	4463	3779	8242	1.42	1.31
0.41	4576	3873	8449	1.41	1.3
0.42	4690	3968	8658	1.4	1.29
0.43	4804	4062	8866	1.38	1.28
0.44	4917	4157	9074	1.38	1.27
0.45	5031	4252	9283	1.36	1.26
0.46	5145	4346	9491	1.35	1.25
0.47	5259	4441	9700	1.34	1.24
0.48	5374	4535	9909	1.33	1.23
0.49	5488	4630	10118	1.32	1.22
0.5	5603	4724	10327	1.31	1.21
0.51	5718	4819	10537	1.29	1.2
0.52	5832	4913	10745	1.29	1.19
0.53	5947	5008	10955	1.27	1.18
0.54	6063	5103	11166	1.26	1.17
0.55	6178	5197	11375	1.25	1.16
0.56	6293	5292	11585	1.24	1.14
0.57	6409	5386	11795	1.23	1.13
0.58	6525	5481	12006	1.22	1.13
0.59	6640	5576	12216	1.2	1.12
0.6	6756	5670	12426	1.19	1.11
0.61	6873	5765	12638	1.18	1.1
0.62	6989	5859	12848	1.17	1.09
0.63	7106	5954	13060	1.16	1.08
0.64	7222	6048	13270	1.15	1.07
0.65	7339	6143	13482	1.13	1.06
0.66	7456	6238	13694	1.12	1.05
0.67	7573	6332	13905	1.11	1.04
0.68	7691	6427	14118	1.1	1.02
0.69	7808	6521	14329	1.09	1.01

Green = 99% MEY target, Orange = Egg Production reduction >20% over 5 yrs

Delta cpue = Proportional change from 2013/14 season