

Establishing a low risk incremental approach for setting TACCs (changing quotas) in the Western Rock Lobster Fishery, taking into account maximum economic yield and other objectives

Peter Rogers, Simon de Lestang, Jason How, Nick Caputi, Paul McLeod, Nathan Harrison and John McMath

October 2016

FRDC Project No 2015-236

© 2016 Fisheries Research and Development Corporation. All rights reserved.

ISBN 978-1-921877-18-6

#### Establishing a low risk incremental approach for setting TACCs (changing quotas) in the Western Rock Lobster Fishery, taking into account maximum economic yield and other objectives

#### Project No. 2015-236

Year Published 2016

#### Ownership of Intellectual property rights

Unless otherwise noted, copyright (and any other intellectual property rights, if any) in this publication is owned by the Fisheries Research and Development Corporation and the Western Rock Lobster Council

This publication (and any information sourced from it) should be attributed to **citation** – **Rogers, P. et al, Western Rock Lobster Council, 2016,** *Establishing a low risk incremental approach for setting TACCs (changing quotas) in the Western Rock Lobster Fishery, taking into account maximum economic yield and other objectives* 

#### Creative Commons licence

All material in this publication is licensed under a Creative Commons Attribution 3.0 Australia Licence, save for content supplied by third parties, logos and the Commonwealth Coat of Arms.



Creative Commons Attribution 3.0 Australia Licence is a standard form licence agreement that allows you to copy, distribute, transmit and adapt this publication provided you attribute the work. A summary of the licence terms is available from creativecommons.org/licenses/by/3.0/au/deed.en. The full licence terms are available from creativecommons.org/licenses/by/3.0/au/legalcode.

Inquiries regarding the licence and any use of this document should be sent to: frdc@frdc.com.au

#### Disclaimer

The authors do not warrant that the information in this document is free from errors or omissions. The authors do not accept any form of liability, be it contractual, tortious, or otherwise, for the contents of this document or for any consequences arising from its use or any reliance placed upon it. The information, opinions and advice contained in this document may not relate, or be relevant, to a readers particular circumstances. Opinions expressed by the authors are the individual opinions expressed by those persons and are not necessarily those of the publisher, research provider or the FRDC.

The Fisheries Research and Development Corporation plans, invests in and manages fisheries research and development throughout Australia. It is a statutory authority within the portfolio of the federal Minister for Agriculture, Fisheries and Forestry, jointly funded by the Australian Government and the fishing industry.

esearcher Contact Details		FRDC Contact Details	
Name:	Peter Rogers	Address:	25 Geils Court
Address:			Deakin ACT 2600
Email:	16 Jean Hulley Road Highwycombe 6057 Phone: 08 94546724	Phone:	02 6285 0400
		Fax:	02 6285 0499
		Email: Web:	frdc@frdc.com.au
			www.frdc.com.au
	pprogers49@hotmail.com		

# Foreword

To: Chairman of the Western Rock Lobster Council (Council) and the Director General of the Western Australian Department of Fisheries (Department).

The aims of this project are focused on developing a generally accepted methodology for setting the annual Total Allowable Commercial Catches (TACCs) in the Western Rock Lobster Fishery in the current legislative context and to better predict the impact of changes on the performance of that fishery.

The Aquatic Resources Management Bill 2015 which is expected to become operative by January 1 2018 provides a new legislative and policy context to the West Coast Rock Lobster Harvest Strategy and Control Rules 2014-2019. This report has therefore focused its attention on the emerging context of the new legislation and therefore the mechanisms through which the Council and the Department are expected to advise on and determine the Total Allowable Catch (TAC) and subsequently the TACC for the rock lobster resource.

The use of Maximum Economic Yield (MEY) as the secondary objective specified in the Harvest Strategy for the commercial sector fishery assigns with it responsibilities for understanding not only the work on resource stock assessment but detailed knowledge on the rock lobster markets and economics. How changes in the TACC impact on industry total profits in the changing dynamics of the fishery, markets, cost efficiencies of changing rock lobster abundance and continuing evolvement of trading relations, technologies and world markets is neither well researched or independently documented. Of course there are many opinions, with the industry and processors largely adopting a cautious approach to increasing the harvest level for an annual TACC expected to be consistent with achieving a longer term MEY objective.

The twenty recommendations of this report focus on the engagement necessary between the Department and the Council in clarifying the changing legislative and policy framework for management of the rock lobster resource, their respective roles and responsibilities, and suggested changes in governance for the Council in advising on the determination of the TAC and TACC. This approach includes shifting the responsibilities for economic and market evaluation to the Council and a range of complementary changes to the existing Harvest Strategy and particularly shifting away from a single year determination.

Should the Council fail to embrace over a reasonable time period the directions but not necessarily the recommendations proposed by this report, the Minister and the CEO have other policy choices on how to obtain advice on both setting the TAC and the TACC separate to the Council. If the Council wishes to embrace the recommendations proposed in this report, it would be prudent to convene a joint meeting of key stakeholders to map out a work program to facilitate their implementation.

The new research directions specified in this report are all aimed at improving the advisory role of the Council and the scientists in the context of both TAC and TACC future assessments and decision making for the resource.

The resource sharing methodology around TAC determination and allocations between the commercial and recreational sectors including respective consultative approach in the context of a MEY objective has yet to be clarified in policy even though there exists an informal view on how this is to be achieved outlined in the findings for recommendation 20. Similarly there also needs to be policy clarity in the use of the term TACC in the context of MEY, preserving a future entitlement for the commercial sector to increase the total commercial catch at a higher harvest rate if the full commercial allocation determined by the ARMS is not fully utilised under the present harvest objectives. In other words no reallocation of underutilised commercial allocation. Both matters need early attention.

Leadership by the Council and the Department and priority for resourcing especially by the rock lobster industry will be fundamental to achieving long term full society benefits from utilisation of the western rock lobster resource. The value and importance of the resource warrants the rock lobster industry and government's investment and attention.

P.P Rogers

Principal Investigator

## Contents

Foreword	iii
Acknowledgments	. vii
Abbreviations	viii
Executive Summary	ix
Summary of Recommendations	. xii
Background to study	. 16
Introduction	.16
Objectives of Study	.17
Approach to the study	.18
Research Findings	. 21
Introduction	.21
Aquatic Resources Management Bill 2015	.21
Harvest Strategy	.26
Governance Requirements for WRLC in setting TACC	.31
TACC setting strategy	.37
Resource Sharing	.45
Implications	. 46
Extension and Adoption	. 47
Further Development	. 48
Appendix 1: Current Status of the Western Rock Lobster Fishery	. 49
Part 1 Total Allowable Catch Assessment for 2017 Western Rock Lobster season	.49
Part 2 Assessment of proposed 6300 t total allowable catch for 2017 Western	
Rock Lobster season	.49
Background	.50
Current situation	.51
Empirical Assessment	.51
Weight of evidence summary	.60
Background	.01
Empirical Assessment	.01 61
Weight of evidence summary	.01 68
Appendix 2: Dresont Approach to softing the TACC for the Eichery including Hary	. 00
Strategy	est . 69
CONTENTS	. 74

1.1 OBJECTIVES	76
1.3 Harvest Objective	76
2.1 KEY MANAGEMENT PRINCIPLES	
3.1 TACC SETTING PROCESS	
Harvest Strategy and Control Rules Flow Chart	79
APPENDIX 1	80
Northern region (Zones A and B)	
Southern region (Zone C)	
APPENDIX 2	
Application of the Sustainability Objective – Zones A and B	
Appendix 3: Implications of provisional clauses of the <i>Aquatic Resou</i> <i>Management Bill 2015</i> on setting the TACC for the Western Rock Lob Fishery.	<i>rces</i> oster 83
Appendix 4: Data Analysis and Modelling for Understanding Market on TACC	s and Advising 93
Appendix 5: Research Strategy and Information Needs for Improving TACC Assessment for the Western Rock Lobster Fishery	g Stock and 107
Appendix 6: Short Version of proposals for WRLC future approach to advice on setting TACC (Power Point) presented at AMM's 2016	providing 116
Appendix 7: MFL Holder Survey Results and Questionnaire on setting	g of TACC 130
Annondiu 9. Deferences	150

# Acknowledgments

The executive of eight Professional Fishermen's Associations, all affiliated with the Western Rock Lobster Council are acknowledged for their assistance in organising venues and attendees (MFL licence holders) to 16 different meetings at short notice between Fremantle and Kalbarri in a two week period in May 2016. Without their involvement the survey and much of the industry input to this research's outputs (Appendix 5 and 7) could not have been achieved. The executive of six processing companies and two independent marketers also graciously provided their time presenting many insights to the world rock lobster market and more particularly the live market in China. The impressions gained helped the principal author to understand the cautious approach held by the majority of the rock lobster MFL holders in Western Australia towards increasing quota without having a sound foundation of knowledge on the uncertainties in both the fishery and the market.

Many in the Western Australian Department of Fisheries also assisted in various ways with the preparation of this report, especially in the way the Aquatic Resources Management Bill 2015 was expected to evolve in the development of subsidiary legislation and supporting policy for management of the western rock lobster resource. Of especial note were Michael McMullan, Andrew Cribb and Lindsay Joll.

Katherine Chow from the WRLC assisted with administrative aspects of this project and greatly appreciated for her work.

# Abbreviations

**ACE-Annual Catch Entitlement** 

**AHL-Annual Harvest Level ARMA-Aquatic Resources Management Act ARMS-Aquatic Resources Management Strategy ARUP-Aquatic Resource Use Plan** BSMA-Breeding Stock Management Areas CEO-Chief Executive Officer holding the title of Director General of the Western Australian Department of Fisheries but referred as CEO under the Aquatic Resources Management Act FRMA-Fisheries Resources Management Act HSCR-Harvest Strategy and Control Rules LPH-Legal Proportion Harvested **MFL-Managed Fishery Licence MEY-Maximum Economic Yield** MSY-Maximum Sustainable Yield **NPV-Net Present Value TAC-Total Allowable Catch** TACC-Total Allowable Commercial Catch TARC-Total Allowable Recreational Catch WRLC-Western Rock Lobster Council

# **Executive Summary**

This report outlines a preferred pathway for the Western Rock Lobster Council (WRLC; Council) and the Director General (CEO) of the Western Australian Department of Fisheries to advise the Minister in determining the method to be used in calculating the Total Allowable Catch (TAC) and ultimately the commercial catch (TACC) for the Western Rock Lobster Fishery within the context of new legislation; the Aquatic Resources Management Bill 2015, which is currently before the Western Australian Parliament. This includes continuing with the current practice of referral by the decision maker to the WRLC for advice on management decisions. A large part of the advice and recommendations provided focus on issues of governance for the WRLC in advising on TACC, shifting the focus to a longer time horizon in advising on TACC, bringing increased expertise to the table through a subcommittee reporting to the Council and the appointment of a market analyst to provide evidence based advice and information through trade, market and economic analyses.

A total of twenty recommendations are provided in this report, many outlining proposed changes to the current Harvest Strategy in the context of supporting guidelines and integrating supporting legislative requirements for the Aquatic Resource Management Strategy (ARMS), the Aquatic Resource Use Plans (ARUP), the Harvest Strategy for the fishery and formal identification and transfer of prescribed functions by the Minister of Fisheries to the WRLC. Many of the recommendations will require consideration by the Council in discussion with the Department of Fisheries and as appropriate with other stakeholders.

Much of the evidence supporting the findings of this report is covered in the eight appendices to the report. These appendices cover the current status of the fishery, current approach to setting the TACC, implications of new legislation, proposed supporting scientific, market and economic research and information requirements together with supporting analyses undertaken as part of this tactical research, particularly on trade data and the need for four new areas of research in support of continuous improvement in future determination of the TACC.

The timing of this report sponsored by the WRLC is fortuitously linked to the observed increasing industry support to increase the TACC for the fishery as the biological status of the resource and fishery improves and identified market and transport opportunities linked to the implementation of the China Australia-Free Trade Agreement come fully into effect on 1 January 2019. This has followed a substantial period of management restructure, industry adjustment and re-building of rock lobster stocks.

A cautious incremental approach to future TACC setting is strongly supported by the commercial rock lobster fishery and for the most part by the processing and marketing sector. Strong emphasis is placed on learning more about the impacts of TACC changes as they are implemented to better inform future decision making.

The project has also facilitated the further education of Managed Fishery Licence (MFL) holders and others on the existing harvest strategy and the concept of maximum economic yield (MEY) and reasons for change in support of the WRLC.

Much of the evidence for the recommendations proposed has come from in excess of thirty separate meeting by the principal investigator with MFL holders, individual meetings with all processors and marketers operating in the Western Australian rock lobster fishery and a range of experts in and outside Western Australia on other governance options for setting TACC used in other jurisdictions and key individuals within the Department. Dr Paul McLeod also assisted in development of a working paper (see Appendix 4) of this report.

The industry survey results presented in Appendix 7 provided invaluable comment on current perspectives on the future setting of a TACC for the fishery as did meeting feedback from over 250 attendees at the two industry Annual Management Meetings (AMM) of the commercial rock lobster sector held on the 13<sup>th</sup> and 16<sup>th</sup> of June 2016 at Fremantle and Geraldton respectively.

A national approach by Industry and Government(s) is warranted to ensure the full benefits of the China Australia-Free Trade agreement are realised into the future. This needs actioning by the WRLC along with the processing and marketing sector of the fishery in concert with Australia's other state based rock lobster fisheries, expectantly with the support of relevant Governments.

The findings of this research has ongoing implications for the Department of Fisheries and the Western Rock Lobster Council along with other stakeholders, especially the recreational fishing sector for rock lobster and Recfishwest in relation to negotiations concerning the ARMS and redefining the past agreement on resource sharing and the particulars around resource reallocation. This has become particularly important as the commercial fishery has moved from an effort-controlled fishery to an individual transferable quota (ITQ) fishery and adopted MEY as its management target rather than just focusing on sustainability.

The four defined research projects outlined in Appendix 5 will require consideration by the Research and Development Advisory Group of the Council and the Department with ultimately two projects likely to be developed for future FRDC funding under the Industry Partnership Agreement.

The current project was never about determining TACC for the lobster fishery but was designed to provide tactical advice to the WRLC and indirectly to the Department of Fisheries relating to improving overall performance in their respective roles and more particularly on changes to the current harvest strategy. The strategy and recommendations provided outline the steps necessary to developing a more inclusive strategy and approach based on a risk-based weight of evidence decision making, development of a set of guidelines to assist in that process through proposed changes to the harvest strategy coupled with research directions and information needs for setting the TACC and increasing business certainty for at least two years with direction over four years. In effect the report in its entirety has provided a strategy and identification of much of the information needs for setting the TACC and through proposed changes in governance and industry capability

assisted by future preparation of well-crafted operating guidelines, a pathway to better predicting the impact of TACC (quota) changes on the performance of the rock lobster fishery.

This report and industry survey has endorsed the objectives of the current harvest strategy. Detailed assessment around each of the sub-objectives reported in the introduction is presented in this report's findings and throughout the various appendixes. Well in excess of 250 people were exposed to maximum economic yield concepts and the policy reasons as to why it is world best practice in the eight meetings with processors and marketers, 16 meetings with MFL holders and the two AMM's, noting many of the MFL holders attended both sets of meetings.

The TACC subcommittee proposal reporting to the WRLC was presented and discussed at the AMM's and feedback from the council members and industry in the authors view supported the subcommittee proposal. Similarly there was no opposition from the Fisheries Department, noting the Western Australian Government had previously abolished all statutory management advisory committees including the Rock Lobster Industry Advisory Committee as part of a government strategy to reduce the number of statutory committees and Boards within Government. The Government was therefore unlikely to re-instate any government initiated committee.

The appointment of a senior Scientist on TACC committees is not unusual given the emphasis and need for science lead advice. Precedents for such appointments exist for rock lobster fisheries in New Zealand, New South Wales, Tasmania and an Industry Advisory Committee in South Australia. Formal membership of a senior scientist improves accountability and transparency in the delivery of science advice relevant to decision making noting the science itself has been subject to continued independent review under the Commonwealth environmental legislation as well as the Marine Stewardship Council certification processes in the case of the Western Rock Lobster Fishery.

In the event, the CEO determines the TAC and TACC based on different science advice to that of the subcommittee and the WRLC, responsibly that advice should be referred back to the WRLC and the subcommittee for further comment before finalising a determination decision. This situation is likely to be rare especially in the normal circumstance of the same senior scientist advising both parties. The CEO needs to set down reason for a variance in decision making where not the same as recommended by the WRLC.

On the broader issue optimising economic and social benefits to society, much of that debate has been predetermined by the allocation of the TAC prescribed by legislation and Ministerial fiat. The prospect of external parties seeking access to use of underutilised commercial quota if the TACC is set below the industry share of the resource determined by resource sharing principles is clearly a political risk that must be managed. The rock lobster industry is primarily export based, consumer surplus estimates has little relevance to maximising economic benefits for WA community and therefore an approach based on maximising producer surplus is the key relevant policy issue. Strategies that facilitate channelling rock lobster production for local consumption benefits could be examined in the context of national competition rulings politically to gain local community support.

Importantly it would need to have a substantial support base in industry to succeed. The current strategy provides the necessary framework to manage the optimisation of benefits from the fishery and if Government wants to change the allocation mix, it does so through market processes or compensates for changes in resource shares. To do otherwise will undermine the whole basis of rights based management for fisheries.

The findings and recommendations were effectively reviewed by senior members of the Fisheries Department to ensure consistency with the proposed directions under the Aquatic Resources Management Bill 2015 facilitating the identification of issues which will be the basis of future negotiations with the WRLC and perhaps support by the Council for the recommendations of this report. The report also defines in its elements, a work program setting the direction and actions required by the WRLC and the Department of Fisheries towards improving future processes for determining the TAC and TACC for the rock lobster resource.

In essence it will take several years of endeavour, policy development and negotiation for the WRLC and the Department of Fisheries to implement the requirements for an accountable and entirely professional approach to the provision of advice and determination of TAC and TACC (quotas) for the rock lobster industry that takes full account of the evidence of science, economics and markets in the context of resource sustainability and MEY objectives. Even with acceptable levels of confidence in the available information, such decisions will involve elements of risks and judgement in the knowledge that the future is not totally predictable and is uncertain. The value of the industry warrants the rock lobster industry and government's investment and attention.

# Summary of Recommendations

### Aquatic Resources Management Bill 2016

- 1. The WRLC on the passing by the Western Australian Parliament of the Aquatic Resource Management Bill 2015, commence negotiations with the CEO of the Fisheries Department on the Council's role in development of the use of aquatic resource management strategy (ARMS) and the accompanying aquatic resource use plans (ARUP) (See Part 3 of the Bill). Whilst the legislation is not specific on the use of a harvest strategy *per se*, the provisions of Section 16(1) read together with Section 9 would enable reference in an ARMS to a harvest strategy that encompasses those objectives covering sustainability of the resource as well as social and economic objectives relevant to the management of the commercial component of the Western Rock Lobster Fishery.
- 2. The WRLC on the passing by the Western Australian Parliament of the Aquatic Resource Management Bill 2015, to also commence negotiations with the CEO of the Fisheries Department and the Minister towards entering into an agreement to

carry out a range of functions concerning the "management" of the fishery (see Section 222 of the Bill). This should include the provision of advice on the setting of the TAC and TACC and on other functions relevant to the management of the aquatic resource, especially the commercial sector and its representation.

3. The WRLC and the Department of Fisheries note that the ARMA requires that the ARMS, ARUPs, and harvest strategy for a resource are linked and consistent in content. These should be supported by an agreement between the Minister and the WRLC under section 222 as an integrated set of documents supporting the advice and determination roles of the WRLC and CEO respectively in determining the TACC.

#### Harvest Strategy

- 4. To the extent practical, during the construction of a revised harvest strategy for the commercial sector fishery, the approach applied in assessment be built around a risk-based weight of evidence approach taking into account multiple stock assessment and strategy evaluation approaches using a range of key performance indicators, empirical data and models with sufficient flexibility to adopt new tools of assessment as they are developed. This requirement especially applies in areas of marketing and economic evaluation in a process for recommending any TACC that is below the commercial sector share of the TAC.
- 5. That market and economic data as such analyses and information becomes available, be recognised along with strategies to address significant risks for the commercial sector fishery as part of any consideration around setting of TACC. This should include strategies agreed by the WRLC as being in the long term interest of the industry on issues such as market diversification. That the harvest strategy be modified accordingly.
- 6. The existing harvest strategy objectives covering sustainability as the prime objective and MEY as the second key objective should continue to be the central platform of objectives for the commercial rock lobster fishery harvest strategy.

### Governance Requirements for WRLC in setting TACC

- 7. Creation of an expertise and evidence based approach through a sub-committee of the Council to provide advice on future TACC settings for the rock lobster commercial sector fishery and the grounds of those decisions in a written report incorporating the available evidence. The role of the WRLC in advising on future TAC determinations to be clarified with the CEO and Minister.
- 8. The sub-committee to have an independent chairperson, four members of the Western Rock lobster Council, two members from the rock lobster processing and marketing sector; and two representatives from the Fisheries Department; one from management and the other from fisheries research. The sub-committee could invite expert observers to present to the committee to assist in their deliberations.

- 9. The subcommittee report on future TACC settings for the fishery to be made available to the WRLC for distribution on the WRLC website and written referral to rock lobster industry associations for comment and written Industry feedback to the Council inclusive of the processing and marketing sector.
- 10. The WRLC to formulate its advice to the CEO of Fisheries taking into account the subcommittee report and written feedback and provide its reasons for supporting or amendment of the sub-committee's advice to the Council, together with a copy of the sub-committee's report.
- 11. The WRLC and the subcommittee, especially during the formative years of this process have access to independent (e.g. biological, economic and modelling) expertise as warranted.
- 12. The WRLC to appoint an appropriately qualified analyst to facilitate the assembly and analysis of a range of industry data, including market information made available under appropriate privacy and audit protection requirements. The appointment to be either an external consultant at arm's length to the Council with all data files and reports owned and held as part of Council's records or as an employee of the Council.
- 13. The Harvest Strategy for the Western Rock Lobster Fishery incorporate "non-legal" operating guidelines for advising on the information requirements for assessment of the TACC, the consultative processes to be undertaken, ongoing strategies to be implemented in a specified time frame to evaluate the robustness of science, market and economic analysis undertaken in assessing TACC, ongoing evaluation on the impacts of TACC decisions and guidance in drafting evidence-based decisions. This should include time frames for the TACC determination and reporting. The content of such a guideline to be negotiated between the WRLC and the Fisheries Department.

### TACC setting strategy

- 14. That a strategy of determining statutory quota setting for two years (effectively 18 months) and tentative for next two years-requires a four year rolling program of advice on the TACC annually to be incorporated into the Harvest Strategy and the provision of that advice to the CEO of the Fisheries Department.
- 15. There be a strong caveat of urgent intervention for TACC amendment for unforeseen sustainability or major market crisis (e.g. withdrawal of China from the market) if not within a quota year, but at very least for the second quota year.
- 16. That the information and research needs for setting TACC for the fishery as described in Appendices 4 and 5 and accompanying strategies be noted by the WRLC and the Department of Fisheries and be considered through the Research and Development Advisory Group for advice on future implementation.

- 17. That the WRLC progress the development of an evaluation framework for considering economic, market and social data using a risk-based approach in the assessment of these factors in advising on future TACC determinations within the next 3 years.
- 18. That the WRLC and the Department of Fisheries note that in the medium term it is proposed the work on markets and economics for management of the fishery will be assumed by the Council over the next five years as new economic models are constructed. The timing and priority for those changes to be discussed between the parties.
- 19. An ongoing strategic approach by the WRLC in providing professional evidencebased advice on the future setting of TACC's for the commercial Western Rock Lobster Fishery, must go hand in hand with providing ongoing leadership in managing the broader issues, risks and opportunities for a better industry future. Some of these risks are being articulated in a separate FRDC project that is currently underway. Without adequate resourcing of the WRLC, the future will be determined by others.

#### **Resource Sharing**

20. That clarification of policy objectives around resource sharing between the commercial and the recreational rock lobster fishery sectors is a prerequisite for progressing the ARMS and Harvest Strategy under the Aquatic Resources Management Bill.

# Background to study

## Introduction

The application lodged with the Fisheries Research and Development Corporation was sponsored by the Western Rock Lobster Council (WRLC) due to the need to increase its professionalism in providing advice on setting the Total Allowable Commercial Catch (TACC) in the Western Rock Lobster fishery. The fishery had also substantially recovered from a period of low recruitment and low stock abundance following the introduction of quota management into the fishery five years ago. A history of the changes that took place provides a useful back ground to this tactical research study (Caputi et al., 2014).

The fishery stocks have rebuilt to the point that breeding stock levels are at high levels, record financial returns are being received in the fishery and through significant fleet size reductions the total industry cost of fishing has been reduced. The emergence of China as the principal world market for live rock lobsters post the 2007 Global Financial Crisis and substantial devaluation of the Australian dollar against the United States dollar, noting trading in the export market is undertaken in American currency, has also added substantially to financial returns. The change in product mix for western rock lobster away from historical levels of frozen cooked and green rock lobster, including tails to in excess of 95% of product volume as live rock lobster sales has also added to profit levels. The asset value currently linked to quota ownership in this fishery is reported to be in the order of five billion Australian dollars today.

In providing advice to the Minister for Fisheries for the 2016/17 quota year, the Council came under increasing pressure from parts of the catching and processing sectors to increase the TACC. The failure to act for the 2016/17 season had industry political consequences for Council board representation.

It was against this back ground of events and opportunity, the WRLC were of the view it was now timely to review the approach being applied in setting the TACC for this fishery. At the same time the Council also commissioned a parallel investigation into risk assessment and strategy determination to address the major risks facing the industry into the future.

The harvest strategy issued by the Minister for Fisheries outlines in principle form, the approach to be applied by the WRLC in advising on TACC determination. This strategy has also been included as a background document in this report (Appendix 2) for ease of reference as less than half of the Managed Fishery Licence holders within the industry survey (Appendix 7), had actually read the document. It is also central to this research study and its objectives.

## Objectives of Study

The title of the study in itself "Establishing a low risk incremental approach for setting TACCs (changing quotas) in the Western Rock Lobster Fishery, taking into account maximum economic yield and other industry objectives" infers a specific approach to advising the Minister for Fisheries on future setting of TACC. The two major objectives specified in the application for research funding are specified below.

To develop a generally-accepted methodology for setting the annual TACC
To better predict the impact of quota changes on the performance of the rock lobster fishery.

Noting the Harvest Strategy for the Western Rock Lobster Fishery is open to further review and the Government has within the Western Australian Parliament, a new Bill to manage fisheries, it is also opportune to provide advice on the future drafting of a replacement harvest strategy and relevant policy and subsidiary legislation once the legislation is assented to and anticipated to occur in January 1 2018.

It is against this background the following sub objectives were determined.

### Other sub-objectives

Clarify Government's objectives for managing fishery;

To determine the form and responsibility of the decision making body recommending to the Minister the determination of the TACC for the Western Rock Lobster Fishery allocation of quota including;

- Role of the WRLC;
- Role of the Department of Fisheries;
- The composition of the body that recommends the TACC;
- Role of the Minister for Fisheries in setting of the TACC.

To determine the major drivers of costs, market price and other factors as required as inputs for optimising the economic rent (profit) from the rock lobster fishery.

To gain from industry their understanding of factors influencing the total profit return from the fishery and their approach to setting future TACC's including:

- Time period (annually, one, two or three year projections, some other option);
- Factors to be taken into account and supporting data required;
- Governance requirements

To review and provide advice on the changes required to the existing decision making framework for setting TACC's for the Western Rock Lobster Fishery;

To undertake a review of literature and separate analyses of relevant market practices and data on the fishery and on the Chinese market, in particular to build knowledge on the relevance and importance of influencing factors.

On a one to one and group basis, facilitate discussion of maximum economic yield concepts with members of the catching and processing sector towards educating and facilitating further dialogue and decision making on the primary objectives of this research.

Set the environment for a joint government-industry agreement on the future way forward in setting TACC's for the Western Rock Lobster Fishery.

#### Approach to the study

The research approach taken was both collaborative and based on a weight of evidence approach drawing upon the expertise and knowledge of members of the research team, a survey of managed fishery license (MFL) holders, consultations with all rock lobster processors and two independent marketers based in Western Australia and other experts across Australia and New Zealand.

In excess of 30 individual meetings took place which included 16 separate meetings organised through fishermen associations with MFL holders at 8 locations between the ports of Fremantle and Kalbarri.

The 16 meetings with MFL holders were broken into 3 parts. The first required MFL holders to complete a survey (reported in Appendix 7 along with final survey results). A total of 83 survey forms were completed with over a 100 individuals attending the meetings. The same survey was placed on the WRLC website and 524 letters were sent to MFL holders inviting them to participate. Only 15 completed forms were obtained from that source totalling 98 completed surveys.

The second part of the meeting provided a presentation by the principal author to MFL holders on back ground to the concept of Maximum Economic Yield (MEY), current status of the fishery and advice on the current harvest rate relative to the Harvest Strategy and the overall approach taken in this study. The TACC at 6,000 tonnes for the fishery is significantly below a harvest rate at the position of MEY as a longer term policy concept (Caputi et al., 2014).

The third part of the meeting focused on information needs for determining MEY taking into account stock assessment, economic and market information requirements, seeking comment and ideas from MFL holders and in this instance separately from processors. This combined information was further developed by the research team taking into account issues identified throughout the combined outcomes from all meetings and is reported under 4 projects in Appendix 5.

The preliminary results of the survey were reported to the survey respondents several days prior to the Annual Management Meetings (AMM's) of the Rock Lobster Industry and subsequently placed on the WRLC website for industry information.

All members of the research team attended at least one of the two AMM's at Fremantle and Geraldton on the 13<sup>th</sup> and 16<sup>th</sup> of June respectively. Importantly the Fisheries Department Members of the research study updated the meetings on current research and population status of the Western Rock Lobster Fishery, which is summarised in Appendix 1.

The principal author, Dr P Rogers outlined an interim proposed direction for the WRLC for feedback from the meeting attendees to consider for the provision of advice on the setting of TACC. These meetings had a combined attendance in excess of 250 people who had the opportunity to discuss these proposals which are summarised in a shortened power point version in Appendix 6. Generally the research team members and members of the WRLC believed these proposals were well received, however it was made clear at those meetings the final TACC setting advice was the role of the WRLC and outside the scope of this research project.

Throughout the middle of May to the end of June 2016, any person desiring to lodge a submission with Dr Rogers was invited across all forums to do so. Four have been received, two on identified areas of low rock lobster productivity in waters less than 10 fathoms in the fishery adjacent to Kalbarri (R. McVeigh, pers. comm.) and between Leander Point and Beagle Islands (J. Fitzhardinge, pers. comm.). Two submissions were comments and advice on the future setting of TACC which were passed to the Council and considered as part of the information set for this research study and report.

In drafting this report, a number of working documents have been prepared that contain detailed information and analysis on matters central to the report's objectives. These have separate authorship and are included as stand-alone documents in the Appendixes to this report. This has allowed the discussion on the key findings of this tactical research project to be brought forward and integrated early in the report minimising overloading of detail in articulating the various findings and recommendations.

The documents found in the appendixes are described below:

Appendix 1 on the "Current Status of the Rock Lobster Fishery" has been presented in two parts. Part 1 is a report prepared by the Department of Fisheries scientists for presentation to the rock lobster Industry (updated) with the data presented at the AMM's. Part 2, not previously presented in this format, updates the expected impacts of changes in the TACC supported by the WRLC for the 2017/18 year on projected catch rates for different regions of the fishery and on the breeding stock, calculated with 95% confidence limits. The latter report should form the basis of any future science advice provided to the WRLC and the decision maker on the determination of the TACC.

Appendix 2 sets down in brief form the "Present Approach to setting the TACC for the Fishery including the Harvest Strategy". It places into context the current role of the WRLC in providing advice to the Minister for Fisheries and for ease of reference, the formal "WEST COAST ROCK LOBSTER HARVEST STRATEGY AND CONTROL RULES 2014 – 2019".

Appendix 3 provides a brief description of relevant sections of the Aquatic Resources Management Bill 2015 pertinent to this project. The Bill is currently before the Western Australian Parliament.

Appendix 4 has been prepared by Dr Paul McLeod as part of this project providing by case example the type of information that can be gleaned from trade data on trends in the China market for rock lobster and lobster, adding support for the appointment of an analyst by the WRLC into the future. This information together with that of project 4 in Appendix 5, sets down a prospective work program for an analyst to undertake in economic and market analysis in support of future TACC and MEY assessments.

Appendix 5 sets out as a summary the results of a workshop on information needs for providing advice on TACC determination taking into account the rapidly changing circumstances of the rock lobster resource as it re-builds, the changing fleet dynamics and market circumstances. This workshop identified four areas of research requiring attention to place future decisions on TAC and TACC on a more solid foundation. These are described under four project descriptions together with the parameters and information requirements with each project, the latter presented in tabular form.

Appendix 6 provides in summary power point format an extract of the presentation provided by Dr Rogers at the AMM's on a suggested approach by the WRLC in future formulation of advice on the TACC for the rock lobster resource.

Appendix 7 provides the final results of a survey of MFL holders and the survey questions asked that assisted in the framing of advice for the WRLC on future strategy, responsibilities and roles in the formulation of advice on the TACC for the rock lobster resource.

All references used in this report are found in Appendix 8.

# **Research Findings**

## Introduction

This section draws substantially on the detail embodied in the 8 appendices attached to this report, reference material and the collective experience of the research team. The findings are reported under five headings together with the relevant attributable recommendations. This approach should allow readers of the report to gain a rapid understanding of the issues and findings without the need to draw on the detail found in the appendices. Those that need to consider and implement the recommendations proposed or choose a different course of action will need to better understand the detail, which are found in the associated appendices.

### Aquatic Resources Management Bill 2015

At the time of writing, the Aquatic Resources Management Bill had been introduced into the Western Australian Parliament and it is likely to gain passage through the Parliament during 2016. It has bipartisan support. Once the Bill is enacted and assented to, the drafting of the *Aquatic Resources Management Regulations* can start, with the Aquatic Resources Management Act anticipated to come into effect on 1 January 2018.

In this context there was little point in further examination of processes under the existing Fisheries Resource Management Act 1994, particularly as it relates to the consideration of TACC for the commercial Western Rock Lobster Fishery although the existing harvest strategy may continue until the end of 2019 with the Minister determining the TACC. The new legislation requires the Minister to approve the methodology for setting the TAC for the rock lobster resource, and the proportion of the TAC to be allocated to the commercial and recreational sectors. However, once the methodology and allocations have been approved by the Minister, it is the CEO who is required to determine the TAC in accordance with the approved methodology. It is also open to the CEO to approve a TACC at any level up to the commercial allocation of the TAC with a view to achieving MEY on behalf of the industry. This approach is consistent with practices in setting rock lobster quota in South Australia in effectively separating the role of the Minister in determining the policy framework for managing fisheries from administrative decisions made by the CEO, removing the Minister arguably from the industry politics of day to day decision making.

The CEO in the context of administrative law will need to take into account the relevant aquatic resource management strategy (ARMS) in setting an initial TAC for the rock lobster resource and aquatic resource use plans (ARUP) for the commercial and recreational fisheries as well as any accompanying harvest strategy for both sectors in setting ultimately the TACC and the Total Available Recreational Catch (TARC). A determination decision by the CEO would not be open to appeal to the State Administrative Appeals Tribunal.

The current structure of the Bill could incorporate the concept of a harvest strategy for a fishery resource in the provisions relating to the Aquatic Resource Management Strategy (ARMS) under Section 16. In this context the harvest strategy will become the principal policy document for guiding the process and method of determination of the TAC for a resource, and potentially the annual harvest levels for each fishing sector under the umbrella of both the ARMS and the ARUP. How this will be achieved in practice has yet to be clarified and will require active engagement between the WRLC and the Department of Fisheries, and possibly including other stakeholders at the appropriate time. Once an ARMS is determined, the current Management Plan for the Western Rock Lobster Fishery under the Fish Resources Management Act 1994 will be replaced by the ARUP.

The ARMA requires that the ARMS, ARUPs and relevant elements of the harvest strategy are linked-see Section 16(1)(g)(k) and (I),Section 24 and Section 25(2) (Appendix 3).

The savings provisions in Sections 271-282 inclusive in the Aquatic Resources Management Act have no effect on the current harvest strategy management arrangements under the Fisheries Resources Management Act 1994 as these are essentially policy documents and will continue until new arrangements come into place. In any event subsidiary legislation prescribing the commercial fishery management arrangements for the Western Rock Lobster Fishery and prescribed harvest settings will remain in force and can continue to be amended as specified by Section 273.

### Recommendation

1. The WRLC on the passing by the Western Australian Parliament of the Aquatic Resource Management Bill 2015, commence negotiations with the CEO of the Fisheries Department on the Council's role in development of the use of aquatic resource management strategy (ARMS) and the accompanying aquatic resource use plans (ARUP). See Part 3 of the Bill. Whilst the legislation is not specific on the use of a harvest strategy per se, the provisions of Section 16(1) read together with Section 9 would enable reference in an ARMS to a harvest strategy that encompasses those objectives covering sustainability of the resource as well as social and economic objectives relevant to the management of the commercial component of the Western Rock Lobster Fishery.

The Aquatic Resources Management Bill 2015 specifies:

"The objects of this Act are -

(a) to ensure the ecological sustainability of the State's aquatic resources and aquatic ecosystems for the benefit of present and future generations; and(b) to ensure that the State's aquatic resources are managed, developed and

used having regard to the economic, social and other benefits that the aquatic resources may provide."

In executing these objects further guidance is provided by Section 10 towards achieving them by having regard to managing aquatic resources and aquatic ecosystems through

use of relevant scientific data and principles, encouraging the public to participate in decisions about the management and conservation, ensuring that the interests of different sectors of the community that use them are identified and considered, and that in undertaking their management, that it is as practical, efficient and cost effective as possible.

In establishing consultative arrangements for managing aquatic resources the Bill provides for establishing formal advisory committees either by the Minister or the CEO and the appointment by the Minister of an external corporate organisation to undertake specified functions. In the case of the commercial Western Rock Lobster Fishery, this could include the representation of an industry by the WRLC and an advice role in setting a TACC and arguably the TAC.

Under current arrangements for the Western Rock Lobster Fishery there is no formal legislative appointment of the WRLC to provide advice to the Minister on the determination of TACC or on the management rules for the fishery. Instead consultative arrangements have been informal with the Minister considering and accepting the advice of the Council as it is received. Whilst that advice is acted upon with no difference in any TACC decision taken by Minister, or the Department in its advice role, trust in the process of consideration will remain assuming effective governance, transparency and communication of decision making prevails.

The use of informal advisory committees for the purposes of management in TACC advice roles external to government can be found in abalone, pearl oysters and other fishery management arrangements in Western Australia and within rock lobster fisheries across Australian state jurisdictions and New Zealand. They work, are effective and accepted by the community, the industry participants and by Ministers with the caveat there is the right balance of expertise and representation. This is not to say more formal management advisory committees prescribed by legislation as set in New South Wales and previously existed in Western Australia and South Australia do not work, history shows they do. Their removal in the legislature have largely been driven by Government's policy directions aimed at reducing the number of Government committees and therefore direct costs of consultation rather than effectiveness.

In moving forward under the provisions of the Aquatic Resources Management Bill 2015 the WRLC and Government need to reach agreement on future consultative arrangements for setting the TAC and TACC. As seen from a survey of MFL holders, there was strong support for broader representation inclusive of processors and use of independent expertise in setting the TACC.

In comparing the formal and informal options for management advisory structures under the Aquatic Resources Management Bill, the use of Section 222 was considered the most logical direction for the WRLC to take as it opens the scope for a range of functions and advice roles that the Council could assume responsibility in a formal agreement with the Minister. For example these can go beyond the TACC advice role Section 222(2) (I) and include the provision of advice under Section 222(2)(a)-(g) as it relates to the commercial fishery and undertaking the function for the collection and analysis of data relevant to industry economics and marketing. These aspects will require negotiation initially with Fisheries Department officials prior to any agreement with the Minister.

Remaining with the WRLC as a final source of advice on TACC setting helps to take into account the fishery participants appetite for risk balanced against the commercial uncertainties and risks with adjustment in quota (TACC) on the beach price and total fishery profits, including the industry's substantial asset value. This approach does not prevent the WRLC from establishing its own subcommittee which meets the object requirements of the Aquatic Resources Management Bill 2015. This aspect is further discussed under the Governance recommendations.

#### Recommendation

2. The WRLC on the passing by the Western Australian Parliament of the Aquatic Resource Management Bill 2015, to commence negotiations with the CEO of the Fisheries Department and the Minister towards entering into an agreement with the Western Rock Lobster Council to carry out a range of functions concerning the "management" of the fishery (see Section 222 of the Bill). This should include the provision of advice on the setting of the TAC and TACC and on other functions relevant to the management of the aquatic resource, especially the commercial sector and its representation.

Full details of the Harvest Strategy for the Western Rock Lobster Fishery are found in Appendix 2 and have been included in this report along with the existing practices described in its application. Prescriptive comments on that policy to facilitate the drafting of a replacement updated Harvest Strategy can also be found in the content of various Appendices for those having responsibility for future development and implementation. These are not repeated in this part of the report which deals with four key issues which by themselves have a fundamental impact on the drafting of the harvest strategy itself and requires clarity from the WRLC and the Fisheries Department in moving forward with the re-vision of the strategy.

The four key issues discussed below cover the following topics:-

- i. The interrelationship between the ARMS, ARUPs, the harvest strategy and an agreement between the Minister and the WRLC under Section 222 of the Aquatic Resources Management Bill.
- ii. Use of "risked-based weight of evidence" approach in TACC decision making.
- iii. The accommodation of strategies that address major risks in TACC decision making for the rock lobster Industry.
- iv. The appropriateness of the current harvest strategy objectives.

The interrelationship between the ARMS, ARUPs, the harvest strategy and an agreement between the Minister and the WRLC under Section 222 of the Aquatic Resources Management Bill.

Whilst the details of the Regulations are yet to be drafted, one possible administrative approach for prescribing the management and TACC assessment arrangements for the rock lobster fishery is the following.

Issues of principles be embodied in the ARMS for the resource and for the management of the commercial fishery within the ARUPs in accord with the legislation. The harvest strategy be modified to consist of two parts, the first as per the current strategy document incorporating specific objectives, key management principles, the TAC, the TACC setting process, controls and performance indicators. The second part to be drafted as a "non-legal" operational guideline schedule which potentially could be attached as part of an agreement under Section 222 between the Minister and the WRLC.

It is proposed this guide could incorporate instructive advice on the information requirements for assessment of the TACC, the consultative processes to be undertaken, ongoing strategies to be implemented in a specified time frame to evaluate the robustness of science, market and economic analysis undertaken in assessing TACC, ongoing evaluation on the impacts of TACC decisions and guidance in drafting evidence based decisions.

There also needs to be clarity in the use of the term TACC in the context of MEY and statutory determination based on resource shares, preserving a future entitlement for the commercial sector to increase the total commercial catch at a higher harvest rate if the full commercial allocation determined by the ARMS is not fully utilised under an industry based harvest objectives. This currently occurs with a lower annual catch entitlement (quota) and therefore lower harvest rate than would be expected to occur at a harvest rate synonymous with a longer term MEY objective. This approach is also relevant to other industry objectives for smoothing inter-annual variations in catch or reduced annual catch entitlements for market reasons.

All of the above matters would need negotiation between the Department of Fisheries and the WRLC. Once established, future revisions of the combined group of documentation desirably should be limited to amendment to the guidance schedule with the scope for that schedule incorporated in the agreement under Section 222 to be amended from time to time without requiring restarting of the initial agreement.

This type of arrangement that could be specified in the ARMS -that the CEO will consult with the WRLC in determining the TACC at a level within the commercial allocation, could be achieved through administrative guidelines under the FRMA (Section.246) or under the ARMA- Section 254, if necessary.

#### Recommendation

 The WRLC note that the ARMA requires that the ARMS, ARUPs, and harvest strategy for a resource are linked and consistent in content. These should be supported by an agreement between the Minister and the WRLC under Section 222 as an integrated set of documents supporting the advice and determination roles of the WRLC and CEO respectively in determining the TACC.

#### Harvest Strategy

The Department of Fisheries in making decisions under administrative law and in stock assessment are increasingly using a "weight of evidence" coupled with a risk assessment approach to making decisions. This type of approach is consistent with current practices in examining the status of the rock lobster fishery by the scientists from the Department and in the projection of future catch scenarios for consideration of different TACC setting scenarios. This extension of philosophy and approach should equally apply to the consideration of market and economic data for all information sets used as part of an advisory or administrative law advice or decision.

Ideally as new methodologies are developed in either stock assessment or other realms of market or economic analysis, there should be sufficient flexibility in prescription of any supporting policy or strategy documentation, to allow new data and data analysis techniques to be used. This approach goes hand in hand with provision of confidence limits around key data sets, new empirical data sets, recalibration of assumptions used in modelling and independent audit and appraisal of methodologies applied from time to time.

Connected to this requirement and continuous improvement in the processes and methods employed in the assessment of TACC settings is the need for contiguous research strategies and investment in evaluation frame works as resources permit executed on a priority basis.

This must also take into account the evidence available once a change in TACC is made, so the learnings can be taken into account in future decisions.

When constructing a Harvest Strategy, to an extent that is practical, a conscious decision is required to ensure that those principles and objectives which are less likely to change over time are embodied in the text whereas those strategies or new developments that could alter with time are "scheduled" so they can be more easily altered without the need for major redrafting and renegotiation in the interest of cost effectiveness.

#### Recommendation

4. To the extent practical, during the construction of a revised harvest strategy for the commercial sector fishery, the approach applied in assessment be built around a risk-based weight of evidence approach taking into account multiple stock assessment and strategy evaluation approaches using a range of key performance indicators, empirical data and models with sufficient flexibility to adopt new tools of assessment as they are developed. This requirement especially applies in areas of marketing and economic evaluation in a process for recommending any TACC that is below the commercial sector share of the TAC. In practice there has been very little written evidence provided on the market for rock lobster, on either threats or opportunities since quotas have been introduced in the Western Rock lobster Fishery. Most of the information used by the Council on these matters has been gleaned from member's personal knowledge or hearsay evidence from individual processors or marketers supplemented by the occasional written reports or from their own experience.

Until recently this has not been an issue as most of Industry and Government's focus has been sorting out issues of resource sustainability and the efficacy of management arrangements and industry adjustment under the new TACC management arrangements that have come into effect over the last five years. Independent demand analysis on the rock lobster market was commissioned and resulted in two reports providing some further insights on the market for live western rock lobster (McLeod, P. 2014 and ERA 2015). During 2015, these circumstances changed as Industry and Government's confidence in the resource increased and the issue of increasing the TACC have come to the fore. Alongside this shift in attention is the growing awareness of important risks facing the industry and recent action by the WRLC to commission with funding from FRDC, a strategic risk assessment providing directions on how to address those risks for the Council (Agknowledge<sup>®</sup> - June 2016)

Early assessment work by this Risk project and MFL survey results from this research indicate that having China as the only major market was considered to be the most important risk facing the industry today. The short, medium and long term significance of this risk needs evaluation along with the mechanisms that can be employed to mitigate the risk. Although there are a number of ways to address this risk all potentially come at some cost to industry and result in lower industry aggregate profit. The commencement of zero tariff arrangements between Australia and China in 2019 may go a considerable way to reducing this risk but not removing it entirely. Strategies to manage this market risk are being addressed by the Council through a separate FRDC project (Agknowledge<sup>®</sup> - June 2016).

In terms of TACC settings and harvest strategy, as a matter of principle any harvest objective set around MEY needs to be able to accommodate other industry objectives determined from time to time by the Council where issues are judged to be of major risk for the commercial fishery.

#### Recommendation

5. That market and economic data as such analysis and information becomes available be recognised along with strategies to address significant risks for the commercial sector fishery as part of any consideration around setting of TACC. This should include strategies agreed by the WRLC as being in the long term interest of the industry on issues such as market diversification. That the harvest strategy be modified accordingly. The current harvest strategy in Appendix 2 has as its two principle objectives specified as follows:-

#### 1. "Sustainability Objective:

To ensure that the egg production in Breeding Stock Management Areas of the Fishery (see

Appendix 2) remains above its threshold value for the next five years with a probability greater than 75%.

#### 2. Harvest Objective:

Once the Sustainability Objective has been satisfied, TACCs for the Fishery shall use MEY to determine an optimal range of Legal Proportion Harvested (i.e. harvest rate) that would optimise the economic performance of the Fishery by achieving optimal stock abundance and catch rates, and thereby providing high economic returns and greater amenity to the Fishery and the WA community".

In considering these two objectives in the context of the Aquatic Resources Management Bill 2016 and the objects of that Bill, one can presume the meaning of "high economic returns and greater amenity to the Fishery and the WA Community" (if MEY remains the standard for the commercial rock lobster fishery) is inferred by the wording "having regard to the economic, social and other benefits that the aquatic resources may provide" are one and the same, then there is no change issue. Further clarification by Government on what is intended by these objects is highly desirable.

The term Maximum Economic Yield (MEY) is embraced within current Commonwealth Fisheries harvest policy (Department of Agriculture, Fisheries and Forestry, 2007) and is also considered to be in accordance with world's fisheries management best practice (McIlgorm, A. 2013). This cornerstone "long term" policy objective should not be changed unless there are very good reasons for doing so. The use of "long term", the author's words, comes from the observation that the current lack of coherence with harvest rates in the fishery being below the target harvest rates in accordance with policy is a matter of fact and will from experience take a considerable number of years to reach an appropriate rate of harvest at MEY as industry favours an incremental approach to changing the TACC.

The reasons for this apparent dilemma comes from the way the current live rock lobster market operates and the short time frames in which the TACC is determined annually, generally less than six months before it becomes operational.

Virtually all of the western rock lobster catch are sold as live animals into the China seafood market exported in the main through Vietnam and to a lesser extent through Hong Kong. This product competes strongly with live southern rock lobster from other Australian states through the same distribution channels. Southern rock lobster is also exported direct to China from New Zealand within the context of a free trade agreement between China and New Zealand. Relative price movements between different rock lobster products track each other in their perturbations over time (see Appendix 4) and like many seafood markets there exists a significant level of substitution between different rock lobster products driven by their relative price

movements (McLeod, P. 2015; and Norman-Lopez et al. 2013) although often they are sold into different segments of the market depending on price. In the long run prices paid for similar products will move together.

The direct action of rock lobster management of other Australian and New Zealand jurisdictions, of other lobster stocks and potentially other countries, impact on supply and prices received and hence optimal yields (Norman-Lopez et al. 2013). Failure to take into account potential supply and price interactions could lead to suboptimal fishery outcomes for management of Western Australia's commercial rock lobster fishery and must form part of any market consideration around TACC strategy determination.

Southern rock lobster attracts the highest prices due to the robustness of the species (low handling mortality), its reputation and quality followed by western rock lobster with most other products attracting significantly lower prices.

The China market is by far the premium market for live rock lobster in the world and there has been substantial growth of all lobster products into this market. As the Chinese economy continues to expand, the growth in demand for all rock lobster products including western rock lobster will expand reflected in higher prices or with small increases in the TACC, expanded supply into the market at current premium prices.

For the last two years at least, Western Australian rock lobster processors have been divided on the expected impact of increasing the Western Australian rock lobster TACC on the beach price. Setting aside the issue of currency movements the debate taking place focused on the combined issues of lack of air freight capacity and the likely price response from an increase in supply. In the short term price movements in the day to day market to small changes in supply at the premium end of the market were inelastic as traders reacted to stock holdings in live tank facilities within China and Australia. The lack of air freight capacity on wide bodied aircraft especially in peak catching periods of the fishery also meant excess product that could not be delivered to the market were processed as frozen cooked or green, or tailed providing generally a substantial lower contribution to beach price. This lack of freight capacity also appears throughout the year depending on catch responses by the fishing fleet and availability of wide bodied aircraft availability.

This lack of freight capacity principally manifests itself on routes between Singapore and Hanoi, and Hong Kong into Hanoi. If more product could be sold direct into China, up to forty tonnes a day could be delivered during the Chinese New Year out of Perth through cargo carried on passenger flights (Wilkins, D. World Link International. Pers. Comm.).

There was also the fear that the additional supply with increasing the TACC would simply result in processors pushing more product into the Chinese market resulting in a bidding contest between suppliers generating downward pressure on all product

prices. It is worth noting that once Australian live rock lobster left the aircraft in Vietnam there appeared to be little control by Australian processors on either managing the product or its marketing in China.

The industry is not in complete agreement on the market impact of an increase in the TACC. A significant part of the industry is of the view that the combined interaction of all of the above factors means that increases in supply will not increase the total gross value of the fishery or aggregate industry profitability.

Other processors had a contra view arguing that increases in supply would largely be placed into other world product markets adding to the gross value of production and therefore total industry profits. In other words there was a belief that the supply price response over a twelve month season would be elastic.

Both adaptive behaviours described by individual processors are likely to occur. On balance, in the short term, it is probable that given the known constraints in air transport and known large differences in gross margin contributions to beach price, increases in supply could therefore be expected to reduce overall prices paid and possibly reduce total revenue in the fishery. How that will be manifested will ultimately depend on trends in demand growth in China. However in the medium term, the price response in demand to planned changes in rock lobster supply with longer term planning horizons and eventual reduction in constraints are believed to be elastic and would expect to increase industry revenue (McLeod, P. pers. comm.) (Gordon, D.V. 2011).

There has been little independent data or evidence presented to industry that supports one proposition or the other so it was not surprising that the survey of MFL holder and outcome of discussions with majority of processors favoured a cautious approach to increasing the TACC.

Limiting increases in quota to no more than five percent change in any one year and proceeding cautiously can only mean the long term harvest rate at MEY will take a decade or more to reach. However this still provides an adaptive management approach to testing the market so that an annual assessment can be made on the economic effects of the 5% increase in the TACC on the market. It potentially provides a basis of assessing the price elasticity of the market in response to a change in supply without arguably causing any major detrimental effect on the market, but in turn may be sufficient to elucidate full cause and effect from other data noise issues. Only with time and future analysis on market impacts will clarity prevail.

In the absence of adequate understanding of the price response to increases in supply for western rock lobster, the WRLC needs to ensure the impact of future quota changes on the market are well understood.

The current practice of setting TACC in less than six months of the start of the season (and 18 months until it finishes) works against a price elastic response to increases in supply. This short time frame does not effectively allow sufficient time for planned

response on freight arrangements or investment in market research to place additional product in a continuously changing world market or allow business and market plans to be fully developed and implemented with certainty. A two year time frame in determining TACC settings (effectively 18 months under current time scheduling for the start of the second season's TACC) could only improve all aspects of marketing for the fishery. This aspect of the harvest strategy will potentially become more important as the roll out of the China Australia-Free Trade Agreement comes fully into effect post January 1, 2019 when Australian rock lobster suppliers are expected to increase selling direct into China and engage directly with major retail outlets and restaurant chains further up the value chain shortening lines of distribution with potentially improvement in live product quality (and survival rates). Contract marketing of rock lobster to parts of the market may also become an increasing feature of trading arrangements. The current constraints on air freight may also disappear.

It should also assist the fishing sector in their planning and business decision making particularly with greater time separation between TACC determination and the quota trading period. Further comment on this issue is covered by Recommendation 14 on the need for a longer term directed harvest strategy.

#### Recommendation

6. The existing harvest strategy objectives covering sustainability as the prime objective and MEY as the second key objective should continue to be the central platform of objectives for the commercial rock lobster fishery harvest strategy.

### Governance Requirements for WRLC in setting TACC

There has been considerable discussion with members of the WRLC and with members of the catching and processing sector over the role of the Council in providing advice on the determination of TACC and issues of management for the fishery. These options were raised in the industry questionnaire and can be grouped into three categories: the status quo using the WRLC 32% in favour, groups involving expertise based industry leaders 17% in favour and groups involving independent experts 42% in favour. As outlined in the survey results and summary (Appendix 7 pages 1-3), whilst there was considerable support for the WRLC in the role it was undertaking, a majority of the industry surveyed and importantly members of the council itself, supported the use of external expertise in assisting with the formation of advice on the setting of the TACC for the fishery. This could also include the drafting of weight of evidence based decisions to assist the Council in their deliberations and consultation with industry associations of rock lobster MFL holders and final reporting to the CEO providing advice on the TAC decision and the annual catch entitlement for the commercial sector fishery

facilitating both TAC and TACC determinations under the Aquatic Resources Management Bill 2015.

Whilst a number of options were considered, it was noted that the Western Australian Government had previously abolished all fishery statutory management advisory committees including the Rock Lobster Industry Advisory Committee as part of a government strategy to reduce the number of statutory committees and Boards within Government. The Government was therefore unlikely to re-instate any government initiated committee.

For these reasons including the strong desire by members of industry and the Council for the use of independent expertise, the TACC subcommittee proposal reporting to the WRLC was presented and discussed at the AMM's. The subcommittee proposal catered for both independent expertise plus final WRLC control on the advice forwarded to the decision maker with adequate transparency and accountability. Feedback from the council members and industry, in the authors view supported the subcommittee proposal. Similarly there was no opposition from the Fisheries Department but to the contrary officer support, noting Governments expected position on the issue.

In undertaking a weight of evidence approach, due regard in the advice decision crafted will need to take into account the requirements of the ARMS and the ARUP for the fishery as well as any control rule requirements and performance indicators set out in the fishery's Harvest Strategy and Control Rules.

Where the fishery is operating below the harvest rate range for MEY, it is reasonable to assume the evidence presented will support that proposition.

As discussed under Recommendation 2, for reasons of longer term positioning by the Council in undertaking a more active role in the research function for understanding both market and economic issues facing the Council in both TACC and fisheries management advice roles to the CEO and the Minister respectively, the Council would be greatly assisted by the creation of a subcommittee having a range of expertise and representation. As the Bill requires under its objects, the subcommittee representation may need to include, a member of the public to participate in decisions about the management and TACC advice and ensuring at the very least the interests of processors and the marketers who depend on the fishery are identified and considered. The role of fishery science is also strongly advocated in Section 10 of the Bill.

Noting the size of the fishery and need for adequate understanding of fishing operations and its impacts across the geographical range of the fishery, there needs to be at least four fishermen on this subcommittee either from existing membership of the Council or selected by the Council.

The use of an independent chairperson for the subcommittee could effectively represent the public interest in the formulation of any TACC advice as will the scheduled appointment of an independent person to the WRLC board. Any

representation by the recreational sector as an observer or member of the subcommittee will depend on the consultative processes for establishing the methodology for setting the TAC or ARMS for the resource as it is not clear whether or how the CEO will consult with sector bodies on these issues.

For principally these reasons the following representation on the subcommittee is proposed for the WRLC consideration. The sub-committee to have an independent chairperson, four members of the Western Rock lobster Council, two members from the rock lobster processing and marketing sector; and two representatives from the Fisheries Department; one from management and the other from fisheries research. The addition of Recfishwest representatives to the sub-committee will be dependent on the final consultative arrangement for determining the TAC.

This proposed subcommittee composition is similar in structure to the pre-existing Rock Lobster Industry Advisory Committee with the fundamental differences that it will report to the Council, includes a scientist and exclude other stakeholder representation as its prime role is advisory on TACC. The subcommittee is also independent of Government and therefore subject to governance arrangements ultimately established by the Council.

The costs to the Council will be minimal limited to the running of meetings and the costs of the independent chairperson. All other attendance costs should be met by the organisations of those persons appointed.

Whilst a number of different membership compositions could be open for debate, the key to the achievement of outcomes required is the selection of the right people onto the subcommittee and drawing upon external expertise as required and funded on the approval of the Council. This includes use of external providers such as economists, scientists or as in the case of the South Australian informally appointed rock lobster TACC advisory group, the commissioning of a consultant to report annually on the economic performance of the fishery.

Where appropriate and requested, stake holder interests outside the fishing industry could be invited to attend as observers to provide transparency on approaches applied in provision of advice on TACC determination. This includes attendance and respective roles by relevant staff of the Council and the Department of Fisheries.

In order to improve transparency and communication across the industry, it is also proposed the advice prepared by the subcommittee would be placed on the Council's website as part of the Council's action in formally seeking written comment from the associations within a reasonable time frame. That feedback should be part of the deliberative considerations of a meeting of the WRLC in providing the final advice of the Council to the CEO on future TACC determination. Any change to the earlier subcommittee advice to be argued and presented with supporting evidence accompanied with the full report of the subcommittee. However, in the event the subcommittee and the Council is required to provide advice on the setting of the TAC for the fishery, rather than creating another consultative arrangement, the structure of the subcommittee needs to be altered to be inclusive of at least two representatives from Recfishwest and reducing Western Rock Lobster Council membership to three. Governance arrangements would also need to alter to allow the subcommittee report to be made available to Recfishwest for their comment to the CEO in the same way that the Council forms its final advice to the CEO described above.

The role of this subcommittee in providing advice on the TAC is preferred due to the heavy dependence on information generated from the commercial fishery for stock assessment and the assumption that resource allocation between sectors requires a consistent objective approach. Ultimately this will depend on the methodology for setting the TAC set by the Minister and whether an arm's length consultative arrangement is warranted or necessary. This will be an important issue of consideration by the Department and various sector interests.

The role of the scientist on this subcommittee is pivotal in advising on proposed TAC settings for the rock lobster resource as the same scientist could be expected to also advise the CEO. The science advice needs to be transparent and consistent across both parties to maintain confidence in the process providing effectively a power of veto within the limits of the approved methodology for determining the TAC.

The appointment of a senior Scientist on TACC committees is not unusual given the emphasis and need for science lead advice. Precedents for such appointments exist for rock lobster fisheries in New Zealand, New South Wales, Tasmania and an Industry Advisory Committee in South Australia. Formal membership of a senior scientist improves accountability and transparency in the delivery of science advice relevant to decision making noting the science itself has been subject to continued independent review under the Commonwealth environmental legislation as well as the Marine Stewardship Council certification processes in the case of the Western Rock Lobster Fishery.

In the event, the CEO determines the TAC and TACC based on different science advice to that of the subcommittee and the WRLC, responsibly that advice should be referred back to the WRLC and the subcommittee for further comment before finalising a determination decision. This situation is likely to be rare especially in the normal circumstance of the same senior scientist advising both parties. The CEO needs to set down reason for a variance in decision making where not the same as recommended by the WRLC.

The independent chairman could be expected to be experienced, knowledgeable as to the interests of the community and Government and in sufficient liaison with the WRLC, other sector interests and the CEO to understand the broader interests of the community.

#### Recommendations

- 7. Creation of an expertise and evidence based approach through a subcommittee of the Council to provide advice on future TACC settings for the rock lobster commercial sector fishery and the grounds of those decisions in a written report incorporating the available evidence. The role of the WRLC in advising on future TAC determinations to be clarified with the CEO and Minister.
- 8. The sub-committee to have an independent chairperson, four members of the Western Rock lobster Council, two members from the rock lobster processing and marketing sector; and two representatives from the Fisheries Department; one from management and the other from fisheries research. The sub-committee could invite expert observers to present to the committee to assist in their deliberations.
- 9. The subcommittee report on future TACC settings for the fishery to be made available to the WRLC for distribution on the WRLC website and written referral to rock lobster industry associations for comment and written Industry feedback to the Council inclusive of the processing and marketing sector.
- 10. The WRLC to formulate its advice to the CEO of Fisheries taking into account the subcommittee report and written feedback and provide its reasons for supporting or amendment of the sub-committee's advice to the Council, together with a copy of the sub-committee's report.
- 11. The WRLC and the subcommittee, especially during the formative years of this process have access to independent (e.g. biological, economic and modelling) expertise as warranted.

In preparing this report and experiencing the discussions that took place at over 30 meetings, the results of the MFL survey and discussions on TACC setting at the AMM's and accompanying presentations, it is self-evident that neither the Council or the Department of Fisheries have invested heavily to this point in time in understanding the world markets for rock lobster. Without a change in the TACC in recent years, the requirement to understand the impact of changes in western rock lobster supply on prices and revenue warranted little attention. The gathering of independent data was not fully explored.

Whilst the inclusion of processor and marketing representation on the subcommittee will greatly assist provision of knowledge on the markets to all parties involved, the information presented in Appendices 4 and 5 point to an array of information that could be gleaned though independent analysis that would benefit future advice around TACC settings. The employment of an independent analyst to undertake this type of work by the WRLC would be valuable with the correct settings around the ownership of data and any arising reports owned by the Council. Where data is sought from willing marketers and processors, with the right audit and data protection requirements, the analyst could provide ongoing answers

on questions as they arise in industry strategy evaluation. Certainly having this managed by the WRLC helps protect the confidentiality of commercial data as it is not discoverable under Freedom of Information Legislation.

Whether the analyst is employed directly by the Council or an external consultant at arm's length to the Council under contractual arrangements is a matter for consideration, depending on who is available and therefore best fit.

#### Recommendation

12. The WRLC to appoint an appropriately qualified analyst to facilitate the assembly and analysis of a range of industry data, including market information made available under appropriate privacy and audit protection requirements. The appointment to be either an external consultant at arm's length to the Council with all data files and reports owned and held as part of Council's records or as an employee of the Council.

As outlined earlier in this report, it was proposed that guidelines be developed as part of the Harvest Strategy for the fishery to assist the WRLC in defining its roles and responsibilities in advising on the setting of TACC in the rock lobster fishery. In the event the WRLC with the support of the Minister decides to proceed with the proposed sub-committee approach, the guidelines could accommodate the membership, appointment processes and operational requirements of the subcommittee in its engagement with the Council. This would also expect to cover reasonable timeframes for consultation and reporting, desirably built around the present Annual Management Meetings and TACC setting timelines.

This would be in addition to instructive advice on the information requirements for assessment of the TACC, the consultative processes to be undertaken, ongoing strategies to be implemented in a specified time frame to evaluate the robustness of science, market and economic analysis undertaken in assessing TACC, ongoing evaluation on the impacts of TACC decisions and guidance in drafting evidence based decisions discussed earlier. Further recommendations on a forward looking strategy for advising and setting the TACC will also have drafting relevance to the proposed guidelines.

It is noted however much of the proposed guideline information for the Harvest Strategy is relevant to any advisory body the Minister or the CEO seeks to establish to provide advice on future TACC determination. There would also be an expectation by the Minister, the CEO and the community that guidelines provided would be relevant and reasonably complied to by the parties involved.

#### Recommendation

13. The Harvest Strategy for the Western Rock Lobster Fishery incorporate "nonlegal" guidelines for advising on the information requirements for assessment of the TACC, the consultative processes to be undertaken, ongoing strategies to
be implemented in a specified time frame to evaluate the robustness of science, market and economic analysis undertaken in assessing TACC, ongoing evaluation on the impacts of TACC decisions and guidance in drafting evidence based decisions. This should include time frames for TACC determination and reporting. The content of such a guideline to be negotiated between the WRLC and the Fisheries Department.

#### TACC setting strategy

At this stage in the history of the Western Rock Lobster Fishery, there appears to be no clear industry strategy set down by the peak industry body specifying future directions for either managing known risks for the fishery or the market across the entire value chain. Virtually all decision making is short term dealing primarily with shorter term management adjustments to the fishery or annual advice on TACC determination. The primary planning for fishing, processing and marketing, including strategy formulation occurs at an individual business level (as it should) with little attention provided to a collective industry approach. This is not dissimilar to many other primary industries.

The long history of intense competition within the processing and catching sectors of the rock lobster fishery over many decades under input controls in the fishery and the intense competition for product and market share in the processing/marketing sectors has worked against individuals and firms working collectively. It has also shaped the attitudes of many participants in the industry today with their beliefs and prejudices.

Recent initiatives taken by the WRLC to seek independent advice on both risk assessment and strategy formulation and longer term TACC determination amongst other factors, points to perhaps a stronger focus on longer term planning for the industry . For this the current Council representation is to be applauded. Without adequate funding through industry contributions opportunities may be lost, possibly to the longer term detriment of the industry.

There is also a very significant opportunity in front of the Australian primary industries as the full effect of the China- Australia Free Trade Agreement comes into place, especially for the marketing of rock lobster as tariffs are reduced to zero on January 1 2019 from a historical rate of 15 % at imported valuation (refer to HS Code 0306.2190 China tariff schedule). Whilst this certainly has value for Australian rock lobster producers there is no guarantee that "duties" to be paid at the provincial level won't continue or other logistical or administrative issues may arise. Ultimately they may require Australian Government to Chinese Government trade engagement to ensure the full benefit of free trade arrangements extend to all operating in this rock lobster market. The Council has an important contributory role to play in this matter. It is important that industry understands the obligations expected of it by governments and the community under the Free Trade Agreement and learnings from the New Zealand experience may be valuable. This particularly may be the case with larger primary industries demanding priority and exercising influence over government policy and transport access. Whilst these issues are not central to TACC provision of advice, they are nonetheless important in the consideration of maximising industry's total profits from the fishery and the need to involve processors in the decision mix.

Outside of the China Australia Free Trade Agreement, other Agreements have and are being developed providing potentially new market opportunities.

The information on the status of the rock lobster fishery in Appendix 1 strongly suggests on a wide range of parameters, the health of the fishery is in a very strong state based on the parameters of recruitment into the fishery in 2017, the current state of breeding stock, abundance of rock lobster on the fishing grounds, catch rates, known puerulus recruitment and reported high residual numbers of resident rock lobster across the majority of historical fishing grounds.

There is no obvious reason today why the determination of TACC on biological grounds could not be extended from an annual basis (effectively less than six months) to a two year time frame determination rolling forward the second year into the following year. This argument can also be extended to providing an indication of possible TACC setting for the following two years, in other words potentially a four year outlook on quota.

Since 2014, the Geraldton Fishermen's Co-operative Limited, the largest rock lobster processor in Western Australia (ca. 65% by volume) has continued to express the view that annual quota setting was not favoured preferring instead a longer time frame of 14 months as a minimum, for good business reasons (Geraldton Fishermen's Cooperative (2014)., Hoskins, W. (2015). and Richie, J. pers. comm. 2016).

As previously reported, the current practice of setting TACC within four to six months of the operative season works against a price elastic response to increases in supply. This short time frame does not effectively allow sufficient time for planned response on freight arrangements or investment in market research to place additional product in a continuously changing world market or allow business and market plans to be fully developed and implemented with certainty. A two year time frame in determining TACC settings (effectively 18 months under current time scheduling) could only improve all aspects of marketing for the fishery.

This aspect of the harvest strategy will potentially become more important as the roll out of the China Australia-Free Trade Agreement comes fully into effect post January 1, 2019 when Australian rock lobster suppliers are expected to increase selling direct into China and engage directly with major retail outlets and restaurant chains further up the value chain shortening lines of distribution with potentially improvement in live product quality. Contract marketing of rock lobster to parts of the market may also become an increasing feature of trading arrangements. The current constraints on air freight may also disappear.

It should also assist the fishing sector in their planning and business decision making particularly with greater time separation between TACC determination and the quota trading period." The need for a longer time frame even as an indication of future TACC

quota setting by MFL holders was strongly supported in the survey results (see question 12 and summary of results in Appendix 7) to further improve business certainty and decision making.

It is against this background, a longer term approach is proposed in the future provision of advice for and the determination of TACC for this fishery.

#### Recommendation

14. That a strategy of determining statutory quota setting for two years (effectively 18 months) and tentative for next two years-requires a four year rolling program of advice on the TACC annually to be incorporated into the Harvest Strategy and the provision of that advice to the CEO of the Fisheries Department.

Obviously with any strategy that looks forward over two years of TACC determination, such an approach is not entirely without risk. In the world of geopolitics, trade practices and sanctions for an array of reasons can cause severe disruption to markets. Similarly based on past disease events observed in the pilchard fishery in Australia in 1995 and 1998 (Whittington, R.J. et al (2008) and Ward, T.M. et al (2001)) as well as the impact of 2011-2012 marine heat wave event on Western Australian fisheries (Caputi, N. et al. 2016.) both biological agents and environmental events have a potential to severely impact on a fishery. Cataclysmic outcomes for the fishery from such agents have occurred in Australian abalone (Gavine, F. M., et al., 2009.) and scallop stocks (Caputi, N. et al. 2016.) requiring management intervention.

The recently reported extensive loss of kelp beds in inshore waters off the Western Australian coast due to the marine heatwave and high summer temperatures from 2010-2012, (Wernberg, T. et al. 2016) have not been previously observed in the modern history of the Western Rock Lobster fishery since at least the 1950's (de Lestang, S. and N. Caputi, pers. comm. 2016.). Its impact on the rock lobster resource is still to be assessed. Little evidence exists of any prior history of disease events substantially impacting on western rock lobster stocks, if at all.

Whilst the risk of such events are low but possibly increasing with climate change, their impact should they occur on the industry could be severe. For these reasons, in any harvest strategy the scope to adjust for such emergency events where they threaten the foundation of the fishery would be prudent. Preplanning a response would be invaluable but at the very least the scope for emergency changes in the TACC should form a contingency component in the Harvest Strategy.

Principally due to arising equity issues of drastic changes to TACC in an operating quota year on MFL licence holders, it is likely any emergency TACC amendment response along with management changes would be limited to the second year of a determined decision on TACC. The closure of a fishery at short notice for sustainability reasons however has numerous precedents.

#### Recommendation

15. There be a strong caveat of urgent intervention for TACC amendment for unforeseen sustainability or major market crisis (e.g. withdrawal of China from the market) if not within a quota year, but at very least for the second quota year.

During the 16 meetings held with MFL holders along the coast at the end of May 2016, attention were drawn to two issues identified by participants. The first was an observation of an apparent loss in productivity of rock lobster inside 10 fathoms. Areas believed to be affected were between Beagle Island and Point Leander, a 100 kilometre strip extending along the coast adjacent to Kalbarri and some areas north of Wedge Island towards Greenhead. There was also a lower level of concern over the reliability of interpretation of puerulus settlement in more recent years.

Both of these issues were addressed at the AMM's by the researchers of the Fisheries Department who are also on this research study team.

Preliminary analysis had shown that catches across two transects south of Dongara showed lower than expected rock lobster catches in near coastal waters whereas other areas showed no significant issues from catch rate data from similar transect data. The transect data presented the relative contribution of total catch at latitude over the depth range from shallow to deep water. Further investigation is warranted as other factors may be relevant to the industry observed loss in productivity besides habit change as a result of the kelp losses reported in more detail below. Long term loss in annual rainfall and reduced river flow with associated lower loads of sediments and contributory nutrients and chemicals impacts could have formed part of the explained loss in productivity in some areas (J. Fitzhardinge, pers. comm.).

A review of puerulus data indicated in recent years, possibly due to the later seasonal distribution of puerulus distribution, showed there was a relatively greater contribution to the fishery to successful rock lobster recruitment than otherwise expected from more historical data sets on puerulus data. Further work is warranted due to the reliance of this data on future forecasting of the recruitment to the fishery and breeding stock.

Subsequently a review of research and data information needs for future TACC determination were discussed at a workshop, the outcomes of which are reported in Appendix 5. This research workshop identified four project areas requiring action over the next five years directly relevant to Improving Stock and TACC Assessment for the Western Rock Lobster Fishery (see Appendix 5). The importance of project work particularly on updating rock lobster carrying capacity of different habitat areas, density dependent measurement of changes in natural mortality, catchability and migration patterns in the fishery, all have a high priority for inclusion in modelling work on the fishery as the abundance of rock lobster in the fishery alters. In turn this is also important in gaining a more accurate estimate of future yield parameters for the fishery. This work and that required to investigate the apparent observed loss of productivity in identified areas of the fishery and the factors influencing this will

require the setting aside of two smaller shallow water non rock lobster fishing areas in the fishery, possibly at the Abrolhos Islands and somewhere near Freshwater Point.

The priority for this research is extremely high given the results of a 15 year research monitoring program reporting extensive loss of kelp habitat and likely permanent changes in ecosystem function in the shallow water reef areas (0-30 metres) extending north of Perth, but more profoundly from Jurien to north of Kalbarri. Previously dense kelp forests north of 29 degrees south latitude have disappeared or severely reduced with less than 10% of previous abundance. In its place has been an increase in turfforming seaweeds and changes in species composition akin to a more subtropical environment and tropical reef systems. The drivers for such change have been linked to the observed increasing high summer sea temperature anomalies over 2011-2013 and much reported marine heat event (Wernberg, T. et al. 2016).

The impact of such extensive habitat change on rock lobster productivity are not known, but are likely to be negative accepting the reported observations by fishermen from Kalbarri and Dongara during the coastal meetings (see Appendix 7) and recent comments by CSIRO's, Dr R. Babcock suggesting that the loss in production in the rock lobster fishery could be as high as \$50m annually (Lynne, M. 2016). Ultimately this will depend on how adaptive rock lobster are to the changed habitat, changes to the reef structure and relative changes in predation and shelter as well as food source productivity, all yet to be investigated. If food source productivity increases the change may even be positive for rock lobster production.

The extent of the changes reported raises many more questions than answers at this point in time and requires attention from both an ecological understanding on its impact on rock lobster biology and population as well as future stock assessment and resource risks.

Two of the four projects defined in Appendix 5 can be probably done with existing Department of Fisheries resources and two require possibly new Industry and/or FRDC funding. The summary table also provides a substantial starting point for inclusion of information needs for biological, economic and market analyses in the guidelines proposed under Recommendation 13.

Project 4 in Appendix 5 provides considerable guidance on the types of information market and economic analyses that could be undertaken by an analyst as per Recommendation 12. This insight is substantially augmented by the report presented in Appendix 4. Both of these appendices provide topics of research and evaluations that could be done by the analyst as well as outcomes of some analyses of trade data in Appendix 4.

In addition the Beta version of the Seafood Trade Dashboard being developed by FRDC will add to the capability of an analyst reporting on Australian trade data (C. Ashley, FRDC. July, 2016. pers. comm.).

Some of the key analyses that could be undertaken are identified as follows:

- i. Changing and increasing supply of world lobster products into China provides a long term perspective of changing competition in the market and a measure of likely substitution and changing pressure on WA rock lobster prices.
- ii. Trends in Australian and New Zealand trade figures provide a perspective of price inter relationships between competing products. It would be expected that the relationship between WA prices and other Australian states and NZ prices for rock lobster should trend together over time. As the free trade implementation takes place, with more direct transport and reduced mortality etc., it could be expected these price differences (i.e. NZ, Southern States and WA live product) may get closer together. This data could also be examined historically to assess whether the effect of moving to ITQ and lower TACC in recent years has brought prices closer. Trade data from the Australian Bureau of Statistics and New Zealand is available.
- iii. An analysis of live product trade value and quantity on a monthly basis, corrected for exchange rates say over a six year period ought to give further insights of changes in supply and price response.
- iv. Processors may supply a time series from their records on quantities exported and beach price on a weekly or monthly basis. A time series of this type from one processor out of the four major processors could be sufficient to provide insights on price and changing supply response (at constant exchange rate data corrected). Obtaining this type of commercial data will need to be supported with confidentiality and data audit provisions for it to be provided on a voluntary basis.
- v. Similarly market data on prices for cooked whole frozen and green whole frozen expressed in live weight equivalent, corrected for variable costs for processing, transport and marketing can provide a contribution margin picture as an indicator of difference in contribution to overall beach price from different products. Again this may need to be sourced from a processor(s).
- vi. Advice on \$US price for live product in different markets compared with China market price say in Japan, Taiwan or parts of Europe again may give insights. Again this can be sourced from trade data or from a processor or independent marketer(s). Interpretation of this data without input from a person active in the market may be flawed.

- vii. Data supporting appraisal of economic conditions in major markets- for example understanding economic trends in markets, level of retail expenditure, growth in middle class wealth and population, top centres of economic wealth and emerging destinations, transport trends into country of destinations and within country, currency trends; etc. can provide insights on changing market conditions and likely trends in demand.
- viii. Data analysis and verification of expected outcomes for information used to form TACC decisions as quota changes are implemented is an essential requirement to building knowledge on the success of decision making.

The core requirement apart from building knowledge on the market is understanding the likely response to price both with and without currency movements from changes in supply and the TACC. At best history is no guarantee of the future and judgements are required. The ongoing analysis from time to time of the harvest rate range for MEY as the biological model and fleet cost alter over time is also essential.

The 2 Appendices (4 and 5) should be referred to the Research and Development Advisory Group for implementation.

Whilst there currently exists a risk assessment frame work for the scientific work with appropriate key performance indicators used for biological sustainability assessment undertaken in this fishery by the Department of Fisheries, a similar approach should be developed for the assessment for information used from market and economic evaluations used as part of decision making for TACC advice. At the moment it is too early to commence that work as the WRLC has to date had little experience in economic or market data analysis but expectantly within the next two to three years into the future with experience in the use of market and economic data and research, this need should be met. Ideally this development should align with the revision of the Harvest Strategy required for 2020-2025.

The development of an evaluation frame work for assessing economic and marketing information requires the prioritisation of key information requirements for understanding likely impacts of changes in the TACC on future revenue, costs and profitability of the industry. This framework should be developed in accordance with its key objectives, the relevance of the information and evaluated against the key risks impinging on the industry now and into the future and its own risk appetite in decision making. Key economic performance indicators relevant to attaining longer term MEY objectives once developed, must form the basis for future assessment reporting and TACC amendment. The use of KPI's in other rock lobster commercial fishery jurisdictions will assist this development (see South Australian rock lobster fishery example, EconSearch, 2015).

Part of the supporting research strategy for the TACC setting advice role proposes the WRLC (in Appendix 5), assuming over time final responsibility for the functions of

economic and market research advice on the management of the commercial fishery and forwarding that relevant advice on TACC to the Minister and the CEO. This approach clearly separates the role of the WRLC from that of the Department of Fisheries on matters of marketing and industry economics with the primary responsibility of science remaining with the Department.

Future consideration on the importance of the rock lobster industry to the Western Australian economy is also an area of future research and reporting that could add political status to the importance of the industry as part of its standing with the community. The research required would include cost surveys of the fishing fleet preferably categorised by fleet size composition and home port data every three to five years, the incorporation of transport, processing and marketing costs and value adding inclusive of revenues received and economic multipliers, building a description of the overall economic contribution of the rock lobster Industry to the State of Western Australia (see South Australian rock lobster fishery example, EconSearch, 2015). This survey work on costs would complement and support future work by the Council on MEY analyses.

#### Recommendations

- 16. That the information and research needs for setting TACC for the fishery as described in Appendices 4 and 5 and accompanying strategies be noted by the WRLC and the Department of Fisheries and be considered through the Research and Development Advisory Group for advice on future implementation.
- 17. That the WRLC progress the development of an evaluation framework for considering economic, market and social data using a risk based approach in the assessment of these factors in advising on future TACC determinations within the next 3 years.
- 18. That the WRLC and the Department of Fisheries note that in the medium term it is proposed the work on markets and economics for management of the fishery will be assumed by the Council over the next five years as new economic models are constructed. The timing and priority for those changes to be discussed between the parties.

The advice role resting with the WRLC to optimise the profitability of the Western Rock Lobster Fishery, its asset value and the social and economic contribution to Western Australia brings considerable responsibility to the Council and presents a number of challenges. The advice role on the determination of TACC is arguably the most important step. It also brings with it the need for the WRLC to deal with a range of issues into the future.

These include oversighting risks around black marketing of rock lobster, managing future demands on the fishery for increasing catch shares sought by other resource users, public perceptions of the industry both locally in Western Australia and internationally, retaining the social licence to fish and maintaining and improving property rights are some of these. The action of not meeting the long term objective of

harvesting at a long term level below MEY brings with it a new set of risks. Full justification of proposed decisions on TACC by the WRLC is a must.

To this one could add the value of opportunity and constraints that comes from understanding emerging trends including technological change, market shifts, new international trade agreements, food technology developments, changing fishing fleet efficiencies and size of fleet, and new developing markets and emerging regulatory environment. Undoubtedly there are others. Examination of "what if" scenarios adds to the management of risk as well as opportunity.

Many of these can ultimately impact on the overall performance and value of the industry and in some circumstances impact on advice provided on TACC determination. How the Council deals with these issues is fundamental to the Industry's future well-being and its funding.

#### Recommendation

19. An ongoing strategic approach by the WRLC in providing professional evidence based advice on the future setting of TACC's for the commercial Western Rock Lobster Fishery, must go hand in hand with providing ongoing leadership in managing the broader issues, risks and opportunities for a better Industry future. Some of these risks are being articulated in a separate FRDC project that is currently underway. Without adequate resourcing of the WRLC, the future will be determined by others.

#### **Resource Sharing**

During 2006 the Integrated Fisheries Allocation Committee recommended to the Minister for Fisheries within an Allocation Report for the Western Rock Lobster Resource an allocation of 4.9% and 95.1% of the TAC as proportional catch shares to the recreational and commercial sectors respectively (Integrated Fisheries Allocation Advisory Committee, 2006). This was subsequently changed by the Minister to 5% and 95% respectively and has been accepted as the standard for the Western Rock Lobster Fishery under a five year moving average as a performance indicator. The basis of this allocation reflected the catch history of sector harvest levels in the fishery and some future projections.

Since this allocation policy has been determined, the management of the commercial fishery has shifted from input based controls into quota management with the formal setting of TACC's under the Harvest Strategy with a management economic objective of MEY as a longer term criteria. There was no formal discussion or decision under this change in management approach on the resource sharing objectives for the fishery. It is also noted the commercial fishery is currently operating at a harvest rate significantly below the harvest rate range at MEY projected in the Harvest Strategy report. This will change over time.

Arguably the allocation share to the recreational sector could be set at 5% (1/19<sup>th</sup> of a TACC) of a TAC derived from an estimated TACC in the higher end of the acceptable projected harvest range of MEY for the commercial fishery. This is apparently the current approach to informally determining the TARC based on an assumed harvest rate and level of TACC at MEY. This approach could change as the recreational catch is incorporated into the stock assessment modelling.

How the recreational catch share is established in the ARMS for the fishery and how it will be managed into the future is of vital interest to both the commercial and recreational sectors as well as the Department of Fisheries in moving forward under the provisions of the Aquatic Resources Management Bill. Active engagement by all parties reaching resolution on this issue is desirable otherwise the Minister by necessity will need to determine a final policy position.

#### Recommendation

20. That clarification of policy objectives around resource sharing between the commercial and recreational rock lobster fishery sectors is a prerequisite for progressing the ARMS and Harvest Strategy under the Aquatic Resources Management Bill.

#### Implications

The outcomes to be achieved from adoption of this report's recommendation will substantially change the roles and responsibilities of the Department of Fisheries and the WRLC in the provision of economic data and analysis in ensuring the economic performance of the commercial Western Rock Lobster Fishery in Western Australia into the future. The development of economic and market analytical capacity by the WRLC is seen as a key recommendation to the rock lobster industry. This will enable the Council to provide evidence based accountable advice for TACC determination decisions.

How the WRLC engages with the Department and other stakeholders in the further development of the legislative framework for the Regulations, the ARMS, the ARUP, revision of the Harvest Strategy for the fishery and future advice roles in determining TAC and TACC will be fundamental to achieving long term resource security for the fishery. Without industry involvement potentially optimal benefits for the community of Western Australia and the rock lobster industry itself may not be achieved as other vested interest groups seek to manage the agenda.

The proposals outlined in this report cannot be implemented taking into account industry's interests without adequate resourcing of the WRLC by the commercial sector of the rock lobster Industry to enable it to have the capacity and leadership to be able to effectively influence future management settings for the fishery and secure industry's future. This will require strong and active leadership from the current Council membership and advocacy for the discussion of this report's findings with industry and

other stakeholders and the determination of an agreed implementation strategy between parties.

The likely time frames for full implementation of the new legislative framework required by the Aquatic Resources Management Bill for the rock lobster fishery could be expected to take between three and five years. In the same time period the China Australia Free Trade Agreement will fully come into effect with significant changes expected to occur in how Australia markets live rock lobster with the potential to fundamentally alter distribution channels into and within China. How these changes impact on the rock lobster industry and markets needs explanation particularly for future advice on TACC determination.

This report has also drawn attention to urgent science research needs that must be addressed as a priority, as some of the assumptions around the current modelling work for rock lobster population stock assessment may no longer remain valid. This could particularly be the case in northern areas of the fishery where fundamental long term changes in ecosystem function from temperate to tropical based fish communities are understood to have occurred with extensive loss of kelp beds.

The WRLC need to embrace all of these implications in partnership with its key stakeholders to more accurately assess and advise on future TAC and TACC determinations given current stock uncertainties for Australia's most valuable commercial fishery.

On the 4<sup>th</sup> October 2016, the Western Australian Minister for Fisheries wrote to the WRLC advising that the TACC for the 2017/18 and 2018/19 fishing seasons will be 6,300 tonnes, an increase of 300 tonnes. The early appointment of an analyst by the WRLC proposed by this report will enable work to commence on understanding the marketing of the additional quota and monitoring and evaluating the impact of increasing the TACC on prices paid for W.A. rock lobster as well as gaining an understanding of likely changes to the China rock lobster market as tariffs continue to fall under the China Australia Free Trade Agreement. Should the price response to increase in supply be elastic, there is the potential to further increase the TACC in the order of a thousand to fifteen hundred tonnes across future years with better certainty and industry confidence around analysis of maximum economic yield and improved certainty of both the science and the market.

## Extension and Adoption

A copy of this report needs to be made available to all MFL holders within the Western Rock Lobster fishery. This could be achieved by placing a copy of the report on the WRLC website as well as forwarding the report in PDF format to all MFL holder licensee's on the Council's electronic mailing list. The responsibility for distribution and extension throughout the industry is that of the primary sponsor to the project, the WRLC. This should include the processing and marketing sector for Western Rock Lobster.

Ideally the report in electronic format should also be forwarded formally by the WRLC to the Western Australian Department of Fisheries, the Western Australian Fishing Industry Council and Recfishwest coupled with an invitation to a joint meeting of relevant CEO's to discuss the creation of a steering committee to determine a strategy for implementation of the various parts of the report's recommendations. This is muted in the reports foreword.

The WRLC already has an existing consultative process with MFL holders through the rock lobster fishermen's associations. There would be value in confirming industry's support for progressing the report's recommendations, taking into account financial implication prior to committing of resources and progressing the report's recommendations with external stakeholders to the rock lobster catching sector. This is a matter for the Council chairman, its CEO and the Board.

## Further Development

As outlined in Recommendations 12, 16 and 17 of this report and its associated appendices, further development of research needs in areas of science, economics and applied market analysis have been identified. These need to be further developed into project form for formal consideration by the WRLC and the Department of Fisheries. Some of these projects will require application to FRDC and funding to proceed. These need to be progressed through the Research and Development Advisory Group.

Other areas of development could include a better industry understanding of the implications and measured impact of trade changes expected from the changes in the China Australia Free Trade agreement which will become fully effective on January 1, 2019 for all seafood. Competition from the non-seafood sectors of the Australian food export businesses for transport and market access noting the importance of meat, dairy products, fruit and vegetables in trade could potentially impact on access issues for Australian seafood exports to China. A watching brief and an Australian fishing industry wide approach is warranted.

Another area of stock assessment requiring attention is the development of science and methodology to detect shifts in stock status in the event the Western Rock Lobster Fishery rebounds to stock and recruitment levels hither to, not experienced in the fishery. Whilst not seen as an immediate priority, a rapid rebounding of rock lobster breeding stock levels against a historical back ground of lower abundance of predatory fish and changes in ecosystem functioning for parts of the fishery and environmental changes, has the potential to create a much higher yielding population and fishery than historically the case. Such a scenario is not in the principal author's view out of future scope and warrants attention should catch rates continue to climb longer term.

## Appendix 1: Current Status of the Western Rock Lobster Fishery Part 1 Total Allowable Catch Assessment for 2017 Western Rock Lobster season

This working paper was prepared as part of the background documentation presented to the western rock lobster industry at the AMM's on the 13<sup>th</sup> and 16<sup>th</sup> of June 2016. It forms part of the input to the WRLC in the formulation of advice on the setting of TACC for the commercial sector fishery for 2017. It effectively provides a stock assessment status of the resource and a number of scenario analyses for different TACC settings updated with the current information.

Part 2 Assessment of proposed 6300 t total allowable catch for 2017 Western Rock Lobster season

This working paper was prepared post the receipt of TACC advice from the WRLC for the 2017/18 year to the Minister for Fisheries and provides much of the same information but updated with confidence limits set around the data presented together with projected impacts of TACC proposals.

# Total Allowable Catch Assessment for 2017 Western Rock Lobster season

## Updated Aug 2016 to incorporate latest information

Simon de Lestang, Jason How, Nick Caputi

04 August 2016

## Background

The Harvest Strategy and Control Rules (HSCR - Fisheries Management Paper #264: (<u>fmp264.pdf</u>) for the Western Rock Lobster Fishery (the Fishery) has been formally adopted by the Minister for use over five years. This therefore has been used as the basis for the assessment of the 2017 total allowable commercial catch (TACC). This HSCR was used in the assessment of the 2015 and 2016 season's TACC. The objectives of the HSCR are:

- Sustainability: To ensure that the egg production in each of the four Breeding Stock Management Areas of the Fishery remain above their respective threshold values for the next five years with a probability greater than 75%.
- Harvest: Once the Sustainability Objective has been satisfied, TACCs for the Fishery shall use the principle of Maximum Economic Yield to determine a range of TACCs that would optimise the economic performance of the Fishery by achieving the best catch and catch rates combination, and thereby providing high economic returns and greater amenity to the Fishery and the West Australian community.

The allocation principles used within the HSCR are:

- The TACC is to be split 50:50 between the northern (Zones A and B) and southern (Zone C) regions of the Fishery. This principle will be applied after the Sustainability and Harvest Objectives have been met.
- The TACC for the northern zone is to be further split 36% : 64% between A and B zones. This is consistent with the historic 10-year average between the 1998/99 and 2007/08 seasons and has been used as the basis for setting catch allocations since TACCs were introduced for each Zone.

The TACC range generated based on the MEY principles for the 2015 season was 6343 to 7670 t. For the 2016 season, rather than produce a TACC range, the direction in which the TACC should be changed to move it towards MEY was determined and provided to industry. This change in process followed recommendations from a <u>report</u> finalised by Economic Research Associates in 2015. This report suggested that it was difficult to accurately project scenarios too far away from the 2015 TACC of 6000 t. The 2016 TACC was maintained at 6000 t, which is well below that associated with MEY, it might be again better to determine the 'direction' of MEY in relation to the current TACC.

A similar process to that used in setting he 2016 TACC will again be used for the 2017 TACC. As per 2016 TACC, information on the direction the TACC could be moved towards MEY will be augmented with information based on available empirical information (e.g. catch and harvest rates, egg production etc.) and from a survey of industry (see link) to produce a "weight of evidence" approach.

The fishery-wide TACC determined by the Minister, following input from the Western Rock Lobster Council, for the 2016 season was the same as the 2015 season, at 6000 t. The zone specific levels were set at 1080, 1920 and 3000 t in zones A, B and C, respectively.

A more detailed description of the stock assessment process including the biological and economic modelling used within the TACC setting processes is provided in "Stock Assessment for the Western Rock Lobster Fishery" - Fisheries Research Report #217: <u>frr217.pdf</u>.

#### **Current situation**

The Western Rock Lobster (WRL) stock assessment model has been updated with all current data on puerulus settlement, breeding stock survey, commercial monitoring, catch and effort and tag recaptures.

The model assumes that the current (2016) season's biological controls (minimum size reduced to 76 mm and the removal of maximum size rule for the entire season and setose rule for part of the season) are maintained in the assessment for the following five seasons.

#### **Empirical Assessment**

The empirical assessment examines a range of observed indices developed from Commercial Catch and Effort statistics, Catch Disposal Records (CDR), the Independent Breeding Stock Survey (IBSS) and the Puerulus Settlement monitoring. This assessment indicates that:

- Standardised catch rates are at very high levels in all fishing zones (Fig. 1): Catch rates are standardised to account for the high grading of legal lobsters which began in the 2010/11 fishing season and for variation in the timing of when catch has been landed (i.e. to remove the influence of variable monthly catchability and abundance). In the two coastal zones (B and C) standardised catch rates are currently at record levels, while in Zone A, catch rates have been increasing for the past three seasons and are almost back to the record level. Causes of high catch rates include the improved recruitment, the large proportion of residual biomass left each season because of the conservative catch quotas and the removal of protection from setose and maximum size females.
- Egg production is at high levels throughout fishery (Fig. 2): The preliminary assessment of the 2015 independent breeding stock survey (IBSS) showed a decrease in egg production at five of its seven sites. Big Bank (which has been closed to fishing) showed an increase in egg production while at the Abrolhos Islands the index stayed level.

Although the IBSS egg indices are standardised for water temperature and swell, not all inter-annual variation in catchability is removed from the index. Tag-recapture information from the 2015 IBSS indicated that catchability during the survey was less than that in the previous (2014) year, which would cause some of this apparent decline in egg production. Irrespective of the catchability issue a review of these 2015 results is being conducted.

Lobsters take about six years to grow from puerulus into mature adults. With this time lag lobsters which settled in 2008/09 and 2009/10 would be the dominant age classes entering the breeding stock in 2015. It is therefore not surprising egg production indices have dropped slightly, since 2008/09 and 2009/10 were the lowest settlement years on record (this pattern is shown in the model indices as well). In 2016 we should start to see lobsters which settled as puerulus in 2010/11, which was a better settlement, entering the breeding stock and improving breeding stock levels.

- Recruitment into the fishery is increasing (Fig. 3): Since 2008/09 puerulus settlement in all locations has increased slowly. In 2013/14 the fishery received very high levels of recruitment, near long-term record highs. This good settlement will be entering the fishery during the 2017 season. The 2014/15 settlement saw a reduction in recruitment from the previous year's very high levels, although they were still above average levels two-years before 2013/14. 2015/16 has seen essentially the same levels of settlement as in 2014/15. In 2015/16, the recruitment levels in the north of the fishery were equal to the long-term average level of settlement. The puerulus recruitment of 2015/16 will enter the fishery as juvenile red lobsters in autumn 2019 and as white lobsters in spring/summer of 2019.
- Fishing effort and vessel numbers have declined (Fig. 4): The fleet fishing for lobster has declined from 233 in 2014 to 213 in 2015 and total potlifts have declined from 2.37 million in 2014 to 2.09 million in 2015. Combinded, these result in a reduction in fishery-wide costs.
- Legal biomass increased markedly in 2015: The proportion of the stock considered legal has increased substantially in 2015 due to the removal of protection to setose (1 July 14 November 2015 onwards) and maximum sized females and a reduction in the minimum size (77 to 76 mm).



Figure 1. Standardised catch rates of legal lobsters by Zone

Catch rates have been standardised to account for the introduction of high grading legal lobsters which began in the 2010/11 season (Fig. 1). The average rate of high grading over this period is  $\approx$  15%. Catch rates have also been standardised to remove the monthly influence of variable abundance and catchability as well biases introduced into the index by changes in fishers behavior. For example in some years, large amounts of quota, especially in deep water A zone, have been taken in during periods of high catch rates, thus biasing the annual catch rate estimate. These biases has been removed by modelling the data with a general linear model that incorporates fishing season, depth, month and zone as factors. The average response for each season in each zone has been produced.



Figure 2. IBSS egg production indices

Mean  $\pm$  1 s.d. of egg production from seven areas of the fishery determined from data collection during the annual IBSS (Fig 2). Missing values represent years when that site was not sampled. Egg indices are standardised for changes in water temperature, swell height and sub-location.



Figure 3. Regional puerulus settlement levels

Settlement levels have been standardised to account for a change in fiber type and missing months (Fig. 3).



#### Figure 4. Effort-Vessel numbers relationship

Relationship between the number of pot lifts and number of vessels in the fishery since moving to quota (Fig. 4) shows that as effort has declined the numbers of active vessels has also decreased. This decline has been relatively consistent. It is likely that this decline in vessels is impacted not only by potlifts but by other factors such as lease prices.





Zone C Catch Rate



A range of projections of model derived catch rates are shown, representing different levels of TACC (Fig 5). The numbers associated with the various projections represent the overall annual TACC. These catch rates take into account high grading and therefore represent the average annual catch rate after high grading has occurred (unlike the standardised catch rates in Fig. 1 which include the catch of high-graded lobsters). Up to 2019 catch rates are influenced by known levels of puerulus settlement and are identified by the black numbers, with future years being based on puerulus settlement which has been conservatively assumed to be the lower of either  $25^{th}$  percentile or the previous year's settlement (these estimates are identified by the grey

numbers). These projections assume that future years remain similar to the most recently completed fishing season in terms of:

- Effort distribution.
- The proportion of legal catch discarded (high graded).
- Environmental conditions (water temperatures and swell).









A range of projections of model-derived catch rates are shown, representing different levels of annually increasing TACC by a fixed tonnage (Fig 6). In these scenarios the TACC is increased each year for the next five seasons by a constant amount (either 100, 200, 300, 400 or 500 t). For example, on the figure 100 refers to the scenario where the TACC is increased by 100 t every season: 6100 in first year, 6200 t in second year, 6300 t in the thrid year, 6400 t in the fourth year and 6500 t in fifth year).



Figure 7. Model projected egg production for different levels of TACC

Model derived estimates of egg production are shown in the four Breeding Stock Management Areas (BSMA) (Fig 7). Historical levels are identified by open circles, while projections are represented by dotted lines. Numbers associated with each dotted line identify the whole of fishery TACC for that scenario. Horizontal orange and red lines represent threshold and limit reference levels.



Figure 8. Model projected egg production for different levels of annually increasing TACC by 100 to 500 t from the current level of 6000 t.

Model derived estimates of egg production are shown in the four Breeding Stock Management Areas (BSMA) (Fig 8). In these scenarios the TACC is increased each year for the next five seasons by a constant amount (either 100, 200, 300, 400 or 500 t). For example, on the figure 100 refers to the scenario where the TACC is increased by 100 t every season: 6100 in first year, 6200 t in second year, 6300 t in the thrid year, 6400 t in the fourth year and 6500 t in fifth year).



#### Figure 9. Model estimated harvest rates

Model-derived estimates of harvest rate (legal proportion harvested) are shown for each fishing season in the northern (Zones A and B) and southern (Zone C) regions of the fishery (Fig 9). The harvest rate is the proportion of the legal biomass taken each season. Therefore the higher this value indicates that a greater proportion of legal lobsters are being captured, and lesser "residual" lobsters are being left. The break in the series is caused by the extended 2011/13 fishing season. This extension resulted in the following season being considered the 2013 season.

#### Weight of evidence summary

#### The key indicators of the assessment show that:

- Standardised catch rates are at very high levels in all fishing zones (Fig. 1)
- Egg production is at high levels throughout fishery (Fig. 2)
- Recruitment into the fishery is increasing (Fig. 3)
- Fishing effort and vessel numbers have declined (Fig. 4) and harvest rates are at very low levels (Fig. 7)
- TACC projections indicate that improved catch rates are expected in 2017 (Figs 5 and 6) and very high egg production will continue under all TACC scenarios modelled (Figs 7 and 8).

Based on the above it is likely that increasing the TACC in 2017 would still result in economical catch rates and healthy levels of egg production.

# Assessment of proposed 6300 t total allowable catch for 2017 Western Rock Lobster season

## Updated Aug 2016 to incorporate latest information

Simon de Lestang, Jason How, Nick Caputi

04 August 2016

## Background

In April 2016, the Western Rock Lobster Council (WRLC) was provided with an assessment of the Western Rock Lobster stock and scenarios showing the likely impact of allocating a range of future Total Allowable Commercial Catches (TACC) projected over the subsequent five fishing seasons.

Based on industry feedback at the Annual Management Meetings and on the process outlined in the Western Rock Lobster Harvest Strategy and Control Rules (HSCR -Fisheries Management Paper #264: (<u>fmp264.pdf</u>), the WRLC subsequently provided a TACC submission to the minister of fisheries in July 2016. This submission requested that the Western Rock Lobster TACC for 2017 fishing season be set at 6300 t. The submission also indicated that the WRLC were likely to seek the same TACC for the 2018 fishing season and that they would like to continue to take setose lobsters between May and October.

Based on the WRLCs submission to the Minister, the stock assessment and projections have been reproduced, focussed solely on the 6300 t scenario. This allows the inclusion of associated error structures in the projections.

### Current situation

The stock assessment and projections have been based on a future TACCs of 6300 t for the five subsequent fishing seasons (2017 - 2021). The continued removal of the protection of setose lobsters during the Months of May - October has also been included.

This document represents the final check of the validity of the proposed TACCs for the coming fishing season(s) against the biological and harvest objectives in the HSDR

### **Empirical Assessment**

The empirical assessment examines a range of observed indices developed from Commercial Catch and Effort statistics, Catch Disposal Records (CDR), the Independent Breeding Stock Survey (IBSS) and the Puerulus Settlement monitoring. This assessment remains the same as that provided before and indicates that:

• Standardised catch rates are at very high levels in all fishing zones (Fig. 1): Catch rates are standardised to account for the high grading of legal lobsters which began in the 2010/11 fishing season and for variation in the timing of when catch has been landed (i.e. to remove the influence of variable monthly catchability and abundance). In the two coastal zones (B and C) standardised catch rates are currently at record levels, while in Zone A, catch rates have been increasing for the

past three seasons and are almost back to the record level. Causes of high catch rates include the improved recruitment, the large proportion of residual biomass left each season because of the conservative catch quotas and the removal of protection from setose and maximum size females.

• Egg production is at high levels throughout fishery (Fig. 2): The assessment of the 2015 independent breeding stock survey (IBSS) showed a decrease in egg production at five of its seven sites. Big Bank (which has been closed to fishing) showed an increase in egg production while at the Abrolhos Islands the index stayed level.

Although the IBSS egg indices are standardised for water temperature and swell, not all inter-annual variation in catchability is removed from the index. Tag-recapture information from the 2015 IBSS indicated that catchability during the survey was less than that in the previous (2014) year, which would cause some of this apparent decline in egg production.

Lobsters take about six years to grow from puerulus into mature adults. With this time lag lobsters which settled in 2008/09 and 2009/10 would be the dominant age classes entering the breeding stock in 2015. It is therefore not surprising egg production indices have dropped slightly, since 2008/09 and 2009/10 were the lowest settlement years on record (this pattern is shown in the model indices as well). In 2016 we should start to see lobsters which settled as puerulus in 2010/11, which was a better settlement, entering the breeding stock and improving breeding stock levels.

- Recruitment into the fishery is increasing (Fig. 3): Since 2008/09 puerulus settlement in all locations has increased slowly. In 2013/14 the fishery received very high levels of recruitment, near long-term record highs. This good settlement will be entering the fishery during the 2017 season. The 2014/15 settlement saw a reduction in recruitment from the previous year's very high levels, although they were still above average levels two-years before 2013/14. 2015/16 has seen essentially the same levels of settlement as in 2014/15. In 2015/16, the recruitment levels in the north of the fishery were equal to the long-term average level of settlement. The puerulus recruitment of 2015/16 will enter the fishery as juvenile red lobsters in autumn 2019 and as white lobsters in spring/summer of 2019.
- Legal biomass increased markedly in 2015: The proportion of the stock considered legal has increased substantially in 2015 due to the removal of protection to setose (1 July 14 November 2015 onwards) and maximum sized females and a reduction in the minimum size (77 to 76 mm).



Figure 1. Standardised catch rates of legal lobsters by Zone

Catch rates have been standardised to account for the introduction of high grading legal lobsters which began in the 2010/11 season (Fig. 1). The average rate of high grading over this period is  $\approx$  15%. Catch rates have also been standardised to remove the monthly influence of variable abundance and catchability as well biases introduced into the index by changes in fishers behaviour. For example in some years, large amounts of quota, especially in deep water A zone, have been taken in during periods of high catch rates, thus biasing the annual catch rate estimate. These biases has been removed by modelling the data with a general linear model that incorporates fishing season, depth, month and zone as factors. The average response for each season in each zone has been produced.



Figure 2. IBSS egg production indices

Mean  $\pm$  1 s.d. of egg production from seven areas of the fishery determined from data collection during the annual IBSS (Fig 2). Missing values represent years when that site was not sampled. Egg indices are standardised for changes in water temperature, swell height and sub-location.



Figure 3. Regional puerulus settlement levels

Settlement levels have been standardised to account for a change in fibre type and missing months (Fig. 3).



#### Figure 4. Model projected catch rates (with 95% CI) with a fixed TACC of 6300 t.

Projections of model derived catch rates and their 95% confidence intervals (CI) resulting from future TACCs set at 6300 t show that a general increase in catch rates would occur in all three management zones of the fishery (Fig 4). These catch rates take into account high grading and therefore represent the average annual catch rate after high grading has occurred (unlike the standardised catch rates in Fig. 1 which include high-graded lobsters in the catch of ). Up to 2019 catch rates are influenced by known levels of puerulus settlement and are identified by the black point, with future years being based on puerulus settlement which has been conservatively assumed to be the lower of either  $25^{th}$  percentile or the previous years settlement (these estimates are identified by the open points and dotted lines). These projections assume that future years remain similar to the most recently completed fishing season in terms of:

- Effort distribution.
- The proportion of legal catch discarded (high graded).
- Environmental conditions (water temperatures and swell).



Figure 5. Model projected egg production (with 95% CI) with a fixed TACC of 6300 t.

Model derived estimates of egg production are shown in the four Breeding Stock Management Areas (BSMA) (Fig 5). Historical levels are identified by solid lines, projections from a TACC of 6300 t are represented by dotted lines and 95% CIs are shown in grey. Horizontal orange and red lines represent threshold and limit reference levels. **Northern Harvest Rate** 



#### Figure 6. Model estimated harvest rates (with 95% CI) with a fixed TACC of 6300 t.

Model-derived estimates and 95% CI of harvest rate (legal proportion harvested) are shown for each fishing season in the northern (Zones A and B) and southern (Zone C) regions of the fishery (Fig 6). The harvest rate is the proportion of the legal biomass taken each season. Therefore the higher this value indicates that a greater proportion of legal lobsters are being captured, and lesser "residual" lobsters are being left. The break in the series is caused by the extended 2011/13 fishing season. This extension resulted in the following season being considered the 2013 season. Historical levels are identified by solid lines, projections from a TACC of 6300 t are represented by dotted lines and 95% CIs are shown in grey.

#### Weight of evidence summary

#### The key indicators of the assessment show that:

- Standardised catch rates are at very high levels in all fishing zones (Fig. 1)
- Egg production is at high levels throughout fishery (Fig. 2)
- Recruitment into the fishery is increasing (Fig. 3)

- Projections indicate that catch rates and egg productions are expected to continue/increase under a TACC of 6300 t for 2017 onwards (Figs 4 and 5).
- Harvest rates are at very low levels and projected to decline further under a TACC of 6300 t for 2017 onwards (Fig. 6).
  Based on the above it is likely that a TACC of 6300 t 2017 will result in economical catch rates and healthy levels of egg production.

# Appendix 2: Present Approach to setting the TACC for the Fishery including Harvest Strategy

The Western Rock Lobster Council (WRLC) is the peak industry body representing the interests of Managed Fishery Licence (MFL) holders of the West Coast Rock Lobster fishery. The Council itself has eight fishermen representatives elected annually by MFL members, some of which are affiliated with the eight regionally based Professional Fishermen Associations. The Council is also in the process of appointing an independent community member to the Council. The processing and marketing sector of the rock lobster industry is not represented by the Council.

The primary role of the Council is to represent the interest of catching sector through MFL holders on the management of the commercial fishery and more particularly under the West Coast Rock Lobster Harvest Strategy and Control Rules 2014-2019. The Council provides written advice on the Total Allowable Commercial Catch (TACC) and on management for the commercial fishery to the Minister for Fisheries, upon the annual receipt of a request to do so from the Department of Fisheries.

On other matters impinging on the interest of the fishery, this role is shared between the Council and as appropriate with the Western Australian Fishing Industry Council. More details can be found on the Council's website.

The commercial rock lobster fishery accounts for ca. \$400 million annual export revenue for Western Australia and has a current licence asset value of ca. \$4 billion based on a 6000 tonne TACC. The Industry still provides a significant economic and social contribution to many regional coastal towns but at a much reduced level with the essential lowering of the total catch and substantial reduction in vessel numbers operating in the fishery since the advent of quota management.

The process undertaken by the Western Rock Lobster Council (WRLC) to make annual recommendations to the Minister for Fisheries on TACC is a consultative and collaborative one with members of industry and the Department of Fisheries.

A strong economic performance and a number of key achievements have highlighted the past year for the rock lobster sector – the State's most valuable commercial fishery. In addition, extensive research has been undertaken by the Department of Fisheries, in conjunction with the industry, to monitor the fishery, ensure sustainability, improve catch rates and residual rock lobster abundance and through models, project future

catch rate and breeding stock levels for future scenario analyses of various TACC strategies.

In addition to the research undertaken by the Department, the WRLC instigates targeted research projects under the Industry Partnership Agreement (IPA) with the Fisheries Research and Development Corporation. Examples of such projects currently include;

- A comprehensive industry risk analysis project to better understand the risks that may adversely affect the rock lobster industry and the mitigation and management measures that can be undertaken.
- A project to establish a low risk incremental approach for setting TACC's (changing quotas) in the western rock lobster fishery taking into account maximum economic yield and other industry objectives.

The WRLC has also established an operational Research Development and Advisory Group (RDAG) that has achieved significantly improved operation of the IPA bringing together the more formal engagement of the Fisheries Department scientists and managers in determining with the Council, research and funding priorities for the rock lobster resource.

Each year the WRLC undertakes extensive consultations with the Department and with industry members. Meetings are held with regional professional fishermen's associations (PFA's) and processors, as well as other key stakeholders in the industry. Annual Management Meetings (AMM's) are held to allow the Department to provide a summary of research findings and provide information on stock assessments. Presentations are also made to industry members on various research projects and management and operational matters. A separate industry forum is also convened to allow frank and open discussion amongst industry members on management issues as well as discussions on advice for TACC settings.

Following the AMM's, the WRLC requests PFA's to complete a questionnaire on the issues that require a recommendation to be made to the Minister. The WRLC Board then meets to consider the research findings, matters discussed at the AMM's, questionnaire responses, and other feedback obtained from industry and stakeholders.

Having considered these matters the WRLC Board then agrees the scope of the recommendations that will be made to the Minister that best reflects the views of industry and having regard to the best interests of the industry and fishery overall. A letter of recommendation, which includes an outline of the material used and reasons for any recommendation, is then provided to the Minister and the Department. In accordance with the Harvest Strategy, the WRLC advice is provided on the next TACC determination and where appropriate the Council has provided an indicative TACC forecast (and reasons) for a subsequent year in order to achieve greater planning certainty.

Further advice is also provided on management changes and directions on the management rules for the fishery.

The close and co-operative working relationships that are a consistent theme for the WRLC and the rock lobster industry continues to result in outcomes that benefit Western Australia. The responsible behaviour of the industry in numerous areas continues to provide better insights into the fishery and provide a robust foundation for the growth of the fishery. It also provides a strong position for industry to make recommendations in the best interests of the future of the industry.

Whilst evidence around the science and its assessment is of leading world standards, the Council recognise that much of the evidence presented around the market and economic performance of the commercial rock lobster was currently under developed and needed focused attention. Pending changes to the Aquatic Resources Management Bill, the progression of the China Australian Free Trade Agreement and the opportunity arising from current rapid rebuilding of the rock lobster resource all featured as reasons for the two IPA funded research projects including the review of the current Harvest Strategy which is incorporated in full in this Appendix.

WRLC, July 2016.

# WEST COAST ROCK LOBSTER HARVEST STRATEGY AND CONTROL RULES 2014 – 2019

FISHERIES MANAGEMENT PAPER NO. 264

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

June 2014

ISSN 0819-4327
West Coast Rock Lobster Harvest Strategy and Control Rules 2014 - 2019

June 2014 Fisheries Management Paper No. 264 ISSN 0819-4327



Government of Western Australia Department of FIsherles

# CONTENTS

INTRODUCTION1				
1.0	OBJECTIVES	. 2		
	1.1 Sustainability Objective	. 2		
	1.2 Harvest Objective	. 2		
2.0	KEYMANAGEMENT PRINCIPLES	. 4		
3.0	TACC SETTING PROCESS	. 4		
API	ENDIX 1	. 6		
API	ENDIX 2	. 8		

# **INTRODUCTION**

The *Fish Resources Management Act 1994* (the Act) provides the overarching legislative framework for management of the West Coast Rock Lobster Fishery (the Fishery). The objects of the Act 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.

Consistent with the objects of the Act, the Harvest Strategy and Control Rules (HSCR) for the Fishery will be used to set the Total Allowable Commercial Catch (TACC). The HSCR will also provide the Allowable Harvest Level (AHL) for the western rock lobster resource (i.e. the total quantity of lobster that can be taken by the commercial and recreational sectors combined) from which the Allowable Recreational Catch is determined in accordance with the principles of Integrated Fisheries Management (IFM)<sup>1</sup>.

The HSCR was developed in consultation with the Western Rock Lobster Council (WRLC), having regard for the outcome of broader industry consultation on two discussion papers:

- Fisheries Management Paper 254. West Coast Rock Lobster Managed Fishery Harvest Strategy and Decision Rules Framework Proposals Under a Quota Management System - A Discussion Paper (2012) http://www.fish.wa.gov.au/Documents/management\_papers/fmp254.pdf
- Fisheries Management Paper 263. West Coast Rock Lobster Harvest Strategy and Control Rules 2015 – 2019 - A Discussion Paper (2013) http://www.fish.wa.gov.au/Documents/management\_papers/fmp263.pdf

-----

<sup>1</sup> see Considerations for the Implementation of Western Rock Lobster Sectoral Allocations. Fisheries Management Paper 236 athttp://www.fish.wa.gov.au/Documents/management\_papers/fmp236.pdf

# **1.1 OBJECTIVES**

# **1.2** 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.

#### Sustainability Objective:

To ensure that the egg production in Breeding Stock Management Areas of the Fishery (see Appendix 1) remains above its threshold value for the next five years with a probability greater than 75%.

There are four Breeding Stock Management Areas (BSMAs) which will be used to assess the status of the fishery (Appendix 1, Figure 1).

Appendix 1, Table 1 provides a description and threshold reference years for each of the BSMAs.

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 the Legal Proportion Harvested (LPH) through a change in the biological controls, or more likely a reduction in the TACC for the relevant Zone(s).

Further detail on how this would be applied can be found at Appendix 2.

# 1.3 Harvest Objective

The Harvest Objective is to be used to determine the maximum LPH for the Fishery based on Maximum Economic Yield (MEY). The maximum LPH is used to determine the AHL for the resource.

#### Harvest Objective:

Once the Sustainability Objective has been satisfied, TACCs for the Fishery shall use MEY to determine an optimal range of LPH that would optimise the economic performance of the Fishery by achieving optimal stock abundance and catch rates, and thereby providing high economic returns and greater amenity to the Fishery and the WA community.

For the purposes of the HSCR the "optimal LPH range" will be determined by 99% MEY (i.e. 99% average Net Present Value [NPV]). This is illustrated in Figure 1.

As MEY usually generates a catch level which is below Maximum Sustainable Yield, application of the Harvest Objective should represent a conservative first step in the TACC setting process. However, precedence must always be given to achieving the Sustainability Objective. This is to ensure that, in the unlikely event that the application of the Harvest Objective results in egg production that falls below the threshold levels in one or more of the BSMA's, the LPH for the relevant Zone would be reduced until the Sustainability Objective was met. In this instance the

Harvest Objective would not be used for determining the TACC(s) for the affected Zone(s).

The Harvest Objective does not require that the TACC be set within the optimal LPH range (i.e. 99% MEY), provided it is set below the maximum LPH. However industry will need to provide some justification should it recommended the TACC be set below the optimal LPH range.



**Figure 1.** 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.

# 2.1 KEY MANAGEMENT PRINCIPLES

The key principles that underpin the HSCR are:

- 1. The TACC will be equal in the northern Zones (i.e. Zones A and B) and Zone C (50% Zones A and B and 50% to Zone C). This principle will be applied after the AHL for the Fishery has been set under both the Harvest and Sustainability Objectives.
- 2. The proportional allocation of the TACC between Zone A and Zone B will 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 between the 1998/99 and 2007/08 seasons and has been used as the basis for setting catch allocations since TACCs were introduced for each Zone.
- 3. Given there is some uncertainty regarding the stock abundance and the preliminary threshold and limit that have been set for BSMA 1 (Big Bank), the abundance of lobsters in BSMA 1 will not contribute to the TACC setting process even if Big Bank is reopened. This ensures that a precautionary approach to managing breeding stocks in the northern part of the fishery is maintained. This will be re-examined when the HSCR is reviewed.

# 3.1 TACC SETTING PROCESS

The process for setting TACCs and the Allowable Recreational Catch (for IFM purposes) is set out below and illustrated in Figure 2:

- 1. Determine the optimal LPH range through the Harvest Objective;
- 2. Ensure Sustainability Objective is met in all BSMAs;
- 3. If Sustainability Objective is not met in a BSMA, reduce the LPH in the relevant Zone or Zones until the Sustainability Objective is met (see Appendix 2);
- 4. The highest LPH within the optimal range that results from the Harvest Objective (or through the reduced LPH if the Sustainability Objective is not met) will determine the Upper TACC limit for the commercial Fishery. This is then used to determine the AHL though the following formula:
  - AHL = Commercial Upper TACC Limit/0.95

Therefore the allowable catch for each sector is determined by:

- Allowable Recreational Catch = AHL x 0.05; and
- Allowable Commercial Catch =  $AHL \times 0.95$
- 5. The WRLC will provide TACC recommendations based on an equal TACC for Zones A/B and Zone C taking into account the catch ranges derived in step 3 above;
- 6. The TACC for Zones A/B will then be proportioned 0.36 to Zone A and 0.64 to Zone B; and
- 7. The resulting TACC recommendations will then be provided to the Minister for consideration, and the Management Plan will be amended accordingly.



#### Harvest Strategy and Control Rules Flow Chart

# **APPENDIX 1**

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 them would still necessitate management action.

#### 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  $28^{\circ}$  and  $30^{\circ}$ 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.



**Appendix 1, Figure 1.** Four Breeding Stock Management Areas (BSMA) covering areas of significant egg production throughout the fishery.

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 ° S 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

# **APPENDIX 2**

# Application of the Sustainability Objective – Zones A and B

Zones A and B – BSMA 1, 2 and 3					
Projected Indicator Value - egg production	Management Response				
Is above the threshold value for the next five years with 75% confidence.	TACC to be set based on Harvest Objective.				
Less than 75% probability that the indicator will be above the threshold value in BSMA 1, 2 or 3 in any year(s) in the next five years.	Adjust the TACC down in the combined Zones A and B, 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 1, 2 or 3 in any year(s) in the next five years.	Significantly reduce the combined Zones A and B 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.				

# Application of the Sustainability Objective – Zone C

Zone C – BSMA 4	
Projected Indicator Value - egg production	Management Response
Is above the threshold value for the next five years with 75% confidence.	TACC to be set based on Harvest Objective.
Less than 75% probability that the indicator will be above the threshold value in any year(s) in the next five years.	Adjust the TACC down in Zone C, 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 any year(s) in the next five years.	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.

# Appendix 3: Implications of provisional clauses of the *Aquatic Resources Management Bill 2015* on setting the TACC for the Western Rock Lobster Fishery.

The Aquatic Resources Management Bill 2015 (the Bill) has been introduced in the Western Australian Parliament. It is likely to gain passage through the Parliament during 2016. Once the Bill is enacted and assented to, the drafting of the Aquatic Resources Management Regulations can start, with the Aquatic Resources Management Act anticipated to come into effect on 1 January 2018.

The key provisions affecting the determination of the TAC for a fishery are set down by sections covering the establishment and use of aquatic resource management strategy (ARMS) and the accompanying aquatic resource use plans (ARUP). See Part 3 of the Bill. Whilst the legislation is not specific on the use of a harvest strategy per se, the provisions of Section 16 (1) read together with Section 9 would enable reference in an ARMS to a harvest strategy that encompasses those objectives covering sustainability of the resource as well as social and economic objectives relevant to the management of the commercial component of the Western Rock Lobster Fishery. The harvest strategy could also contain the detail of operational science methodology and other matters required to be set down within both the ARMS and the ARUP as outlined in sections 16 and 25 respectively.

Section 33 requires the CEO of the Department of Fisheries to determine the TAC for the commercial fishery effectively removing the role of the Minister in essentially an operation role. The CEO in the context of administrative law will need to take into account the relevant ARMS and ARUP documents for the fishery as well as any accompanying harvest strategy document for the commercial fishery in setting a TAC. A determination decision by the CEO would not be open to appeal to the State Administrative Appeals Tribunal.

Only matters specified in Part 9 are reviewable by SAT. If there are concerns about the proposed methodology in the ARMS for setting the TAC (16(1)(g)), then these should be brought to the attention of the CEO/Minister during the public comment for the ARMS. In practice, Industry will have ample opportunity to raise any concerns with the Department before the Draft ARMS is released for public comment.

Part 13, Division 4 of the Bill allows the Minister or the CEO to create formally an advisory committee. The Minister may also enter into an agreement with a recognised outside corporate body such as the Western Rock Lobster Council to carry out a range of functions concerning the "management" of the fishery (see Section 222 of the Bill). Arguably a harvest strategy for the commercial TACC could also be linked to this provision formally recognising the role of the Council in advising the Minister on any range of functions relevant to the management of the aquatic resource, especially the commercial sector.

# Part 1 — Preliminary

# 3. Terms used

**aquatic resource management strategy (ARMS)**, in relation to a managed aquatic resource, means a strategy approved for the aquatic resource under section 20(1) as in force from time to time;

**aquatic resource use plan (ARUP)**, in relation to a managed aquatic resource, means a resource use plan made in respect of the aquatic resource under section 24(1) as in force from time to time;

# Part 2 — Objects

# 9. Objects of Act

The objects of this Act are -

(a) to ensure the ecological sustainability of the State's aquatic resources and aquatic ecosystems for the benefit of present and future generations; and

(b) to ensure that the State's aquatic resources are managed, developed and used having regard to the economic, social and other benefits that the aquatic resources may provide.

# **10.** Means of achieving objects of Act

The objects of this Act are to be achieved in particular by —

(a) conserving and protecting aquatic resources and aquatic ecosystems and where necessary, restoring aquatic ecosystems; and

(b) managing aquatic resources and aquatic ecosystems on the basis of relevant scientific data and principles; and

(c) encouraging the sustainable development of fishing, aquaculture and other activities reliant on aquatic resources; and

(d) encouraging members of the public to actively participate in decisions about the management and conservation of aquatic resources and aquatic ecosystems; and (e) ensuring that the interests of different sectors of the community that use aquatic resources or aquatic ecosystems are identified and considered; and

(f) managing aquatic resources and aquatic ecosystems in a manner that is as practical, efficient and cost effective as possible.

# Part 3 — Managed aquatic resources

# **Division 2** — Strategy and planning

# Subdivision 2 — Aquatic resource management strategies

# 15. Requirement for ARMS

As soon as is practicable after an aquatic resource is declared to be a managed aquatic resource an aquatic resource management strategy (ARMS) must be approved under section 20 in respect of the aquatic resource.

## 16. Content of ARMS

(1) An ARMS for a managed aquatic resource must set out the following things -

(a) a description of the aquatic resource that is to be managed;

(b) the main objective to be achieved by managing the aquatic resource;

(c) the minimum quantity of the aquatic resource that is considered necessary to be maintained for the resource to be ecologically sustainable;

(d) the activities that should be regulated in respect of the aquatic resource;

(e) the details of each period for which activities in respect of the aquatic resource are to be regulated (fishing period);

(f) the quantity of the aquatic resource that is to be available in a fishing period for customary fishing and public benefit uses;

(g) the method to be used in calculating the total allowable catch (TAC) for the aquatic resource;

(h) the proportion of the TAC that is to be available for recreational fishing for the resource;

(i) the proportion of the TAC that is to be available for commercial purposes, including —

(i) the proportion of the TAC to be available for commercial fishing for the resource; and

(ii) the proportion of the TAC that is to be available for taking incidentally in the course of commercial fishing for other aquatic resources;

(j) the number of shares in the resource that are to be available to the commercial sector;

(k) the scientific parameters to be used to assess how effectively the aquatic resource is being managed;

(I) the consultation to be carried out in relation to the making, amendment or revocation of an aquatic resource use plan (ARUP) to implement the ARMS.

(2) For the purposes of subsection (1)(d), the activities that should be regulated in respect of the aquatic resource may include the taking of other aquatic resources incidentally in the course of commercial fishing for the aquatic resource.

# 22. Regulations for ARMSs

Regulations may be made for purposes relating to ARMSs.

#### Subdivision 3 — Aquatic resource use plans

#### 23. Terms used

In this Subdivision —

ARMS, in relation to an ARUP, means the ARMS identified in the ARUP in accordance with section 25(1)(b);

*resource* means a managed aquatic resource, and in relation to an ARUP, means the managed aquatic resource to which the ARUP relates.

#### 24. Minister to make ARUP for managed aquatic resource

(1) The Minister must make an ARUP, or more than one ARUP, to implement an ARMS that is in effect for a managed aquatic resource.

(2) The Minister is not to make an ARUP for a resource unless —

(a) the consultation required in relation to the making of the ARUP set out in the ARMS for the resource has been carried out; and

(b) in the opinion of the Minister, the plan is consistent with -

(i) the ARMS for the resource; and

(ii) all other ARUPs made for the resource, or that apply to or in relation to the resource; and

(iii) regulations made under section 22 in relation to the ARMS for the resource.

(3) An ARUP is subsidiary legislation for the purposes of the Interpretation Act 1984, and section 42 of that Act applies to and in relation to a plan as if the plan were a regulation.

## 25. Content of ARUPs

(1) An ARUP must —

(a) identify the resource to which the ARUP relates; and

- (b) identify the ARMS that the ARUP is to implement; and
- (c) set out the objectives to be achieved by the ARUP; and
- (d) identify the activities regulated under the ARUP; and

(e) identify the class or classes of persons that may undertake the activities regulated under the ARUP; and

(f) specify the type of authorisation (if any) required to undertake activities regulated under the ARUP; and

(g) specify the form and the minimum and maximum amounts of surety (if any) that may be required to be provided for an authorisation to undertake activities regulated under the ARUP; and

(h) specify the number of resource shares (if any) in the aquatic resource available under the ARUP; and

(i) set out the method for allocating any resource shares available under the ARUP at the commencement of the ARUP; and

(j) set out any restrictions in relation to persons who are eligible to be holders of resource shares available under the ARUP; and

(k) set out procedures for monitoring the quantity of the resource that is taken in a fishing period; and

(I) set out any conditions that are to apply in respect of the transfer of catch entitlement for the resource; and

(m) set out any circumstances in which the CEO may, by notice published in the Gazette, modify provisions in the ARUP in order to ensure that the objectives to be achieved by the ARUP are achieved.

(2) An ARUP may include any provision that, in the Minister's opinion, is necessary for —

(a) the protection or management of the resource; or

(b) the protection of the aquatic environment, other aquatic resources, aquatic mammals, aquatic reptiles, aquatic birds and amphibians from activities related to the resource.

(3) The objectives to be achieved by an ARUP are to be consistent with, but not limited to, the main objective of the ARMS that the ARUP is to implement.

# **Division 3** — Administrative matters for managed aquatic resources

#### Subdivision 1 — Preliminary

# 33. CEO to notify TAC and catch

(1) At least 30 days before the commencement of each fishing period for a managed aquatic resource the CEO must publish in the Gazette a notice setting out the following in respect of the fishing period -

- (a) the TAC for the resource;
- (b) the quantity of TAC available for commercial fishing for the resource;
- (c) the quantity of TAC available for recreational fishing for the resource;

(d) the catch to be allocated for a resource share in the resource.

(2) For the purposes of subsection (1), the TAC and the quantity of TAC available for commercial fishing and for recreational fishing are to be calculated in accordance with the ARMS for the resource.

(3) For the purposes of subsection (1)(d), the catch to be allocated for a resource share for a fishing period is the quantity of TAC referred to in subsection (1)(b) divided by the number of shares in the resource.

# Part 13 — Administration

## Division 3 — Use of outside bodies in performance of functions

## 220. Term used: agreement

In this Division —

agreement means an agreement entered into under section 222.

## 221. Minister may recognise body

The Minister may, by instrument in writing —

(a) formally recognise a body corporate as suitable to carry out a function referred to in section 222(2); or

(b) vary or revoke an instrument referred to in paragraph (a).

#### 222. Minister may enter agreement with recognised body

(1) The Minister may enter into a written agreement with a body to carry out a function for the purposes of this Act if the Minister has recognised the body as suitable to carry out that function.

(2) The agreement may relate to any of the following functions —

(a) collection and analysis of data relevant to an aquatic resource;

(b) advising the Minister about the management of an aquatic resource;

(c) developing plans for the management of an aquatic resource;

(d) the management of specified aspects of an aquatic resource;

(e) restricting access to an aquatic resource on a specified basis, including for a specified period;

(f) the conduct of trading resource shares in an aquatic resource;

(g) representing the interests of the commercial fishing sector;

(h) representing the interests of the recreational fishing sector;

(i) providing education and training about the management of an aquatic resource to persons who have, or want to have, access to the aquatic resource;

(j) the control and management of an aquatic habitat protection area or part of an aquatic habitat protection area;

(k) the control and management of a declared organism;

(I) any other prescribed functions.

(3) An agreement must include the following —

(a) details of the parties to the agreement;

(b) details of the function or functions to be carried out under the agreement;

(c) the term of the agreement;

(d) the financial arrangements under which the agreement is to operate which may include arrangements in relation to any of the following matters

(i) payments to be made by the Minister to the body for carrying out functions under the agreement;

(ii) fees that may be payable to the body by persons other than the Minister;

(iii) fees or payments to be made by the body to the Minister;

(e) the conditions under which the agreement may be varied or terminated;

(f) penalties that apply in the event that the body fails to comply with the terms of the agreement.

(4) The Minister must —

(a) cause notice of an agreement to be published in the Gazette as soon as is practicable after the agreement is made; and

(b) make the agreement available for inspection by members of the public at times and places specified in the notice.

# 223. Effect of agreement

(1) Nothing in an agreement limits the power of the Minister to carry out a function under this Act.

(2) If there is any inconsistency between fees payable under the regulations made under this Act and fees payable for the same service under an agreement, the fees payable under the agreement prevail to the extent of the inconsistency.

# Division 4 — Advisory Committees

# 224. Establishment and functions of advisory committees

(1) The Minister may, by instrument in writing, establish advisory committees, consisting of persons considered by the Minister to be suitable, to provide information and advice to the Minister or the CEO on matters related to one or more of the following —

- (a) the protection and management of an aquatic resource;
- (b) the management of a fishing activity;
- (c) the management of aquaculture;
- (d) the administration of this Act.

(2) The CEO may, by instrument in writing, establish advisory committees, consisting of persons considered by the CEO to be suitable, to provide information and advice to the CEO on matters relating to one or more of the following —

(a) the protection and management of an aquatic resource;

(b) the management of a fishing activity;

(c) the management of aquaculture;

(d) the administration of this Act.

Aquatic Resources Management Bill 2015

(3) The instrument establishing an advisory committee —

(a) must specify the functions, and identify the members, of the committee; and

(b) may provide for any other matter that, in the opinion of the person establishing the committee, is necessary for the operation of the committee.

(4) The person establishing the committee may, by further instrument in writing, amend or revoke an instrument made under this section.

# Appendix 4: Data Analysis and Modelling for Understanding Markets and Advising on TACC

#### Paul McLeod (July 2016)

Currently, virtually all of the exports of Western Rock Lobster go to China. Currently, this export trade goes largely via Vietnam. In the future this is likely to change as the China Australia- Free Trade Agreement comes into force, with exports going directly to China. This is what happened to exports of Southern Rock Lobster from New Zealand to China after the formalization of a free trade agreement between New Zealand and China. Exports previously going through Hong Kong went directly to China.

Although there are other markets for lobster (Japan, Europe, USA) in recent years the market in China has come to dominate exports. The growth in exports to China as a share of total exports and overall catch is shown in Figure 1. The graph shows that exports to China (blue) and total exports (red) converge from mid-2013 on and account for virtually all production (green).



Figure 1: Recent Export Trend for Western Rock Lobster.

Source: WA Department of Fisheries and Australian Bureau of Statistics International Trade Customised Report.,

Chinese consumers have been willing to pay higher prices than elsewhere and the market in China is a "live" market meaning that processors do not have to invest heavily in capital equipment for cooking and processing as they would for some other markets. The Western Australian processing sector through its history of past investments, still has sufficient capacity to process the entire TACC into other rock lobster products. Prices and margins appear to be considerably higher in the live market compared to other product markets (whole green or cooked frozen and tails) (see Figure 11).

While the past can never be taken as a foolproof indicator of the future, it is typically the best basis for understanding what might happen in the near future and what analysis is needed to understand what might happen in the longer term. Moreover, there are two forces that reinforce this view. First, in recent years the harvest of Western Rock Lobster has been subject to quota and the level of the quota is not likely to increase significantly in the near term. Second, the expected growth in the Chinese economy and the associated increase in real incomes and the number of middle income and higher income groups suggest that demand growth will occur in China, reinforcing China's ability to absorb current production volumes and pay prices higher than or at least competitive with alternative export markets.

On balance the evidence suggests that the market in China will remain the dominant focus for exporters of lobster from Western Australia and also from the rest of Australia and New Zealand.

This being the case, there needs to be an analytical focus on the underlying drivers affecting the market from live lobster in China and how these are likely to impact future prices. From the perspective of Western Rock Lobster exports the relevant information is;

- What will happen to the demand for lobster in China?
- What will happen to the supply of Western Rock Lobster into China?
- What will happen to the supply of competing lobster products into China (e.g. Southern Rock Lobster from other Australian States and New Zealand, lobster from US, Canada and emerging suppliers like Mexico, South Africa, etc.)?

In recent years the balance between demand and supply in China has been such that lobster prices have exhibited consistent price increases and market analysis is required to determine if this is likely to be continue and with what strength.

#### Recent price and volume trends for exports to China

The following graphs summarize lobster exports to China from Australia, New Zealand, the United States and Canada based on UN Comtrade data. Graphs are exports as reported by Australia, NZ, US and Canada to China, HK and Vietnam combined to capture the HK and Vietnam routes for exports to China. Graphs show export volume, export price in \$US/kg and Total Export Value in \$US. NZ has only one year in which exports to Vietnam are recorded and the volume is very small, in the hundreds of Kgs only. NZ exports are dominated by HK and then mainland China once free trade started. Australia, Canada and US all show exports to China, HK and Vietnam but the export price is virtually the same for all three destinations for each of these exporters.

The data shows that both export volumes and prices have increased contributing to the increase in export revenues/value.



Figure 2: Australian Exports to China, Hong Kong and Vietnam as Reported by Australia – Volume and Price.

Figure 3: Australian Exports to China, Hong Kong and Vietnam as Reported by Australia – Export Value



Source: United Nations Trade Statistics Division (2015) UN Commtrade Data Base. available from: <u>http://comtrade.un.org/data/</u>



Figure 4: New Zealand Exports to China, Hong Kong and Vietnam as Reported by New Zealand – Volume and Price

Figure 5: New Zealand Exports to China, Hong Kong and Vietnam as Reported by New Zealand – Export Value



Source: United Nations Trade Statistics Division (2015) UN Commtrade Data Base. available from: <u>http://comtrade.un.org/data/</u>



Figure 6: US Exports to China, Hong Kong and Vietnam as reported by US Volume and Price

Figure 7: US Exports to China, Hong Kong and Vietnam as reported by US: Export Value



Source: United Nations Trade Statistics Division (2015) UN Commtrade Data Base. available from: <u>http://comtrade.un.org/data/</u>





Figure 9: Canada Exports to China, Hong Kong and Vietnam as Reported by Canada – Export Value



Source: United Nations Trade Statistics Division (2015) UN Commtrade Data Base. available from: <u>http://comtrade.un.org/data/</u>

In the case of exports to China from the US since 2010 volumes have increased markedly, without substantially reducing price. The volume increase coincides with the downturn in the European market during and subsequent to the GFC when US and Canadian exports were redirected to China.

A more detailed Australian view of export prices is shown in Figure 10 where the export prices for Western Rock, Southern Rock from Australia and New Zealand and US exports are shown along with their trend increase.





Source: Prices derived from value and volume data in: Australian Bureau of Statistics International Trade Customised Report, Statistics NZ. Harmonized Trade Exports and the United States Census). USA Trade Online

#### **Interpretation of Prices**

The data on prices suggest that lobster export prices to China are related to each other in the sense that while there is price hierarchy with Southern Rock Lobster commanding higher prices than Western Rock Lobster and Western Rock Lobster commanding a higher price than Maine Lobster, movements in Southern and Western Rock lobster price are related. A positive demand side shock will tend to push all prices up. A supply side shock for one major supplier will tend to affect all prices. In this sense the prices are "co-integrated" suggesting that the various live rock lobster products are substitutes at the margin.

Evidence for substitutability is found in a number of studies that have tested for cointegration of lobster export prices (Lopez, 2013, McLeod, 2015). Gordon (2011) looking at Canadian export prices over time concludes that assuming a constant price is most

appropriate for lobster exports. Although these methods are relatively sophisticated, the overall pattern is simply illustrated in the price trends shown above, especially for the Western and Southern Lobster supplies.

Taking the fact of a general relationship between prices paid for the various live lobster products, the trend in prices in China over time will reflect the balance between demand in China and supply into China.

#### Other Products and Markets

Before live exports to China came to dominate exports of lobster Western Rock lobster, other markets and products were relevant. These included exports to the US, Taiwan and Japan and exports of live, whole cooked and green frozen products, and most notably tails to the US. It was noted above that the attraction of China as a market is the fact that it is a "live" market and the higher prices and margins that can be achieved. Data on margins is limited but Figure 12 shows for each size grade of rock lobster the indicative price position at the current point in time. The values were provided by the Geraldton Fishermen's Cooperative and show relative prices adjusted for processing costs, transport and time value of money allowing for the time it takes to sell the various products (up to 12 months for frozen product). The data are for a particular trading day in the last couple of months, mid 2016. Any changes in trading volumes (say more to the US tails market) would change the relativities.

Although these data are only indicative, the fact that virtually all export now go live to China is confirmation of the higher returns to be earned in that market.





Source: GFC

#### **Demand Drivers**

Over recent years, exporters have been able to sell higher volumes to China and achieve higher or stable prices. As a consequence, export value has grown (See Figures 3, 5, 7 and 9). Logically this must reflect the growth to demand in China being high relative to the increase in supply.

Data on consumption and incomes in China is limited. Monthly regional data or city area data is virtually non-existent. Data at the national level is patchy. As an indicator data from the China National Bureau of Statistics on retail sales of urban consumer goods can be taken as a proxy for growing consumption expenditure and incomes. Figure 12 shows the trend in combined export volumes from WA, SA, NZ and US into China and the trend in the nominal value of retail sales on urban and consumer goods. Given the quality of data on China this should simply be taken as indicative of the importance of refining our understanding of demand growth in China and its relationship to the future demand for lobster.



#### Figure 12: Trend Growth in Retail Sales in China and Lobster Export Volumes

Source: (Australian Bureau of Statistics). International Trade Customised Report, China National Bureau of Statistics Retail Sales Monthly, United States Census. USA Trade Online and Statistics NZ Harmonized Trade Exports

Demand in China will be driven by a number of factors including:

- Real incomes in China. Increases in real incomes in China will lift the demand for lobster, all other things equal. If live lobster is regarded a luxury good, increases in real incomes may have an even greater proportionate effect on demand.
- Chinese preferences for live lobster versus other products. As real incomes grow and the consumption patterns in China change so may the preference for live lobster. If preferences move away from more traditional foods like live lobster, this will tend to reduce the demand for live lobster.
- Market expansion. The number of households in the higher/ middle income group in China is growing and this will expand the demand for live lobster, all other things equal. Geographic market expansion may also be possible if more cities open to lobster trade under the free trade agreement.
- The price of live lobster compared to other products. If substitute products for live lobster become relatively cheaper, demand will be negatively affected, all other things equal.

As reflected in prices, the recent past has been a period when demand in China has been growing at a rate greater than supply. The economic drivers from this outcome can be represented fairly simply as is done in Figure 13which shows how demand growth relative to supply growth can push up export prices across to related but different lobster markets.



Figure 13: Illustrative Impact of Demand and Supply growth in China

In the diagram above let 'Lobster 1' be the higher priced lobster such as Western Rock and Southern Rock and let 'Lobster 2' be other lower valued lobster, such as lobster from the US and Canada. The interaction between demand and supply establishes the price in the 'Lobster 1' segment (Plob1). The interaction between demand and supply establishes the price in the 'Lobster 2' segment (Plob2). The price in 'Lobster 2' is lower reflecting its lesser value in the overall market. Overall demand supply establishes a market price which can be thought of as a composite of prices in segments 1 and 2. This is shown as Plob in the combined demand and supply in the lobster market. The equilibrium prices across different segments reflect the relative demand supply conditions and establish the price hierarchy. The accepted price hierarchy in China is for the price of Southern Rock to be higher than the price for Western Rock and this is in turn higher than the market price for lobster from the United States and Canada.

Substitutability, as discussed above, suggests that if this market is shocked all prices will adjust over time to maintain the relativity. Suppose there is an increase in demand, relative to supply. Overall demand increases and after a time demand adjusts to supply in each segment and in the market overall so that all prices are increased and the relativity is maintained. This outcome is indicated by the red demand curve (D') and prices shown above as Plob1', Plob2' and Plob'. A supply side shock would similarly be transmitted to each segment.

The shock (demand or supply side) can be initiated in any segment. Whatever the initial shock, the effect is spread throughout the market and reflects the demand and supply conditions in each segment. A key issue in markets with related segments is how long it takes for an initial shock to result in all prices being restored to the equilibrium set of relative prices. The initial impact in the 'shocked' segment might be significant before the various adjustments take place.

The illustration in the diagram assumes that there are no exogenous constraints affecting any market segment. For example, the demand increase illustrated is based on unconstrained supply responses. Yet some constraints may exist. These might be management constraints such as quotas or market constraints such as limits on transport capacity.

If we introduce a constraint on the supply side then this will impact the price outcome for the particular segment that is constrained and this will in turn impact prices overall, all other things equal.

For example, if transport/shipping capacity limits the ability to supply China from segment 1, the demand increase will impact prices even more, relative to the unconstrained case, as shown below.

Figure 14: Illustrative Impact of Demand and Supply Growth in China with a supply constraint.



The constrained outcome is shown in green. In this case the transport constraint in 'Lobster 1' restricts the volume that could be delivered to the market to Tc. The previous supply increases as indicated by the shift from S to S' cannot be delivered to the market.

As demand rises with supply limited in "lobster 1', prices rise even more in 'Lobster 1', some consumers switch to 'Lobster 2' so that demand is higher in that segment, and lower in segment 1 compared to the unconstrained (red) case. Prices are higher overall because supply is lower compared to the unconstrained (red) case.

In the long run as transport capacity constraints are overcome, the expectation would be for the unconstrained solution shown in red to be achieved.

Currently there appears to be a limit on transport capacity from Singapore to Hanoi or Hong Kong to Hanoi which restricts the volume of Western Rock Lobster that can be delivered at various times. However, as the free trade agreement becomes effective live exports may well be redirected to go direct to mainland China, as happened with New Zealand exports. This would open up enhanced transport options.

If domestic supply increased in 'lobster 1' even with the transport restriction in place, the excess domestic supply would have to be delivered to another market. In the case of Western Rock Lobster, alternative markets are likely to be lower margin markets (Figure 11).

#### Looking Ahead

Whist the analysis on past export volumes and price relationships is instructive, the past is not necessarily the best predictor of the future. It does however offer the best starting point.

Ongoing analysis is needed to understand how the market might evolve and to monitor changes in the lobster market ranging from changes in local policy (e.g. changes to TACC) through to changes in trade policy (e.g. the impact of the free trade agreement) and changes in relevant export markets (e.g. future growth in China and its impact on lobster

demand). In essence there is a need to understand the drivers behind the demand and supply curves used in the illustrative diagrams above.

At a minimum, this involves undertaking a range of analyses that address issues on both the supply and demand side of the analysis.

- On the supply side analysis is needed to document the potential for supply increases from the various supply sources including Australia, NZ, US, Canada, Mexico, South Arica, Indonesia etc. This will indicate the extent to which competitive supplies can increase supplies in competition with Western Rock Lobster for China and other markets.
- Understanding the potential for aquaculture to expand lobster supply. Although in its infancy, research into lobster aquaculture is ongoing and appears to have long run potential.

On the demand side several pieces of analysis (with an emphasis on China) are required including:

- Understanding the trends in prices and documenting the exact relationship between the prices in various lobster segments. Time series analysis of lobster trade and prices is required for this.
- Understanding the relationship between the various lobster segments and between lobster and other food products that may become more effective competitors for lobster (fish, steak etc.).
- Documenting the price elasticity of demand for lobster and for the segment Western Rock Lobster in both the short and long run. In addition to the time series analysis noted, detailed analysis of price and sales data from processors would enable more detailed modelling of the impact of supply changes on price. Documenting the demand curve is important for setting the TACC where this is to reflect MEY.
- Understanding the evolution of preferences for lobster relative to other products in these markets as real incomes grow including marketing research to understand how consumption patterns change over time.
- Understanding more about the likely pattern of economic growth and incomes growth in the major export markets, especially in China and in regions of China, where potential is greatest for lobster exports. This would include identifying and analysing measures, for example retail sales or wages indexes useful in predicting lobster demand. It would also include seeking out city based data directly relevant to the major locations where lobster is or is likely to be exported.
- Analysis of the prices and margins in alternative markets both country and product including cooked whole frozen and green whole frozen. While all product is essentially live at the moment it would be useful to know how competitive these were with the live market to China in order to understand options for producers if combinations of market demand growth and supply growth change to cause prices in China to fall in future and the extent to which there is an incentive for all projected increases in supply to be sent ongoing to China.

As already noted, while production and export price data relating to Australia is available in some detail, data relating to market demand in China and the drivers of demand growth in China is limited. Data in the public domain is limited. General assessments of potential demand growth are available in some financial services publications. For example, Agriculture and Agri-Food Canada (Clarke,2015) and ANZ (Campbell, 2015) have both produced recent assessments of the potential for growth in the demand for crustaceans over the short run, with 8% per annum growth projected through to 2018/19. These are general forecasts for the growth sales of crustaceans in China but do not drill down by city/region or type of lobster. In furthering the analysis requirements discussed above, additional economic and marketing data is needed which may have to be sourced through commissioned studies or data acquisition.

Accessing more detailed data to better predict demand and price sensitivity is a requirement for producers to be in the best possible position to understand how demand will evolve in China and how the price sensitivity of the demand for Western Rock lobster will be affected. The data currently available in the public demand does not facilitate a detailed analysis of the dynamics of the live rock lobster trade in China but we can expect those dynamics to change over time as Chinese demand patterns change and as supply changes occur for Western Rock Lobster (through TACC) and for other major suppliers that may offer increased competition in future. The requirement for more detailed analysis is of course given more importance in view of the implementation of the China Australia-Free Trade Agreement, as this has the potential to change the current market arrangements on which exports and pricing to date are based.

# Appendix 5: Research Strategy and Information Needs for Improving Stock and TACC Assessment for the Western Rock Lobster Fishery

The summary of research directions outlined below was generated from a workshop of the following Participants: Drs N Caputi; S. de Lestang; N.Hall, A. Hesp, P. McLeod; P. Rogers

The four projects below are aimed at addressing stock modelling risks from parameter estimates in the predictive power of stock estimates, the impacts of increasing biomass density and ultimately future TACC settings and the determination of MEY as a long term objective target.

Small reserve areas closed to rock lobster fishing need to extend to shallow water areas of the fishery possibly near Freshwater Point and at the Abrolhos Islands to better understand the apparent loss of shallow water loss of rock lobster productivity reported as part of the industry meetings. It will also be valuable for understanding the impact of high lobster density on the key biological inputs such as carrying capacity, natural mortality and catchability for the juvenile stages of rock lobster in the shallows supported by further work in the existing deeper water closed areas to rock lobster fishing.

The requirement for further model development and their independent validation and the appointment of an analyst supporting analysis of market and economic trends are also seen as essential inputs to future TACC settings.

This strategy needs to be progressed through the Research Development Advisory Group for the rock Lobster fishery.

The information needs in support of the four projects identified in the table at the back of this appendix, combines the information needs for assessment of the TACC discussed and augmented by the MFL holders and processors at 22 meetings held by the principal investigator with this project. The combine outcome provides effectively a list of key areas to be investigated during the next five years as part of any strategy building confidence in future TACC advice and decision roles.

Four Projects specifying Research Directions

1. Examine the sensitivity of the stock assessment process to key input parameters,

The stock assessment of the western rock lobster fishery utilises a wide range of inputs, including various data sources and biological parameters. Some changes to parameters such as size of maturity and size of migration have been implemented in the stock assessment model. However, many of the input parameters, such as natural mortality rates, growth rates and catchability, do not vary temporally within the modelling framework. Variation in these parameters has not been implemented because, although it is likely these and other parameters do vary in response to factors such as water temperature and lobster density, little is known as to how they vary.

However, it may not be necessary to modify all model parameters to be dynamic, if this has little impact on the overall assessment. For example, the growth rates of lobsters within the fishery may have increased in concert with water temperatures over the past 50 years. However, since the sizes at maturity and migration in the model change temporally with water temperature (i.e. they are dynamic), there may be little benefit in the modelling process if growth rates are also made dynamic.

Conducting an assessment of the sensitivity of the model to a range of model inputs (dynamic vs static) will allow for the prioritisation of research focus on the many biological parameters. The focus of research into input parameters to which the model is very sensitive will improve the predictive power of the stock assessment and the determination of MEY for this fishery.

As the lower west coast of WA is one of the global hotspots for water temperature increases it is important to continue to monitor the effect of changing environmental conditions on the biological parameters of the western rock lobster.

2. Assess the impact of increased biomass on key biological parameters in the stock assessment process.

The western rock lobster fishery is in a very unique position. No other large commerciallyexploited fishery receives such low exploitation, which is resulting in increasingly high biomass levels that are at 50-year record high levels and presumably moving towards "virgin" levels. Stock dynamics theory states that the productivity of a stock will decline once the biomass increases above that associated with Maximum Sustainable Yield (*B<sub>msy</sub>*). This is currently not a significant issue from a sustainability point of view as it implies that the biomass is relatively high and well above levels associated with overfishing. Problems mayarise however, when exploitation rates are increased again in the future as markets and the economic position of the fishery changes. The reason problems may arise is that the model may becoming too optimistic, since it currently assumes high productivity, which may actually be incorrect. The model needs to build in the impact of high lobster density on the key biological inputs such as carrying capacity, natural mortality and catchability.

Although traditionally difficult biological measures to examine, natural mortality and catchability have successfully be determined using a combination of tagging and closed area monitoring. The Western Rock Lobster fishery is in a good position for conducting this research as it currently has two research areas closed to fishing and tag-recapture programs running in both. Further small shallow-water research areas, closed only for a short (5 year) period of time would aid in the determination of these measures for smaller sub-adult populations of lobsters.

Understanding how natural mortality and catchability are changing with increased biomass will significantly improve the accuracy of model projects and the ability of industry to set TACCs to target MEY.

3. Model review/additional models
The integrated population model used to assess the Western Rock Lobster fishery has been externally reviewed multiple times. Even though these reviews considered the model to be sufficient for this process the new assessment protocol being developed by the Department of Fisheries, WA, (and world's best practice) requires a weight-of-evidence approach to stock assessment. This includes the consideration of all empirical data sources (e.g. puerulus settlement, spawning survey catch rates, commercial catch rates, size composition, spatial areas fished) as well as, if possible, the outputs from a range of models. The western rock lobster fishery currently has an integrated population model (IM) as well as a biomass dynamics model, the outputs of which are compared for each assessment (note the more complicated and reviewed IM is used for all formal stock projections and TACC setting).

In keeping with this philosophy it may prove prudent to examine the usefulness of developing additional models for the western rock lobster fishery, especially those that utilise only components of data, such as models based only on size composition data (catch curves analysis).

The introduction of additional modelled data on the Western Rock Lobster fishery will improve the confidence behind the "weight-of-evidence" approach to stock assessment and the ability of industry to set TACCs and longer term to target MEY.

4. Independent analyst to examine the lobster markets and economics

After ensuring the sustainability of the fishery, the most important aspect of the stock assessment and TACC process is to determine the appropriate level of fishing to maximise economic return to the industry (Maximum Economic Yield - MEY) as MEY represents the target for the TACC setting. For the determination of MEY information is needed on the changes in effort that will be required to achieve various levels of exploitation (determined by the biological model), the cost structures of industry (e.g. how will boat numbers change with exploitation) and the market's response to variation in landings. Sensitivity analysis indicates that this latter measure, that of the market, has the greatest impact on the MEY analysis.

Properly understanding the lobster market, and thereby improving TACC setting and longer term improved MEY analysis, requires a dedicated and independent analyst whom can consolidate information from databases such as ABS and COMDAT with information on market place indices (e.g. urban growth in China) and commercially sensitive information from the lobster processing sector. This analyst will also need to be able to interpret this information and disseminate it to the Western Rock Lobster Council and the wider industry. The analyst may also be able to utilise biological modelling data and the bio-economic model from the Department of Fisheries and conduct the MEY analysis, thus providing an independent assessment of MEY, which industry can then use in their TACC setting process.

Ultimately it is envisaged that the WRLC may need to develop a broader set of data on the annual costs of the fishing fleet stratified by size class of vessels as input to a more comprehensive valuation of MEY and economic value significance of the fishery to the Western Australian economy. This is not seen as a high priority at this time.

## Future Research Project Proposals and Associated Information Requirements

Red indicates work is needed		
Project 1: Examine the sensitivity of the stock assessment process		
to key input parameters		
Key Drivers (majority provided spatially and temporally) for		
Biological Models	Comments on Drivers	
Changes in somatic growth rate	Spatially variable / need to examine temporal variation	
Size (soon Age) at maturity	Temporally and spatially variable	
Timing of egg production(berried), setose and tarspot	Spatially variable / need to examine temporal variation	
Fecundity size relationship	Constant	
Independent Breeding Stock Status Index	Temporally and spatially variable	
Migration rate and distribution of whites	Spatially variable / need to examine temporal variation	
Catchability / density dependent / migration	Spatially variable / need to examine temporal variation	
Puerulus distribution	Temporally and spatially variable	
Pot efficiency / fishing efficiency	Temporally and spatially variable	
Catch rates of legal lobsters	Temporally and spatially variable	
Level of high grading of catch / Selectivity	Temporally and spatially variable	
	Limited knowledge / M is spatially variable / needs greater	
Carrying capacity / Natural Mortality	examination	
Relevance of threshold levels	Spatially variable / need to examine temporal variation	
Size composition	Temporally and spatially variable	
Project 2: Assess the impact of increased biomass on key biological		
parameters in the stock assessment process		
Impact of lobster biomass on a range of biological and behavioural		
parameters		

Impact of environmental changes on a range of biological and	
behavioural parameters	
Environmental drivers include: water temperature, ocean acidity,	
currents	
Key parameters include:	
	Limited knowledge / catchability and migration are spatially variable
Catchability / density dependent / migration	/ examine temporal variation
	Limited knowledge / M is spatially variable / examine temporal
Carrying capacity / Natural Mortality	variation
Others identified by project 1 that are highly influential to the stock	
assessment	

Project3: Model review/additional models		
Biomass Dynamic Model	Draft Model needs independent assessment	
	Review value - possibly trial a dynamic approach over the	
Catch Curve Analysis	equilibrium method	
Single-area Integrated model	Requires development	
Size -Structured Integrated Model	Ongoing appraisal as part of MSC certification every five years	
Bio-Economic Model and assessment of MEY	Initial Assessment complete, needs re-development in 5 + years	
Modify outputs generated from Models		
Estimation of Harvest Rate, Residual Biomass for fishery over time.	Completed (documented in the Resource Assessment Report)	
Model estimation of fishery and IBSS catch rates to fishery		
compared with observed values at regional scale over time with		
associated error.	Completed (documented in the Resource Assessment Report)	
Egg Production and harvest rate projections into future four years		
under different assumptions of TACC settings at zonal scale over		
time.	Completed (documented in the Resource Assessment Report)	
Risk analysis of population status of the fishery using derived		
data from all models and observed data from the fishery.	Completed (documented in the Resource Assessment Report)	
Predicted Recruitment into Fishery for next 3 years	Completed (documented in the Resource Assessment Report)	
Residual fishable biomass( [previous year)	Completed (documented in the Resource Assessment Report)	
variation in RFB catch due to:		
i) fishing induced mortality (catch and handling)	Completed (documented in the Resource Assessment Report)	
ii) estimate of illegal catch (commercial and recreational)	Requires estimating	
iii)economic minimum catch rate as a proxy for a base residual		
biomass	Needs Determination	
Estimates of total available catch over next 4 years	Completed (documented in the Resource Assessment Report)	
Allocation to recreational fishing	Policy determined	
Allocation to commercial fishing	Policy determined	
last Year's quota target	Completed (documented in the Resource Assessment Report)	
Target Harvest Rate for MEY (possibly 35%)	Needs agreed Industry position (Sensitivity work required)	

Predicted quota for next 4 years	Can be derived
Percentage change in Quota for each year	Can be derived
Establish smoothing mechanism for year to year quota	Can be derived ( Options need consideration )

Project 4: Independent analyst to examine the lobster markets	
and economics	
Analyst might initially be a fulltime position	
	Can be derived from export statistics of NZ,USA, Canada, Australia
Last years total supply of all Rock lobster to China	and
and other markets as relevant (show historical trend)	industry knowledge
Average Beach Price previous seasons (show historical trends)	Can be derived from Australian Fisheries Statistics
Average Monthly \$US trade prices and volume by product type	Can be derived from Comtrade statistics
for lobster sourced from WA,Qld,SE Aust,NZ,US, Canada incl trends	
Analysis of price series for live rock lobster normalised for	Can be derived
exchange rate for Australian and NZ product Incl. trends.	
Estimate contribution to WA beach price for different products	Can be derived by processors
on a kg equivalence removing variable processing, transport and	
marketing costs	
Predicted range of Beach prices for next season/2 seasons	Modelling work needs to be done in this area (doubtful)
Expected shifts in exchange rates	Generally unreliable
Expected shifts in total rock lobster Supply to China	A processors judgement decision required-future catch
and other markets as relevant	prediction for Australian and NZ fisheries reliable
Monitor prices for different rock lobster products in different key	Can be derived from trade statistics
markets	
Trends in Economic conditions in Principal markets	Can be derived
Expected supply elasticity response on price from WA	Critical area needs development-information will become available
quota change	as quota increased
More databases could be accessed (e.g. ABS)	
Expected Trends in Costs within the fishery	
i). In response to abundance (total pot pulls)	Requires a specific analysis that incorporates fleet size composition
ii). Cost shifts from broader economy (fuel prices)	Need to separate cost shifts outside inflationary pressures

Transport		
Monitor number of flights direct to China vis a vis Hanoi or	Processors have information	
Hong Kong carrying live lobster to markets		
Evaluation of Constraint Issues		
Aircraft freight capacity for live product	Significant constraint seasonally- will change with Free Trade	
Holding capacity for live product in WA	Needs Transparency	
Holding Capacity for live product in Market destination	Processors have the information-qualitative	
Investment impacts from increases in quota	Processors and catching sector understanding-qualitative	
Political Environment		
Trade Directions and policies	These are known to industry and government and available	
Timing Risks of Political intervention limiting market access	Random events and unpredictable	
Economic modelling and scenario evaluation using existing MEY		
model		
Creation of a framework to consider the economic/market data and		
examine MEY	Conducted by Analyst	
Examine economic contribution of industry to regions and WA	Conducted by Analyst	

Appendix 6: Short Version of proposals for WRLC future approach to providing advice on setting TACC (Power Point) presented at AMM's 2016

# A Potential Solution to Future setting of TACC

Please rate your responses to the following questions regarding the information and processes for setting annual quotas? (please choose one option per line)

Below is the % of those that either strongly agree or agree with the statement

There is good description of the data used for stock assessment	92
There is good description of the assumptions used for stock assessment	88
There is good description of the data used for maximum economic yield analysis	74
There is good description of the assumption used for maximum economic yield analysis	68
There is a good level of transparency on reasons for recommended decisions for TACC settings by the Fisheries Department	63
There is a good level of transparency on reasons for recommended decisions for TACC settings by the Western Rock Lobster Council	68

# How can industry have a more effective input into quota (TACC) setting processes?

Answer Choices—	Responses—
Happy with current arrangements with WRLC	32.98%
Prefer assessment by expertise based industry leaders (WRLC appointed)	14.89%
Prefer assessment by expertise based industry leaders (Ministerial appointed)	3.19%
Prefer assessment by fishery independent experts including industry (WRLC appointed)	14.89%
Prefer assessment by fishery independent experts including industry (Ministerial appointed)	4.26%
The use of fishery independent experts to provide comment before WRLC recommendations are forwarded to the Minister	24.47%
Other	5.32%

# Who should be responsible for providing recommendations to the Minister on quota



# Governance Requirements For WRLC

- Creation of an evidence based approach through a Sub-committee of the Council to determine quota recommendations for the fishery and the grounds of those decisions in a written report.
- The report to be made available to the industry through the WRLC for comment and written Industry feed back.
- The WRLC to formulate it's advice to the Minister and provide it's reasons for supporting or amendment of the sub-committee's advice to the Minister, together with a copy of the subcommittee's report.
- A policy document be prepared by the WRLC and Fisheries Department for the operations of the Sub-committee of the Council setting down the information requirements to be considered covering data analysis of market and biological information, assessment of models and the assumptions used for stock assessment and bio economic objective determination and other objectives as relevant. This should include time frames for quota determination and reporting.

## Governance Requirements for WRLC

- The sub-committee to have an independent chairperson, four members of the Western Rock lobster Council, two members from the rock Lobster processing and marketing sector; and two representatives from the Fisheries Department; one from management and the other from fisheries research.
- The WRLC and the sub-committee, especially during the formative years of this process, to access independent( e.g. biological, economic and modelling) expertise as warranted.
- The WRLC to appoint an analyst to facilitate data analysis on a range of industry data including market information under appropriate privacy and audit protection requirements

## TACC setting strategy

- The WRLC needs to determine with input from the greater Western Rock Lobster fishery, a longer term strategy for the Management of this Industry and consequently determination of future quota.
- This strategy needs to cover the major risk issues for the industry including an acceptable lower limit on harvest rate, future market strategy, growing concerns over black marketing, other sector interests in the fishery as well as various "what if" scenarios.
- Provide recognition to emerging trends and opportunities including technological change, market shifts, changing fleet efficiencies, size of fleet etc.

# What should happen to the quota (TACC for the next season (2017)



What level of variation in quota (TACCs) from year to year (up or down) is reasonable for industry planning (assuming no stock sustainability issue)?



# What do you consider the ideal number of years required for determination of quotas (TACCs) for the fishery?

Answer Choices	Responses
Annually	27.55%
Annually with indicative quota for next three years	40.82%
Two years with indicative quotas for next two years	21.43%
Three years with indicative quota for one year	9.18%
Four years	0.00%
Other	1.02%

## Proposed TACC Setting over next Four Years

- 2016 6000tonnes Current Quota
- 2017 6300 tonnes WRLC proposed Quota
- 2018 6600 tonnes Be Determined at time of 2017
- 2019 6600 tonnes Set as tentative quota in 2017 Det.2018
- 2020 6600-6900 tonnes Set as tentative quota in 2017 Det. 2019
- Suggested strategy is determine quota setting two years (effectively 18 months) and tentative for next two years- requires change in Harvest Strategy
- Strong Caveat of change for Sustainability or Major market Crisis.

# Model projected Harvest Rates



# Implications of Four Year TACC Strategy

Is It the right strategy? Is there a better Strategy? How do you evaluate this approach? What are the major risks? What steps do you take to understand those risks? What steps do you take to understand those risks? What are the key fishery research questions? How will the market respond ? What information do we need? Have we the right tools? What can we learn from the strategy to facilitate future decision making?

## Remember it is the WRLC who recommends TACC setting to the Minister who determines

- Longer Term Strategy should keep the Industry in a Better Place
- An information building and open, inclusive process of TACC advice and recommendation supported by evidence places the industry in a good place
- Time and experience must lead to ongoing improvement in confidence by those advising on TACC setting including industry, the Minister and subsequently government and ultimately the community.
- Remember the Fishery is not broken; the fishery is information rich and a good basis to move forward; it needs to be kept that way.

# Questions

Written Submissions welcome Confidential Submission Dr. Peter Rogers C/-Western Rock Lobster Council P.O. Box 1605 Fremantle 6959 Appendix 7: MFL Holder Survey Results and Questionnaire on setting of TACC

# Survey Results-Setting TACCs (changing quotas) in the Western Rock Lobster Fishery

# June 30, 2016

This survey report has been compiled by Dr Peter Rogers assisted by Dr J How for the project "Establishing a low risk incremental approach for setting TACCs (changing quotas) in the Western Rock Lobster Fishery, taking into account maximum economic yield and other industry objectives" for the Western Rock Lobster Council in order to provide early feedback to participants and the members of the Rock lobster Industry on the results of the survey conducted for this project. The principal author Dr Peter Rogers does not warrant that the information in this report is free from errors or omissions. The author does not accept any form of liability for the contents of this report or for any consequences arising from its use or any reliance placed upon it. This report is intended to provide background information only and does not purport to make any recommendation.

# Survey Results-Setting TACCs (changing quotas) in the Western Rock Lobster Fishery

### Introduction

This survey was part of a Fisheries Research and Development Corporation (FRDC) project sponsored by the Western Rock Lobster Council as part of the study: "Establishing a low risk incremental approach for setting TACCs (changing quotas) in the Western Rock Lobster Fishery, taking into account maximum economic yield and other industry objectives."

All holders of Managed Fisheries Licenses (MFL) for the Western Rock Lobster Fishery were invited to complete this survey by correspondence to each MFL licence holder. They were instructed to access the questionnaire through a Survey Monkey <sup>™</sup> link on the Western Rock Lobster Council website. In addition the principal author, Dr P Rogers under took 16 meetings with active fishers and MFL holders, including investors and fishing family members. Approximately 100 people at ports between Fremantle and Kalbarri were interviewed over a two week period in late May 2016. These meetings were organised through the executive of the respective professional fishermen associations along the coast. Individuals attending the meeting were invited to complete the survey, with the survey taken prior to any discussions on the issues around setting the TACC for the fishery and information needs.

A total of 83 forms were manually collected at these meeting and a further 15 were completed online. All manually completed forms were entered directly into the Survey Monkey <sup>™</sup> site by data entry staff following closure of the survey early June.

The survey seeks to gain a current understanding of quota setting practices by industry and issues of importance to industry in determining future directions for quota (TACC) determination. A copy of the survey undertaken is at the back of this Appendix. The final summary below also took into account feedback and impressions gained from fishers at the meetings following the completion of the surveys. An interim report on the survey was sent by email to participants prior to the AMM's with the industry with some elements of the results included in the presentation by Dr Rogers at those meetings. The interim survey results were also posted on the WRLC website.

### Summary of Results

The majority of those completing the questionnaire were active participants in the fishery either as operators of their own quota (often leasing additional quota), or operating under share fishermen agreements. Investors who were not active in the fishery were a minor component represented in the survey. For this reason there was little need to separate the answers by category of MFL holders (Qu 3). Some preliminary analysis was undertaken between MFL holders which held quota in the northern zones (A and B) and the southern zone (C). Those that held both southern and northern quota were only not included in the analysis of TACC for the 2017 season when split by zone (Qu. 10), but their responses for quota were more reflective of those from the southern zone.

The general impression gained from the survey was that those completing the surveys were well informed, were generally happy with the role taken by the Fisheries Department and the Western Rock Lobster Council. Less than half had read the 2014 Harvest Strategy paper issued by the Department of Fisheries (Qu. 5) with a similar ratio aligning to a management objective of Maximum Sustainable Yield rather than the actual Harvest Strategy objective of Maximum Economic Yield (Qu. 4). The majority believed however, Maximum Economic Yield was the correct objective (Qu. 9).

The role of the Minister in determining the TACC was well understood and to a lesser extent the relative roles of the Western Rock Lobster Council and the Department of Fisheries (Qu. 6).

Responses regarding the TACC for the 2017 season showed almost 80% of respondents wanted the TACC to either remain at 6000 tonnes or for it to increase by 300-500 tonnes (Qu. 10). However, when this information was examined based on the zone which peopled fished a clear split was noted. The northern zone MFL holders marginally preferred not to change quota at this time whereas the southern zone MFL holders supported an increase quota of around 300-500 tonnes although there was outliers that supported either a reduction in overall quota or a much larger increase than the norm (Qu. 10). This outcome matched a higher level of concern for the fishery in the northern areas of the fishery linked to an apparent loss in productivity of rock lobster inside 10 fathoms. Areas believed to be affected were between Beagle Island and Point Leander, a 100 kilometre strip extending along the coast adjacent to Kalbarri and some areas north of Wedge Island towards Greenhead. There was also a lower level of concern over the reliability of interpretation of puerulus settlement in more recent years. How much the belief of MLF holders views were influenced by differing views on the capacity of the market to adsorb extra product by the processing sector may have also reflected in the observed survey result. The observed absence of independent data on the market could have been a factor. Another factor could have been the belief held by some fishermen particularly in the southern zone that an increase in quota could provide some relief on the cost of leases.

Throughout all meetings there was a tenor of a cautious approach in changing quota with a core value of not changing quota by more than 5 % at any time consistent with Combined Zone C Association Inc. and Geraldton Fishermen's Co-operative values and represented in the results of this survey (Qu. 14).

Whilst sustainability of the fishery and predictability of legal harvest available were seen as core requirements for managing the fishery, total industry profits, better market information and market diversification were identified as high priorities in setting quota (Qu. 7).

The case for increasing overall quota next year (2017) was linked to the low harvest rate currently in the fishery, current and expected higher abundance of rock lobster and further need for market development and diversification (Qu. 11).

The majority of industry favoured annual setting of quota but saw significant value in providing advice on indicative quotas (TACC targets) for the next three years to assist with industry planning and improving business certainty (Qu.13). It also provided the opportunity to deal with any arising risk from the market or stock sustainability.

There appeared to be mixed messages coming from questions 16, 17, 18 and 19 which is open to interpretation. It seems on one hand the majority are satisfied with the role the Western Rock lobster Council and the Fisheries Department undertake in setting TACC for the fishery but believe there should be broader representation of the processing sector and independent expertise involved in the determination of quota. The tenor of the survey outcomes and subsequent meeting discussions points to additional expertise being required in marketing, in particular and economics/independent science on as needs basis. Whilst there was strong majority support for a ministerially appointed committee to set TACC the option of a Council lead expertise based represented sub-committee was not canvassed as an option in the survey. There was strong support and need for greater information on the markets for rock lobster and evidence lead data for informing industry and TACC decision makers from this survey and subsequent meetings across all sectors of the rock lobster fishery.

The comments offered as part of the survey often re-emphasised the points individuals prioritised in the survey questions and on occasion added new points to interpreting individual positions taken. For instance concerns linked to increasing quota prior to full impact of the Free Trade Agreement with China and this opportunity to increasing freight air space.

Other comments reflect on processors having too much influence and lack of independent market information. There was also s level of criticism aimed at various sections of the catching, processing and government, over past research, past decisions in management of the fishery, particularly on equity and concerns over current leasing practices in the fishery and lack of limits on quota aggregation. Further development of the domestic Australian market was considered as an opportunity.

Other feedback issues of relevance to the WRLC included issues of governance, lack of transparency of TACC decisions, improving communications with the industry, requirement for greater independence in decisions and alleged vested interests influencing outcomes. Many MFL holders made no additional comments and there were a range of positive comments supporting current TACC setting processes.

Whilst the comments were diverse and interesting by themselves and provide feedback on a range of issues impacting on MFL holders, statistically little further could be drawn from the data. The comments do reflect individuals engaged effectively and honestly in responding to the survey questions.

The summary survey results to each question are presented below.

### **Survey Results**

98 respondents

2. by status of fisher

Status	Number
Active	80

Investor	16
Other	2

3. by Zone

Didn't Say	Both	North	South
3	4	35	56

The breakup of the Northern zone consisted 19 zone B, 3 zone A, 13 Zones A and B, 1 Zones A, B and C, and 3 zones B and C.

4. What is the annual quota (TACC) required to be based on currently? (please choose one option)



5. Have you read the West Coast Rock Lobster Harvest Strategy and Control Rules 2014-2019? (please choose one option)



#### 6. Who sets the annual quota (TACC) currently? (please choose one option)

#### 56% of respondents got it right

Skipped question	3
The Department of Fisheries	5
The Minister for Fisheries	5
The Minister on advice from the Department of Fisheries	6
The Minister on advice from the Department of Fisheries and the Western Rock	
Lobster Council	
The Minister on advice from the Western Rock Lobster Council	17
The Western Rock Lobster Council	7

7. Please rate the relative importance of each of the following factors in setting the annual quota (TACC)? (please choose one option per line)

Those where >50% of respondents saw it as a high importance

- future predictions of legal-size lobster abundance
- sustainability of fishery(i.e. status of stock )
- market price and trends
- total fishery profit levels (48.9%)
- maximising total industry profits
- developing alternative markets (49.47%)

#### Full Details

_	High-	Medium-	Low-	Not Relevant–	Total-
future predictions of legal-size lobster abundance	<b>80.41%</b> 78	<b>16.49%</b> 16	<b>3.09%</b> 3	<b>0.00%</b> 0	97
sustainability of fishery(i.e. status of stock )	<b>92.71%</b> 89	<b>7.29%</b>	<b>0.00%</b> 0	<b>0.00%</b> 0	96
optimal range of Legal Proportion Harvested from rock lobster stock	<b>38.30%</b> 36	<b>53.19%</b> 50	<b>6.38%</b> 6	<b>2.13%</b>	94
total fishing induce mortality (including handling mortality)	<b>26.32%</b> 25	<b>41.05%</b> 39	<b>27.37%</b> 26	<b>5.26%</b> 5	95
share of available catch for recreational sector	<b>9.78%</b> 9	<b>31.52%</b> 29	<b>46.74%</b> 43	<b>11.96%</b> 11	92
level of illegal black market harvest	<b>32.29%</b> 31	<b>22.92%</b> 22	<b>28.13%</b> 27	<b>16.67%</b> 16	96
market price and trends	<b>63.83%</b> 60	<b>31.91%</b> 30	<b>2.13%</b>	<b>2.13%</b>	94
exchange rates	<b>21.28%</b> 20	<b>36.17%</b> 34	<b>26.60%</b> 25	<b>15.96%</b> 15	94
costs of operating	<b>35.79%</b> 34	<b>32.63%</b> 31	<b>18.95%</b> 18	<b>12.63%</b> 12	95
total fleet size	<b>15.79%</b> 15	<b>27.37%</b> 26	<b>34.74%</b> 33	<b>22.11%</b> 21	95
total fishery profit levels	<b>48.94%</b> 46	<b>38.30%</b> 36	<b>8.51%</b> 8	<b>4.26%</b>	94
Net Present Value estimates of future fishery profits	<b>36.56%</b> 34	<b>46.24%</b> 43	<b>11.83%</b> 11	<b>5.38%</b> 5	93
investment requirements of catching sector	<b>24.47%</b> 23	<b>37.23%</b> 35	<b>27.66%</b> 26	<b>10.64%</b> 10	94
investment requirements of processing sector	<b>28.42%</b> 27	<b>33.68%</b> 32	<b>29.47%</b> 28	<b>8.42%</b> 8	95
maximising total industry profits	<b>55.32%</b> 52	<b>37.23%</b> 35	<b>6.38%</b> 6	<b>1.06%</b> 1	94
employment level	<b>21.05%</b> 20	<b>40.00%</b> 38	<b>28.42%</b> 27	<b>10.53%</b> 10	95
community return	<b>24.73%</b> 23	<b>43.01%</b> 40	<b>26.88%</b> 25	<b>5.38%</b> 5	93
developing alternative markets	<b>49.47%</b> 47	<b>26.32%</b> 25	<b>20.00%</b> 19	<b>4.21%</b>	95
supplying the local market	<b>12.37%</b> 12	<b>30.93%</b> 30	<b>45.36%</b> 44	<b>11.34%</b> 11	97
individual fishermen profit levels	<b>43.01%</b> 40	<b>27.96%</b> 26	<b>19.35%</b> 18	<b>9.68%</b> 9	93

9. Is the concept of maximising the economic yield for setting the quota (TACC) for the fishery the best objective? (please choose one option)



## 10. What should happen to the quota (TACC) for the fishery next season (2017)? (please choose one option) <u>All responses</u>



### Split by North (blue) and South (red)



11. What reason(s) are behind your thoughts on the quota (TACC) level for next season (2017)? (please choose one or more option(s))

Answer Choices	Responses
Current TACC set at low end of Legal Portion of Harvest optimal range	<b>40.82%</b> 40
Need to expand market for Rock Lobster by developing new markets, new products	<b>42.86%</b> 42
Lack of available airspace to markets	<b>36.73%</b> 36
Loss of market share to cheaper substitute species	<b>19.39%</b> 19
May increase cost of fishing reducing returns	<b>14.29%</b> 14
Current prices do not warrant increase in TACC	<b>23.47%</b> 23
High level of lobster abundance in the fishery	<b>42.86%</b> 42
Lack of holding capacity within the processing sector	<b>5.10%</b> 5
Market Trends favour an increase in TACC	<b>18.37%</b> 18
Risk of Re-allocation of Commercial Catch share if underutilised	<b>24.49%</b> 24
Uncertainty of Future markets	<b>8.16%</b> 8
Lower Risk	<b>10.20%</b> 10
Other	<b>8.16%</b> 8
Total Respondents: 98	

12. What do you consider to be the ideal number of years required for determination of quotas (TACCs) for the fishery? (please choose one option)

Answer Choices-	Responses-
Annually	<b>27.55%</b> 27
Annually with indicative quota for next three years	<b>40.82%</b> 40
Two years with indicative quotas for next two years	<b>21.43%</b> 21
Three years with indicative quota for one year	<b>9.18%</b> 9
Four years	<b>0.00%</b> 0
_ Other	<b>1.02%</b> 1
Total	98

13. What factor(s) affected your consideration for this number of years for quota (TACC) determination? (please choose one or more option(s))

Answer Choices-	Responses-
Uncertainty of Future markets	<b>39.18%</b> 38
 Lower Risk	<b>18.56%</b> 18
Enables better planning for fishing sector	<b>58.76%</b> 57
Enables better planning for processing sector	<b>29.90%</b> 29
Improves business certainty	<b>43.30%</b> 42
Manages risk against too large a change in TACC	<b>28.87%</b> 28
Other	<b>2.06%</b> 2

14. What level of variation in quota (TACCs) from year to year (up or down) is reasonable for industry planning (assuming no stock sustainability issue)? (please choose one option)



15. Are you satisfied with current arrangements for setting the quota (TACC)? (please choose one option)

Answer Choices	Responses
Yes	<b>42.71%</b> 41
_ No	<b>40.63%</b> 39
 Unsure	<b>16.67%</b> 16
Total	96

16. Who should be responsible for providing recommendations to the Minister on quota (TACC)? (please choose one option)



17. How can industry have a more effective input into quota (TACC) setting processes? (please choose one option)

Answer Choices	Responses
Happy with current arrangements with WRLC	<b>32.98%</b> 31
Prefer assessment by expertise based industry leaders (WRLC appointed)	<b>14.89%</b> 14
Prefer assessment by expertise based industry leaders (Ministerial appointed)	<b>3.19%</b> 3
Prefer assessment by fishery independent experts including industry (WRLC appointed)	<b>14.89%</b> 14
Prefer assessment by fishery independent experts including industry (Ministerial appointed)	<b>4.26%</b> 4
The use of fishery independent experts to provide comment before WRLC recommendations are forwarded to the Minister	<b>24.47%</b> 23
Other	<b>5.32%</b> 5
Total	94

18. Please rate your responses to the following questions regarding the information and processes for setting annual quotas? (please choose one option per line)

Details below, but here is the % of those that either strongly agree or agree with the statement

There is good description of the data used for stock assessment	92
There is good description of the assumptions used for stock assessment	88
There is good description of the data used for maximum economic yield analysis	74
There is good description of the assumption used for maximum economic yield analysis	68
There is a good level of transparency on reasons for recommended decisions for TACC settings by the Fisheries Department	63
There is a good level of transparency on reasons for recommended decisions for TACC settings by the Western Rock Lobster Council	68

-	Strongly Agree	Agree-	Not relevent-	Disagree	Strongly Disagree	Total-
There is good description of the data used for stock assessment	<b>14.58%</b> 14	<b>77.08%</b>	<b>1.04%</b> 1	<b>6.25%</b> 6	<b>1.04%</b> 1	96
There is good description of the assumptions used for stock assessment	<b>9.47%</b> 9	<b>78.95%</b> 75	<b>3.16%</b> 3	<b>7.37%</b> 7	<b>1.05%</b> 1	95
There is good description of the data used for maximum economic yield analysis	<b>11.83%</b> 11	<b>62.37%</b> 58	<b>2.15%</b> 2	<b>20.43%</b> 19	<b>3.23%</b> 3	93
There is good description of the assumption used for maximum economic yield analysis	<b>8.60%</b> 8	<b>59.14%</b> 55	<b>7.53%</b> 7	<b>21.51%</b> 20	<b>3.23%</b> 3	93
There is a good level of transparency on reasons for recommended decisions for TACC settings by the Fisheries Department	<b>8.51%</b> 8	<b>54.26%</b> 51	<b>4.26%</b> 4	<b>30.85%</b> 29	<b>2.13%</b> 2	94
There is a good level of transparency on reasons for recommended decisions for TACC settings by the Western Rock Lobster Council	<b>11.96%</b> 11	<b>56.52%</b> 52	<b>2.17%</b> 2	<b>27.17%</b> 25	<b>2.17%</b> 2	92

19. What market factor(s) should be used to setting annual quotas? (please choose one or more option(s))

Answer Choices-	Responses-
Better information on rock lobster markets	<b>58.76%</b> (57)
Knowledge on export destinations of various rock lobster species into major market(s)	<b>39.18%</b> (38)
Changes in supply and price trends	<b>47.42%</b> (46)
Development of predictive tools for future pricing (if feasible)	<b>15.46%</b> (15)
Provision of trend data on exchange rates	<b>16.49%</b> (16)
Changing trade conditions within primary market(s)	<b>36.08%</b> (35
Understanding trends in prices between different western rock lobster products	<b>26.80%</b> (26)
Other	<b>3.09%(</b> 3)


Setting TACCs (changing quotas) in the Western Rock Lobster Fishery

## Introduction

This survey is part of a Fisheries Research and Development Corporation (FRDC) project sponsored by the Western Rock Lobster Council as part of the study: "Establishing a low risk incremental approach for setting TACCs (changing quotas) in the Western Rock Lobster Fishery, taking into account maximum economic yield and other industry objectives." All holders of Managed Fisheries Licenses for the Western Rock Lobster Fishery are invited to complete this survey.

Individual submissions made in this survey will be kept confidential. This survey seeks to gain a current understanding of quota setting practices by industry and issues of importance to industry in determining future directions for quota (TACC) determination.

Should you wish to forward a more comprehensive written submission on the future setting of TACC's in this fishery, details for forwarding those submissions can be found at the end of this survey. This survey closes on the 30th of May 2016.

Have your say on the key issues for setting TACC's in your Fishery

## FISHING / INVESTMENT INFORMATION

This sections provides some basic information (which will be treated **CONFIDENTIALLY**) to examine industry responses to the questionnaire based on the Zone of their entitlement holdings, ownership levels and fishing activity

1. Please enter your Managed Fisheries Licence(s) (MFL number(s))

2. Please indicate your holdings (either tonnes, units or pots) by Zone for 2016	
Are you entering tonnes	
or units or pots	
A Zone (owned)	
A Zone (leased)	
B Zone (owned)	
B Zone (leased)	
C Zone (owned)	
C Zone (leased)	
3. For 2016, please specify your status (please choose one or more option/s)	
MFL holder who has leased out all or part of their quota	
MFL holder who actively fishes their quota from their vessel	
MFL holder who leases boat and accompanying quota	
MFL holder who employs a skipper to operate their boat and accompanying quota	
Other (please specify)	
UNDERSTANDING OF THE CURRENT QUOTA (TACC) SETTING PROCESS Below are a series of questions to gauge the level of understanding throughout industry as to the current arrangements used to determine quota (TACC)	
4. What is the annual quota (TACC) required to be based on currently? (please choose one option)	
Maximum Sustainable Yield	
Proportion of legal animals harvested	
Maximum industry profits	
Maximum Economic Yield	
Maximum community benefit	
Some other target	
O Don't Know	
5. Have you read the West Coast Rock Lobster Harvest Strategy and Control Rules 2014-2019? (please choose one option)	)
Yes	
○ No	
Not heard of this Document	
	2

6. Who sets the annual quota (TACC) currently? (please choose one option)	
The Minister for Fisheries	
The Western Rock Lobster Council	
The Department of Fisheries	
The Minister on advice from the Department of Fisheries	
The Minister on advice from the Western Rock Lobster Council	
The Minister on advice from the Department of Fisheries and the Western Rock Lobster Council	
The Minister on advice of an independent body	
	3

7. Please rate the relative in (TACC)? (please choose on	nportance of e le option per li	ach of the following fac ne)	ctors in setting the a	nnual quota
	High	Medium	Low	Not Relevent
future predictions of legal-size lobster abundance	$\bigcirc$	0	$\bigcirc$	0
sustainability of fishery(i.e. status of stock)	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$
optimal range of Legal Proportion Harvested from rock lobster stock	$\bigcirc$	$\circ$	$\bigcirc$	0
total fishing induce mortality (including handling mortality)	$\bigcirc$	$\bigcirc$	$\bigcirc$	0
share of available catch for recreational sector	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$
level of illegal black market harvest	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$
market price and trends	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$
exchange rates	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$
costs of operating	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$
total fleet size	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$
total fishery profit levels	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$
Net Present Value estimates of future fishery profits	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$
investment requirements of catching sector	$\bigcirc$	$\bigcirc$	$\bigcirc$	0
investment requirements of processing sector	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$
maximising total industry profits	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$
employment level	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$
community return	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$
developing alternative markets	$\bigcirc$	$\bigcirc$	$\bigcirc$	0
supplying the local market	$\bigcirc$	0	$\bigcirc$	0
individual fishermen profit levels	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$

<u>MPROVEMENTS TO THE CURRENT QUOTA (TACC) SETTING PROCESS</u> These questions are designed to provide the understand the level of satisfaction with the current process and identify areas for possible improvement to the quota (TACC) setting process
3. Are there other factors you believe are not currently taken into account in setting future quotas (TACCs) for the fishery? (please choose one option)
) Yes
○ No
Unsure
f YES or UNSURE; What are, or might be other factors and why?
bijective? (please choose one option)
Yes
○ No
Unsure
10. What should happen to the quota (TACC) for the fishery next season (2017)? (please choose one option)
Decrease by 500 tonnes
Decrease by 300 tonnes
Remains the same (6000 tonnes)
Increase by 300 tonnes
Increase by 500 tonnes
Increase by 750 tonnes
Increase by 1000 tonnes
Increase by 1500 tonnes

11. What reason(s) are behind your thoughts on the quota (TACC) level for next season (2017)? (please
choose one or more option(s))
Current TACC set at low end of Legal Portion of Harvest optimal range
Need to expand market for Rock Lobster by developing new markets, new products
Lack of available airspace to markets
Loss of market share to cheaper substitute species
May increase cost of fishing reducing returns
Current prices do not warrant increase in TACC
High level of lobster abundance in the fishery
Lack of holding capacity within the processing sector
Market Trends favour an increase in TACC
Risk of Re-allocation of Commercial Catch share if underutilised
Uncertainty of Future markets
Lower Risk
Other
Other (please specify)
12. What do you consider to be the ideal number of years required for determination of quotas (TACCs)
for the lishery? (please choose one option)
Annually
Annually with indicative quota for next three years
Two years with indicative quotas for next two years
Three years with indicative quota for one year
O Four years
Other
Other (please specify)
6

Urcertainty of Future markets Lower Risk Lower Risk Enables better planning for fishing sector Enables better planning for processing sector Improves business certainty Manages risk against too large a change in TACC Other Other Other (please specify) Less than 2.5 % between years Less than 5% between years Less than 5% between years Less than 1% between years Other Ot	(please choose one or more option(s))	n
Lower Risk Enables better planning for fishing sector Enables better planning for processing sector Improves business certainty Manages risk against too large a change in TACC Other Other Other Other (please specify) Less than 10% between years Less than 10% between years Other Ot	Uncertainty of Future markets	
Institution: Enables better planning for fishing sector Enables better planning for processing sector Improves business certainty Manages risk against too large a change in TACC Other Other Other Other (please specify) Less than 10% between years Less than 10% between years Other	Lower Risk	
Less than 10% between years Less than 10% between years Other Other Other Other Other Other Other I consist in the image of the image.	Enables better planning for fishing sector	
Enables better planning to processing sector   Improves business certainty   Manages risk against too large a change in TACC   Other     Other (please specify)     14. What level of variation in quota (TACCs) from year to year (up or down) is reasonable for industry planning (assuming no stock sustainability issue)? (please choose one option)   Less than 2.5 % between years   Less than 5% between years   Less than 10% between years   Other   Other     Other     Other     Differ (please specify)     15. Are you satisfied with current arrangements for setting the quota (TACC)? (please choose one option)     Yes   No   Unsure      If No or UNSURE: please specify		
Improves business certainty     Manages risk against too large a change in TACC     Other Other Other (please specify)  14. What level of variation in quota (TACCs) from year to year (up or down) is reasonable for industry planning (assuming no stock sustainability issue)? (please choose one option)     Less than 2.5 % between years     Less than 10% between years     Less than 10% between years     Other		
Manages risk against too large a change in TACC Other Other Other Other (please specify)  14. What level of variation in quota (TACCs) from year to year (up or down) is reasonable for industry planning (assuming no stock sustainability issue)? (please choose one option) Less than 2.5 % between years Less than 5% between years Less than 10% between years Other Other Other Other Other Other Other If NO or UNSURE: please specify If NO or UNSURE: please specify	Improves business certainty	
Other	Manages risk against too large a change in TACC	
Other (please specify)  14. What level of variation in quota (TACCs) from year to year (up or down) is reasonable for industry planning (assuming no stock sustainability issue)? (please choose one option) Less than 2.5 % between years Less than 5% between years Less than 10% between years Other Other Other Other Other (please specify)  15. Are you satisfied with current arrangements for setting the quota (TACC)? (please choose one option) Yes No Unsure If NO or UNSURE; please specify	Other	
14. What level of variation in quota (TACCs) from year to year (up or down) is reasonable for industry planning (assuming no stock sustainability issue)? (please choose one option)         Less than 2.5 % between years         Less than 5% between years         Less than 10% between years         Other         Other (please specify)         15. Are you satisfied with current arrangements for setting the quota (TACC)? (please choose one option)         Yes         No         Unsure         If NO or UNSURE; please specify	Other (please specify)	
14. What level of variation in quota (TACCs) from year to year (up or down) is reasonable for industry planning (assuming no stock sustainability issue)? (please choose one option)  Less than 2.5 % between years Less than 5% between years Less than 10% between years Other Other Other Other Other Other I5. Are you satisfied with current arrangements for setting the quota (TACC)? (please choose one option) Yes No Unsure If NO or UNSURE; please specify		
Less than 2.5 % between years     Less than 5% between years     Less than 10% between years     Other Other Other Other T5. Are you satisfied with current arrangements for setting the quota (TACC)? (please choose one option)     Yes     No     Unsure If NO or UNSURE; please specify	14. What level of variation in quota (TACCs) from year to year (up or down) is reasonable for industry planning (assuming no stock sustainability issue)? (please choose one option)	1
Less than 5% between years     Less than 10% between years     Other Other Other Other (please specify)  15. Are you satisfied with current arrangements for setting the quota (TACC)? (please choose one option) Yes No Unsure If NO or UNSURE; please specify	Less than 2.5 % between years	
Less than 10% between years     Other Other (please specify)  15. Are you satisfied with current arrangements for setting the quota (TACC)? (please choose one option) Yes No Unsure If NO or UNSURE; please specify	Less than 5% between years	
Other Other (please specify)  15. Are you satisfied with current arrangements for setting the quota (TACC)? (please choose one option)  Yes No Unsure If NO or UNSURE; please specify	Less than 10% between years	
Other (please specify)  15. Are you satisfied with current arrangements for setting the quota (TACC)? (please choose one option)  Yes No Unsure If NO or UNSURE; please specify	Other	
15. Are you satisfied with current arrangements for setting the quota (TACC)? (please choose one option)         Yes         No         Unsure         If NO or UNSURE; please specify	Other (please specify)	
15. Are you satisfied with current arrangements for setting the quota (TACC)? (please choose one option) Yes No Unsure If NO or UNSURE; please specify		
15. Are you satisfied with current arrangements for setting the quota (TACC)? (please choose one option)  Yes No Unsure If NO or UNSURE; please specify		
Yes          No         Unsure         If NO or UNSURE; please specify	15. Are you satisfied with current arrangements for setting the quota (TACC)? (please choose one option)	
No Unsure If NO or UNSURE; please specify	Yes	
Unsure If NO or UNSURE; please specify	○ No	
If NO or UNSURE; please specify	Unsure	
	If NO or UNSURE; please specify	
		_

The Western Rock Lobster Council         The Department of Fisheries         The processing sector         A combined Ministerial Committee consisting of representatives of WRLC, processors and the Department with input from independent experts         An independent expertise based legislated body inclusive of industry         Other         Other, please specify         17. How can industry have a more effective input into quota (TACC) setting processes? (please choose one eption)         Happy with current arrangements with WRLC         Prefer assessment by expertise based industry leaders (WRLC appointed)         Prefer assessment by expertise based industry leaders (Ministerial appointed)         Prefer assessment by fishery independent experts including industry (WRLC appointed)         Prefer assessment by fishery independent experts including industry (Ministerial appointed)         Other         Other	16. V (plea	Who should be responsible for providing recommendations to the Minister on quota (TACC)? use choose one option)
The Department of Fisheries         The processing sector         A combined Ministerial Committee consisting of representatives of WRLC, processors and the Department with input from independant experts         An independent expertise based legislated body inclusive of industry         Other         Other; please specify         Image: the specified of the sp		The Western Rock Lobster Council
The processing sector A combined Ministerial Committee consisting of representatives of WRLC, processors and the Department with input from independent experts based legislated body inclusive of industry Other Other Other Other, please specify 17. How can industry have a more effective input into quota (TACC) setting processes? (please choose one option) Happy with current arrangements with WRLC Prefer assessment by expertise based industry leaders (WRLC appointed) Prefer assessment by expertise based industry leaders (WRLC appointed) Prefer assessment by fishery independent experts including industry (WIRLC appointed) The use of fishery independent experts to provide comment before WRLC recommendations are forwarded to the Minister Other	$\bigcirc$	The Department of Fisheries
A combined Ministerial Committee consisting of representatives of WRLC, processors and the Department with input from independent experts An independent expertise based legislated body inclusive of industry Other Other Other Other T. How can industry have a more effective input into quota (TACC) setting processes? (please choose one option) Happy with current arrangements with WRLC Prefer assessment by expertise based industry leaders (WRLC appointed) Prefer assessment by fishery independent experts including industry (WRLC appointed) Prefer assessment by fishery independent experts including industry (Ministerial appointed) Prefer assessment by fishery independent experts including industry (Ministerial appointed) The use of fishery independent experts to provide comment before WRLC recommendations are forwarded to the Minister Other Othe	$\bigcirc$	The processing sector
An independent expertise based legislated body inclusive of industry Other Other Other; please specify  T. How can industry have a more effective input into quota (TACC) setting processes? (please choose one option) Happy with current arrangements with WRLC Prefer assessment by expertise based industry leaders (WRLC appointed) Prefer assessment by expertise based industry leaders (Ministerial appointed) Prefer assessment by fishery independent experts including industry (WRLC appointed) Prefer assessment by fishery independent experts to provide comment before WRLC recommendations are forwarded to the Minister Other; please specify		A combined Ministerial Committee consisting of representatives of WRLC, processors and the Department with input from ndependant experts
Other         Other, please specify         Intervention	\ /	An independent expertise based legislated body inclusive of industry
Other; please specify	$\bigcirc$	Other
17. How can industry have a more effective input into quota (TACC) setting processes? (please choose one option)         Happy with current arrangements with WRLC         Prefer assessment by expertise based industry leaders (WRLC appointed)         Prefer assessment by expertise based industry leaders (Ministerial appointed)         Prefer assessment by fishery independent experts including industry (WRLC appointed)         Prefer assessment by fishery independent experts including industry (Ministerial appointed)         The use of fishery independent experts to provide comment before WRLC recommendations are forwarded to the Minister         Other         Other	Other	; please specify
17. How can industry have a more effective input into quota (TACC) setting processes? (please choose one option)         Happy with current arrangements with WRLC         Prefer assessment by expertise based industry leaders (WRLC appointed)         Prefer assessment by expertise based industry leaders (Ministerial appointed)         Prefer assessment by fishery independent experts including industry (WRLC appointed)         Prefer assessment by fishery independent experts including industry (Ministerial appointed)         The use of fishery independent experts to provide comment before WRLC recommendations are forwarded to the Minister         Other         Other		
<ul> <li>Happy with current arrangements with WRLC</li> <li>Prefer assessment by expertise based industry leaders (WRLC appointed)</li> <li>Prefer assessment by fishery independent experts including industry (WRLC appointed)</li> <li>Prefer assessment by fishery independent experts including industry (Ministerial appointed)</li> <li>Prefer assessment by fishery independent experts to provide comment before WRLC recommendations are forwarded to the Minister</li> <li>Other</li> </ul>	17. ⊢ one (	low can industry have a more effective input into quota (TACC) setting processes? (please choose option)
<ul> <li>Prefer assessment by expertise based industry leaders (WRLC appointed)</li> <li>Prefer assessment by expertise based industry leaders (Ministerial appointed)</li> <li>Prefer assessment by fishery independent experts including industry (WRLC appointed)</li> <li>Prefer assessment by fishery independent experts including industry (Ministerial appointed)</li> <li>The use of fishery independent experts to provide comment before WRLC recommendations are forwarded to the Minister</li> <li>Other</li> </ul>	0	Happy with current arrangements with WRLC
<ul> <li>Prefer assessment by expertise based industry leaders (Ministerial appointed)</li> <li>Prefer assessment by fishery independent experts including industry (WRLC appointed)</li> <li>Prefer assessment by fishery independent experts including industry (Ministerial appointed)</li> <li>The use of fishery independent experts to provide comment before WRLC recommendations are forwarded to the Minister</li> <li>Other</li> </ul>	F	Prefer assessment by expertise based industry leaders (WRLC appointed)
<ul> <li>Prefer assessment by fishery independent experts including industry (WRLC appointed)</li> <li>Prefer assessment by fishery independent experts including industry (Ministerial appointed)</li> <li>The use of fishery independent experts to provide comment before WRLC recommendations are forwarded to the Minister</li> <li>Other</li> </ul>	F	Prefer assessment by expertise based industry leaders (Ministerial appointed)
<ul> <li>Prefer assessment by fishery independent experts including industry (Ministerial appointed)</li> <li>The use of fishery independent experts to provide comment before WRLC recommendations are forwarded to the Minister</li> <li>Other</li> </ul> Other:	F	Prefer assessment by fishery independent experts including industry (WRLC appointed)
The use of fishery independent experts to provide comment before WRLC recommendations are forwarded to the Minister Other Other; please specify	F	Prefer assessment by fishery independent experts including industry (Ministerial appointed)
Other Other; please specify		The use of fishery independent experts to provide comment before WRLC recommendations are forwarded to the Minister
Other; please specify	$\bigcirc$	Other
	Other;	; please specify

There is good description of the data used for stock assessment There is good description of the data used for maximum economic yield analysis There is good description of the data used for maximum economic yield analysis There is good level of transparency on reasons for recommended decisions for TACC settings by the Fisheries Department There is agood level of transparency on reasons for recommended decisions for TACC settings by the Fisheries Department There is agood level of transparency on reasons for recommended decisions for TACC settings by the Fisheries Department There is agood level of transparency on reasons for recommended decisions for TACC settings by the Western Rock Lobster Council	0	Strongly Agree	Agree	Not relevent	Disagree	Strongly Disagree
There is good   description of the   assumptions used for   there is good   description of the   assumption used for   commonic yield analysis   There is good level of transparency on recommended certains for	There is good description of the data used for stock assessment	0	$\bigcirc$	0	0	0
There is good description of the data used for maximum economic yield analysis There is good level of transparency on reasons for recommended decisions for TACC settings by the Fisheries Department There is a good level of transparency on reasons for recommended decisions for TACC settings by the Westerm Rock Lobster Council	There is good description of the assumptions used for stock assessment	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$
There is good description of the assumption used for maximum economic yield analysis There is a good level of transparency on recommended decisions for TACC settings by the Fisheries Department There is a good level of transparency on reasons for recommended decisions for TACC settings by the Western Rock Lobster Council	There is good description of the data used for maximum economic yield analysis	0	$\bigcirc$	0	0	0
There is a good level of transparency on reasons for TACC settings by the Fisheries Department to transparency on reasons for recommended of transparency on reasons for TACC settings by the Western Rock Lobster Council of transparency on reasons for the transparency on transparency on the transparency on the transparency on the transparency on transparency on the transparency on	There is good description of the assumption used for maximum economic yield analysis	0	0	$\bigcirc$	0	$\bigcirc$
There is a good level of transparency on recommended O O O O O O O O O O O O O O O O O O	There is a good level of transparency on reasons for recommended decisions for TACC settings by the Fisheries Department	0	0	0	0	0
	There is a good level of transparency on reasons for recommended decisions for TACC settings by the Western Rock Lobster Council	0	$\bigcirc$	$\bigcirc$	0	$\bigcirc$

18. Please rate your responses to the following questions regarding the information and processes for setting annual quotas? (please choose one option per line)

19. V optic	What market factor(s) shoเ on(s))	9		
	Better information on rock lobste	er markets		
	Knowledge on export destinatior	ns of various rock lobster sp	ecies into major market(s)	
/	Changes in supply and price tre	ends		
	Development of predictive tools	for future pricing (if feasible		
	Provision of trend data on excha	ange rates		
	Changing trade conditions withir	n primary market(s)		
	Understanding trends in prices b	between different western ro	ck lobster products	
	Other			
 Other	; please specify			
mak	er(s) in advising/ recomme	ending to the Minister,	uture quotas (TACC's)?	hann an
mak (Are foreo	er(s) in advising/ recomme as to consider can include cast profits for the fishery,	ending to the Minister, sissues around determ understanding markets	uture quotas (TACC's)? ning sustainability of the fis and areas of new research	hery, assessment of ı).
mak (Are fored 21. F thes com	er(s) in advising/ recomme as to consider can include cast profits for the fishery, Please provide comment o e include, issues on gover munication, or legislation r	ending to the Minister, issues around determ understanding markets on any other issues you mance, reporting or acc relevant to quota (TAC	uture quotas (TACC's)? ning sustainability of the fis and areas of new research have concerning the setting countability, transparency of c) setting	hery, assessment of n). g of quota (TACC); f decisions and their
mak (Are forec 21. F thes com	er(s) in advising/ recomme as to consider can include cast profits for the fishery, Please provide comment o e include, issues on gover munication, or legislation r	ending to the Minister, e issues around determ understanding markets on any other issues you mance, reporting or ac relevant to quota (TAC	uture quotas (TACC's)? ning sustainability of the fis and areas of new research have concerning the setting countability, transparency of c) setting	hery, assessment of n). g of quota (TACC); f decisions and their
mak (Are forec 21. F thes com	er(s) in advising/ recomme as to consider can include cast profits for the fishery, Please provide comment o e include, issues on gover munication, or legislation r	ending to the Minister, e issues around determ understanding markets on any other issues you mance, reporting or ac relevant to quota (TAC	uture quotas (TACC's)? ning sustainability of the fis and areas of new research have concerning the setting countability, transparency of c) setting	hery, assessment of n). g of quota (TACC); f decisions and their
mak (Are forec 21. F thes com	er(s) in advising/ recomme as to consider can include cast profits for the fishery, Please provide comment o e include, issues on gover munication, or legislation r	ending to the Minister, e issues around determ understanding markets on any other issues you mance, reporting or ac relevant to quota (TAC	uture quotas (TACC's)? ning sustainability of the fis and areas of new research have concerning the setting bountability, transparency of c) setting	hery, assessment of n). g of quota (TACC); f decisions and their
mak (Are forec 21. F thes com	er(s) in advising/ recomme as to consider can include cast profits for the fishery, Please provide comment o e include, issues on gover munication, or legislation r	ending to the Minister, e issues around determ understanding markets on any other issues you rnance, reporting or ac relevant to quota (TAC	uture quotas (TACC's)? ning sustainability of the fis and areas of new research have concerning the setting countability, transparency of c) setting	hery, assessment of n). g of quota (TACC); f decisions and their
mak (Are forec 21. F thes com	er(s) in advising/ recomme as to consider can include cast profits for the fishery, Please provide comment o e include, issues on gover munication, or legislation r	ending to the Minister, e issues around determ understanding markets on any other issues you rnance, reporting or ac relevant to quota (TAC	uture quotas (TACC's)? ning sustainability of the fis and areas of new research have concerning the setting countability, transparency of C) setting	hery, assessment of n). g of quota (TACC); f decisions and their
mak (Are forec 21. F thes com	er(s) in advising/ recomme as to consider can include cast profits for the fishery, Please provide comment o e include, issues on gover munication, or legislation r	ending to the Minister, e issues around determ understanding markets on any other issues you mance, reporting or ac relevant to quota (TAC	uture quotas (TACC's)? ning sustainability of the fis and areas of new research have concerning the setting countability, transparency of c) setting	hery, assessment of n). g of quota (TACC); f decisions and their
mak (Are forec 21. F thes com	er(s) in advising/ recomme as to consider can include cast profits for the fishery, Please provide comment o e include, issues on gover munication, or legislation r	ending to the Minister, e issues around determ understanding markets on any other issues you rnance, reporting or ac relevant to quota (TAC	uture quotas (TACC's)? ning sustainability of the fis and areas of new research have concerning the setting countability, transparency of c) setting	hery, assessment of n). g of quota (TACC); f decisions and their
mak (Are forec 21. F thes com	er(s) in advising/ recomme as to consider can include cast profits for the fishery, Please provide comment o e include, issues on gover munication, or legislation r	ending to the Minister, e issues around determ understanding markets on any other issues you mance, reporting or ac relevant to quota (TAC	uture quotas (TACC's)? ning sustainability of the fis and areas of new research have concerning the setting countability, transparency of c) setting	hery, assessment of n). g of quota (TACC); f decisions and their

If there are particular areas you wish to provide further comment upon; evidence supporting a particular view or useful background data or written information on the determination of TACC's in your fishery, please do so. Should you wish to forward a more comprehensive written submission on the future setting of TACC's in this fishery, this can be undertaken by forwarding a written submission to:

Confidential Submission Dr Peter Rogers C/-Western Rock Lobster Council P.O. Box 1605 Fremantle 6959

Individual written submissions will be most valuable if received by 31 May 2016 but will be considered where received by 30th June 2016.

Thank you for taking the time to complete this survey. Preliminary results from this survey will be presented at the Annual Management Meetings in June with a report being provided to the WRLC and FRDC towards the end of 2016. If an email address is supplied below then a summary of the survey results can be emailed to you. Phone numbers will assist with clarifying any responses.

22. Contact Details

Name

Boat Name (if applicable)

Phone Number Email Address

## Appendix 8: References

Agknowledge<sup>®</sup> - June 2016, Review and analysis of the risks associated with the sustainable development of the WA Rock Lobster industry. Fisheries Research and Development Corporation, Canberra. Project No. 2015-237 (In prep.)

Anon, 2014. West Coast Rock Lobster Harvest Strategy and Control Rules 2014 – 2019. Fisheries Management Paper no. 264. <u>http://www.fish.wa.gov.au/Documents/management\_papers/fmp264.pdf</u>

Australian Government, Department of Agriculture, Fisheries and Forestry. *Commonwealth Fisheries Harvest Strategy, Policy and Guidelines* (Sept 2007).

Campbell, J. (2015). *Prized Catch – Rock Lobster's Growth in China,* a paper presented to the Trans-Tasman Rock Lobster Industry Conference, Fremantle, April 2015.

Caputi, N., M. Kangas, Y. Hetzel, A. Denham, A. Pearce & A. Chandrapavan (2016). Management adaptation of invertebrate fisheries to an extreme marine heat wave event at a global warming hotspot. Ecology and Evolution. doi: 10.1002/ece3.2137

http://onlinelibrary.wiley.com/doi/10.1002/ece3.2137/full

Caputi, N., S. de Lestang, C. Reid, A. Hesp & J. How (2014). Maximum economic yield of the western rock lobster fishery of Western Australia after moving from effort to quota control. Marine Policy 51 (2015) pp452-464.

http://dx.doi.org/10.1016/j.marpol.2014.10.006

Clarke, S. (2015). *Competitive Trade Analysis: Fresh, Frozen and Processed Crustaceans in China.* Ottawa; Agriculture and Agri-Food Canada.

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. 217. <u>http://www.fish.wa.gov.au/Documents/research\_reports/frr217.pdf</u>

Economic Research Associates Pty Ltd (2015). *An Analysis of the Demand for Western Rock Lobster.* A report prepared for the Western Australian Department of Fisheries. Perth, Western Australia.

EconSearch, (2015). *Economic Indicators for the South Australian Southern Zone Rock Lobster Fishery*. A report to PIRSA Fisheries and Aquaculture. Adelaide, South Australia.

Gavine, F. M., Ingram, B. A., Hardy Smith, P., and Doroudi, M. (2009). *Biosecurity Control Measures for Abalone Viral Ganglioneuritis: A Code of Practice*. Prepared as part of FRDC Project No. 2006/243.

Geraldton Fishermen's Cooperative (2014). *Submission* on FMP 263: West Coast Rock Lobster Harvest Strategy and Control Rules, 2015-2019.

Gordon, D. V. (2011). The Canadian FishSsupply Chain: Price Links from Ex-vessl to Export Market. Working paper from Department of Economics, University of Calgary 2500 University Drive N.W. Calgary, Alberta, Canada. Retrieved on 18 July 2016 at: https://www.google.com.au/?gws\_rd=ssl#q=Gordon%2C+Daniel+V.+2011.+Canada\_Price\_r ealtionships\_fish\_supply\_chain

Hoskins, W. (2015). Correspondence to the WRLC on TACC settings for the 2016/17 Western Rock Lobster Season.

Integrated Fisheries Allocation Advisory Committee (2006).*Integrated Fisheries Management Allocation Report-Western Rock Lobster Resource*. Fisheries Management Paper No.218. February 2007, Department of Fisheries, Perth. Western Australia.

Lyne, M. (July 2016). *Western Australian kelp forests in hot water*. CSIRO, Home, Posts, Issue 21.

McIlgorm, A. (2013) *Literature study and review of international best practice, fisheries harvest strategy policy approaches.* A report to the Department of Agriculture Fisheries and Forestry (DAFF),

Canberra, by ANCORS, University of Wollongong.

McLeod, P. (2014.) *Governance, social and economic sustainability of WA's Western Rocklobster and finfish industries,* University of Western Australia, Perth, Western Australia.

Norman-Lopez, A.; S. Pascoe, O. Thebaud, I. Van Putten, J. Innes, S. Jennings, A. Hobday, B, Green and E. Plaganyi, (2013), Price integration in the Australian rock lobster industry: implications for management and climate change adaption, Australian Journal of Agricultural and Resource Economics, 58, pp.43-90. doi:10.1111/1467-8489.12020

Ward, T.M., F. Hoedt, L.McLeay, W.F. Dimmlich, M. Kinloch, G. Jackson, R. McGarvey, P.J. Rogers and K. Jones (2001). *Effects of the 1995 and 1998 mass mortality events on the spawning biomass of sardines, Sardinops sagax, in South Australian waters*. ICES Journal of Marine Science, 58:865-875, 2001. doi:10.1006/jmsc.2001.1077 at <a href="http://www.ideallibary.com">http://www.ideallibary.com</a>

Wernberg, T., S. Bennett, R.C Babcock, T. de Bettignies, K. Cure, M.Depczynski, F. Dufois, J. Fromont, C.J. Fulton, R.K. Hovey, E.S. Harvey, T.H. Holmes, G.A. Kendrick, B. Renford, J.Santana-Garcon, B.J. Saunders, D.A. Smale, M.S Thomsen, C.A. Tuckett, F. Tuya, M.A. Vanderklift and S.Wison. *Climate-driven regime shift of a temperate marine system* (Jul 2016) Science, Vol. 353, Issue 6295, pp. 169-172. DOI: 10.1126/science.aad8745

Whittington, R.J.; M. Crockford, D. Jordan and B. Jones (2008). *Herpesvirus that caused epizootic mortality in 1995 and 1998 in pilchard, Sardinops sagax neopilchardus (Steinachner), in Australia is now endemic.* Journal of Fish Diseases 2008, 31, 97-105.

Data Sources.

Australian Bureau of Statistics (2014). International Trade Customised Report. Canberra: ABS.

China National Bureau of Statistics (2015). Retail Sales Monthly. Data extracted in real time from: http://data.stats.gov.cn/english/easyquery.htm?

Statistics NZ (2014). Harmonized Trade Exports. Wellington.NZ Statistics. Data extracted in real time from: http://www.stats.govt.nz/infoshare/TradeVariables.aspx?DataType=TEX.

United Nations Trade Statistics Division (2015) UN Commtrade Data Base. available from : http://comtrade.un.org/data/

United States Census (2015). USA Trade Online. Data extracted in real time from https://usatrade.census.gov