



Department of
**Primary Industries and
Regional Development**

Fisheries Research Report No. 290

Decision tree and rapid appraisal methodology for new fisheries

Anthony M. Hart

August 2018



Correct citation:

Hart, A.M. 2018. Decision tree and rapid appraisal methodology for new fisheries. FRDC Project No 2012/237. Fisheries Research Report No. 290, Department of Primary Industries and Regional Development, Western Australia. 54pp.

Researcher Contact Details

Name: Dr Anthony Hart
Address: 39 Northside Drive
Hillarys WA 6920
Phone: 08 9230 0163
Fax: 08 9203 0199
Email: Anthony.Hart@fish.wa.gov.au

FRDC Contact Details

Address: 25 Geils Court
Deakin ACT 2600
Phone: 02 6285 0400
Fax: 02 6285 0499
Email: frdc@frdc.com.au
Web: www.frdc.com.au

In submitting this report, the researcher has agreed to FRDC publishing this material in its edited form.

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 Department of Primary Industries and Regional Development.

This publication (and any information sourced from it) should be attributed to **Hart, A.M. (2018). *Decision tree and rapid appraisal methodology for new fisheries, Perth, Australia, August 2018. CC BY 3.0***

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.gov.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 reader's 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.

© Fisheries Research and Development Corporation and Department of Primary Industries and Regional Development, Western Australia. August 2018. All rights reserved.

ISSN: 1447-2058 (Print) ISBN: 978-1-921258-06-0 (Print)
ISSN: 2206-0928 (Online) ISBN: 978-1-921258-07-7 (Online)

1182/18

Table of Contents

Abbreviations	vii
Executive Summary	1
1 Introduction	3
Objectives	4
2 Methods	5
2.1 Overall	5
2.2 Objective 1: Design a decision tree and rapid appraisal model (RAM) to assess new fishery development opportunities.....	5
2.2.1 Defining a ‘development opportunity’ and a ‘new fishery’.	5
2.3 Objective 2: Develop novel and cost-effective approaches for sustainability and socioeconomic assessments for potential new fisheries	6
2.4 Objective 3: Design alternative management and regulatory approaches to facilitate future growth and productivity on a cost-effective basis.....	7
2.4.1 Conceptualising the new fisheries initiative.....	7
3 Results	10
3.1 Overall	10
3.2 Decision Tree for New Fishery Proposals (Objective 1).....	12
3.3 Rapid Appraisal Methodology (RAM) – (Objective 2).....	13
3.3.1 Eligibility Test and Renewal Test (RAM ‘engine rooms’).....	13
3.3.2 Economic Viability Proposal.....	15
3.3.3 Sustainability Proposal.....	16
3.3.4 Community Issues Proposal.....	17
3.4 Innovative management and regulatory approaches to facilitate cost-effective growth and productivity (Objective 3)	18
3.4.1 Development opportunity and new fisheries criteria	18
3.4.2 Economic viability criteria	18
3.4.3 Sustainability criteria.....	18
3.4.4 Community issues criteria.....	18
3.5 Schedules and Timelines.....	24
3.6 Evaluation of RAM with simulated new fisheries developments.....	26
3.6.1 Two species bivalve fishery in Shark Bay	26
3.6.2 Area 3 abalone enhancement fishery	32
4 Discussion	37
4.1 Overall	37

4.2 Conclusion	38
5 Implications	39
6 Recommendations	40
7 Extension and Adoption	41
8 Project materials developed	42
9 Glossary	43
10 Appendices.....	44
10.1 Intellectual Property	44
10.2 List of researchers and project staff.....	44
10.3 References	44

LIST OF TABLES

Table 1.	Criteria for the Eligibility Test of proposals for a development opportunity in new fisheries	19
Table 2.	Criteria for the Renewal Test of proposals for a development opportunity in new fisheries	20
Table 3.	Criteria for the Eligibility Test of economic viability (commercial fisheries only)	21
Table 4.	Criteria for the Renewal Test of economic viability (commercial fisheries only)	21
Table 5.	Criteria for the Eligibility Test of sustainability.....	22
Table 6.	Criteria for the Renewal Test of sustainability.....	23
Table 7.	Criteria for the Eligibility Test of Community Issues	23
Table 8.	Criteria for the Renewal Test of Community Issues	24
Table 9.	Proposed new fishery development approval timeline (inclusive of the <i>WildCulture</i> initiative).	25
Table 10.	Simulated eligibility test to determine if the proposed Shark Bay cockle fishery satisfies the development opportunity criteria.....	28
Table 11.	Simulated eligibility test to determine if the proposed Shark Bay cockle fishery satisfies the economic viability criteria.	29
Table 12.	Simulated eligibility test to determine if the proposed Shark Bay cockle fishery satisfies the sustainability criteria.....	30
Table 13.	Simulated eligibility test to determine if the proposed Shark Bay cockle fishery satisfies the community issues criteria.	31
Table 14.	Simulated eligibility test to determine if the proposed Area 3 abalone enhancement fishery satisfies the development opportunity criteria.....	33
Table 15.	Simulated eligibility test to determine if the proposed Area 3 abalone enhancement fishery satisfies the economic viability criteria.	34
Table 16.	Simulated eligibility test to determine if the proposed Area 3 abalone enhancement fishery satisfies the sustainability criteria.....	35
Table 17.	Simulated eligibility test to determine if the proposed Area 3 abalone enhancement fishery satisfies the community issues criteria.	36

LIST OF FIGURES

Figure 1.	Aquatic resources harvest policy, as represented by trade-offs between sustainability risk (or level of Government control) and the public/private nature of resource access rights. A new fisheries initiative (e.g. <i>WildCulture</i>) could be viewed as an intermediate development between the aquaculture/wild fisheries sectors.....	9
Figure 2.	Decision tree depicting the development pathway for creation of new fisheries	12
Figure 3.	RAM decision trees for the assessment of a potential development opportunity for new fisheries	14
Figure 4.	RAM decision tree for the assessment of economic viability of a potential new fishery.	15
Figure 5.	RAM decision tree for the assessment of sustainability of a potential new fishery	16
Figure 6.	RAM decision tree for the assessment of community issues related to a potential new fishery.....	17
Figure 7.	Shark Bay cockle fishery. Species-specific information (from rapid assessment scorecard)	27

Abbreviations

Applicant: *An applicant is the party submitting a proposal to develop a new fishery. It is intended that the rapid appraisal methodology (RAM) provide guidance for both assessors and applicants in a new fishery development process.*

Assessor: *An assessor is the party reviewing a proposal to develop a new fishery. In Western Australia it will generally be the Department of Primary Industries and Regional Development. From time to time, independent assessors may be called upon.*

Proposal: *A submission to the Assessor (Department of Primary Industries and Regional Development) outlining a new fishery development. The first assessment of a proposal is to determine if it is a development opportunity. The second assessment is to determine if the development opportunity becomes a new fishery.*

RAM: *Rapid Appraisal Methodology – acronym for the overall methodological approach used to assess applications for new fishery development. The ‘engine rooms’ of the RAM are the Eligibility Test” and the “Renewal Test”. These provide respectively, a first and second assessment of proposals against specified criteria.*

Decision tree: *An element of the Rapid Appraisal Methodology (RAM). Decision trees provide explicit pathways for assessment of proposals for new fishery development.*

Development opportunity: *A proposal, identifying a development project (species, market characteristics, production method [culture and/or harvest], harvest gear, and location), that is eligible to be assessed against the business case, sustainability science, and community issues decision trees for new fisheries.*

Eligibility Test: *The ‘engine rooms’ of the RAM are the “Eligibility Test” and the “Renewal Test”. The “Eligibility” test provides the first assessment of a proposal against specified criteria and determines the pass/fail nature of it. See also “RAM” and “Renewal Test”.*

Renewal Test: *The second assessment of a proposal against specified criteria. It is undertaken if the proposal fails the Eligibility test. Its main objective is to allow iterative improvement of proposals to increase their chances of passing the Eligibility test*

New fishery: *A new fishery is a development opportunity that has been fully assessed against the business case (economic viability), sustainability science, and community issues decision trees, and passed the scoring criteria.*

Executive Summary

The objective of this report is to provide a process (RAM – Rapid Appraisal Methodology) for assessing proposals for new fisheries. If adopted, the methodology could extend to a potential new initiative, referred to as *WildCulture* in this report. *WildCulture* is the vehicle to receive and assess new fishery proposals which may potentially encompass aquaculture, in line with evolving practices in seafood production worldwide. In this particular context, “Wild” means, first and foremost, maintenance of the natural animal and the natural ecosystem under the principles of ecosystem based fisheries management (EBFM). The “Culture” means a community-based approach to optimal productivity, involving, where appropriate, both fisheries and aquaculture techniques. The RAM process is designed to be a modern, forward thinking, opportunity creating instrument for enhancing seafood production from renewable aquatic resources.

Declines in the gross value of production (GVP) from commercial fishers in Western Australia and increased interest from the commercial sector in diversifying activities to adapt to seasonal variability in supply and demand has prompted the state to seek new ways of promoting sustainable seafood production. However, poor public perception often associated with commercial fishing, low probability of establishing fisheries of considerable scale, and lack of efficient policy strategies hinders development in this area. To enhance the future of the industry, this project reviewed current approaches to fisheries development, with a view to promote innovation and strengthen community ties.

A review of the international literature concluded that the two main impediments to fisheries development were: 1) a too-narrow definition of what constitutes a new fishery, and 2) a lack of resources to improve the knowledge base and implement secure access rights to the fisher. In this project an innovative approach to new fishery development was undertaken, with the objective being to mitigate these impediments. It was recognised at the outset that, in principle, pristine natural waters and a proven track record in fishery and aquaculture management were key assets in Western Australia and Australia in general. With biological sustainability as a given therefore, this project focused on the development of appropriate methods to evaluate potential new fisheries in a timely and cost-effective manner.

A new fishery or aquaculture development needs to be economically viable, biologically sustainable, and socially acceptable. The ‘engine room’ of development in this report is the RAM (Rapid Appraisal Methodology). RAM promotes iterative and innovative improvement in new fishery proposals, with the aim of creating and enhancing development opportunities. RAM applies swift decision making processes (through the use of decision trees and associated elements) without compromising detail, objectivity, or robustness. Testing of the RAM methodology was undertaken using two case studies on the following themes: (1) retrospective test with an existing developmental fishery, and (2) a diversification test with an existing managed fishery.

RAM was found to accurately and swiftly score development opportunities against respective scorecards for economics, sustainability, and social license. In an example based on a

developing bivalve fishery in an environmentally sensitive area (Shark Bay), the RAM scored positives for sustainability and social acceptability, with economic viability being uncertain.

Modern fisheries management is complex and expensive, with the average service cost of \$160-\$180/hr to the community. The high cost is due to the complexity of services, which include maintaining sustainability in managed fisheries and aquaculture operations, allocating resources between and within sectors, protecting the environment, mitigating biosecurity risks (from introduced pests and diseases), managing protected species interactions with fishing gear, addressing community concerns and perspectives, and supporting key initiatives such as MSC (Marine Stewardship Council) and ASC (Aquaculture Stewardship Council) certification schemes. Consequently, economic viability is the first outcome required of any proposal to develop a new fishery. In the case of wild fisheries, one advantage of assessing economic viability is that MEY (Maximum Economic Yield) is more conservative than MSY (Maximum Sustainable Yield) and thus automatically meets biological sustainability criteria. This approach represents a pragmatic reconciliation of policy with practice, and is consistent with the principles of RAM (timely and cost-effective).

Overall, the project delivered a methodology (RAM) which met the three objectives. The process developed under the RAM methodology provides a clear opportunity for aquatic resource managers to innovate in areas of seafood production. However further work is needed on articulation of supporting policy, particularly in the details of integrated fisheries and aquaculture and harvest for both human and non-human consumption such as pharmaceutical development and bioprospecting. In particular, work is needed to enshrine spatial “use” rights and rules in practical policy instruments to avoid this issue being a major stumbling block to any successful new fisheries development.

1 Introduction

Declines in the gross value of production (GVP) from commercial fishers in Western Australia and increased interest from the commercial sector in diversifying activities to adapt to seasonal variability in supply and demand has prompted the Western Australian Fishing Industry Council (WAFIC) to set the goal of introducing ten new fisheries by 2020. However, allocation to the recreational sector, poor public perception often associated with commercial fishing, low probability of establishing fisheries of considerable scale, and limited policy strategies hinder potential new developments.

However, the new State Government's focus on jobs growth, especially in the region, indigenous opportunities and the passing of the new fisheries management act – the Aquatic Resource Management Act 2016 – that will be proclaimed in 2019, provide renewed opportunities to explore the potential for new fisheries

To enhance the future of the industry, there is a very strong need to readdress current approaches to fisheries development, promote innovation and strengthen community ties. Western Australia has already taken the strategic policy decision to aim for independent third-party assessment (by the MSC) of all its fisheries, simplify its regulatory environment, and review and modernise its fisheries legislation. The proposed project adds further impetus to securing a future industry by initiating a research driven co-management approach to fishery development and diversification. By designing a conceptual pathway, compiling relevant biological, environmental and socioeconomic information, and applying these to test-case fisheries, the project presents a robust feasibility study into decision-tree, risk-based alternatives to creating and managing new fisheries.

Objectives

- 1 Design a decision tree and rapid assessment model to assess new fishery development opportunities
- 2 Develop novel and cost-effective approaches for sustainability and socioeconomic assessments for potential new fisheries
- 3 Design alternative management and regulatory approaches to facilitate future growth and productivity on a cost-effective basis

2 Methods

2.1 Overall

This project is focussed on enabling the development and expansion of primary production industries (new fisheries) based on renewable aquatic resources. The main tool employed is a Rapid Appraisal Methodology (RAM). Emphasis is placed on identifying, creating and evaluating potential development opportunities in a timely and cost-effective manner. Given that the target for development will be a renewable aquatic resource, biological sustainability must however, be demonstrated. Criteria that allow sustainability to be demonstrated are included in the RAM (detailed in section 3.3), but sustainability is a tool, not an outcome, of the new fishery development process. The outcome is a new fishery. To this end, the following key methods were developed.

2.2 Objective 1: Design a decision tree and rapid appraisal model (RAM) to assess new fishery development opportunities

2.2.1 Defining a ‘development opportunity’ and a ‘new fishery’.

Traditionally fishers have fished locally available populations. Following full and over-exploitation of local populations and increase in demand of some species, “development” in fisheries has occurred by locating and exploiting new fishing grounds, often following a pattern of serial expansion and depletion. An example of this historical process as it occurred in many fisheries is provided by Jackson (2001). Historically, fishery management and science has evolved as a response to the expansionary phase of fishing. Fishery development as a pro-active or planned activity is less common, and the articulation of supporting methods and policy are consequently less developed.

In this report we adopt a two-phased approach to the development of new fisheries. The first phase is a ‘development opportunity’; the second phase is a ‘new fishery’. In the first phase, applications for development opportunities are assessed with respect to their potential, and if successful, given an opportunity to demonstrate this potential. The second phase occurs after a defined time period, and involves a final assessment on whether a new fishery can be created from the development opportunity. These concepts are defined in detail as follows.

Development opportunity: *An application, identifying a development project, which may become eligible to be assessed against the business case, sustainability science, and community issues RAM for new fisheries.*

New fishery: *A new fishery is a development opportunity that has been fully assessed against the business case, sustainability science, and community issues RAM, and passed the scoring criteria.*

This definition of the term “new fishery” is meant to imply that the proposed species and method has the potential to create or enhance an ecologically and economically sustainable

aquatic harvest industry, which will provide benefits (e.g. GVP, product, employment opportunities) to the wider community.

In practice, a new fishery could be a new species, i.e. currently of which there is little or no exploitation, an old species (old meaning currently or previously exploited), but with a new gear or location (e.g. Australian salmon), or an “enhancement fishery”, where assisted recruitment facilitates a larger yield, GVP, and improved economics (e.g. Greenlip abalone). Emphasis is on development and diversification, whether the product be seafood or for other use, such as algae, fish oil, or bioprospecting for pharmaceutical industries. This emphasis aligns with the broader definition of Ecologically Sustainable Development (ESD) in the National Strategy for Ecologically Sustainable Development (CoA 1992). That strategy defined ESD as “using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased”. It is intended in this project that a new fishery may achieve more than one of the three objectives of ESD, i.e., it may enhance, use and conserve a resource simultaneously. A new fishery therefore could involve both harvest and/or culture of aquatic organisms.

The overall RAM for creating new fisheries employs a decision trees pathway system. Decision trees are an effective tool because they provide explicit pathways for applicants, assessors and the broader community to follow when assessing proposals (Fletcher et al., 2016). The nature of the decision trees and their connection to compliance and assessment tables are outlined in the results.

2.3 Objective 2: Develop novel and cost-effective approaches for sustainability and socioeconomic assessments for potential new fisheries

The RAM for objective two draws together the business case, sustainability science, and community issues, to ensure the relative impact of these on the administrative cost is appropriately considered before arriving at the final decision to commence development of a new fishery.

Steps in the decision tree were developed after consultation with user groups (scientists, managers and fishers, both commercial and recreational) to ensure all the necessary components were addressed. Consultation was enacted through formal (e.g. contacts through WAFIC and Recfishwest) and informal processes (e.g. interviews with individual fishers). The final decision tree model draws together the business case, sustainability science, and community issues to ensure the relative impact of these on the administrative cost is appropriately considered before arriving at the final decision to commence development of a new fishery. The model allows simultaneously for part-time or full-time fisheries development and a varying scale of proposed production operations. For example, a proposed

small-scale, part-time fishing proposal that meets local fisher expectations, market needs and social considerations is considered equally important as a larger-scale proposal. Focus is on the development of proposals with sufficient information (e.g. available biological and fishery data from the literature, and targeted research to estimate critical biological and ecological parameters, social considerations and information, cultural considerations, political considerations). The model requires key criteria to be met, e.g. biomass estimate or proxy, fishing efficiency, sustainable harvest estimates and resulting/expected GVP, targeted fishing plan, fishery compliance indicators, from which management policy can be drafted and implemented.

2.4 Objective 3: Design alternative management and regulatory approaches to facilitate future growth and productivity on a cost-effective basis

2.4.1 Conceptualising the new fisheries initiative.

The RAM process, as devised in this study, provides an ordered and timely schedule for assessing and reviewing proposals in the area of developing new fisheries, and can be implemented on its own merits. However, it also needs to be recognised that the challenge with new fisheries development is conceptual, as well as administrative. This because the contribution of wild fisheries to the increase in worldwide seafood production over the past thirty years has been negligible compared to aquaculture.

Consequently, there would be merit in any new fisheries development initiative being appropriately branded to clarify its innovative and strategic intent. This will allow for development of alternative management and regulatory approaches. The brand of a new fisheries development initiative would need to be unique enough that it could be both differentiated from previous attempts at creating new fisheries, but also connected with the growing role of aquaculture in sustaining and enhancing seafood production worldwide and the diversification of business and employment opportunities through modern disruptive technologies. Ideally, this image would become associated over time with the level of credibility and quality aspired to in the mission statements of organisations tasked with the difficult objectives of both natural resource management and enhancing seafood production while addressing and meeting government policies.

A potential brand is “*WildCulture*”. The components of the brand are as follows:

“*Wild*”: this means, first and foremost, maintenance of the natural animal and the natural ecosystem.

“*Culture*”: this means a culturally acceptable, community-based approach to optimal productivity, involving, where appropriate, both fisheries and aquaculture techniques.

From a management perspective, the *WildCulture* initiative can be viewed as an intermediate development between two forms of management of wild and cultured harvest industries. This is the current wild fisheries/aquaculture dichotomy (**Figure 1**). At one end are wild fisheries, where the sustainability risk, and thus production rates, of a public resource are explicitly

managed by Government policy (**Figure 1**). At the other end are the privately managed production targets of the aquaculture industry on allocated leases (y-axis; **Figure 1**). While this concept of fisheries may appear new, there are existing aquatic resource production industries in Western Australia that express characteristics of this intermediate stage. The most clearly defined is the silver-lipped pearl oyster industry (Hart et al., 2016a). The three components of the silver-lipped pearl oyster industry represent the product development and diversification initiatives being sought within *WildCulture*. They include both wild fishery and aquaculture production components, and production of goods for the both the seafood industry (pearl oyster flesh) and the jewellery industry, i.e. pearls and mother-of-pearl.

The *WildCulture* definition is not designed to exclude traditional fishery or aquaculture enterprises from developing, only to broaden the potential scope of proposals which may be deemed to have merit under a new fisheries initiative.

To give effect to *WildCulture*, a concise set of management and regulatory criteria were designed. These are reported in the results section. These criteria could be applied irrespective of any formal *WildCulture* initiative.

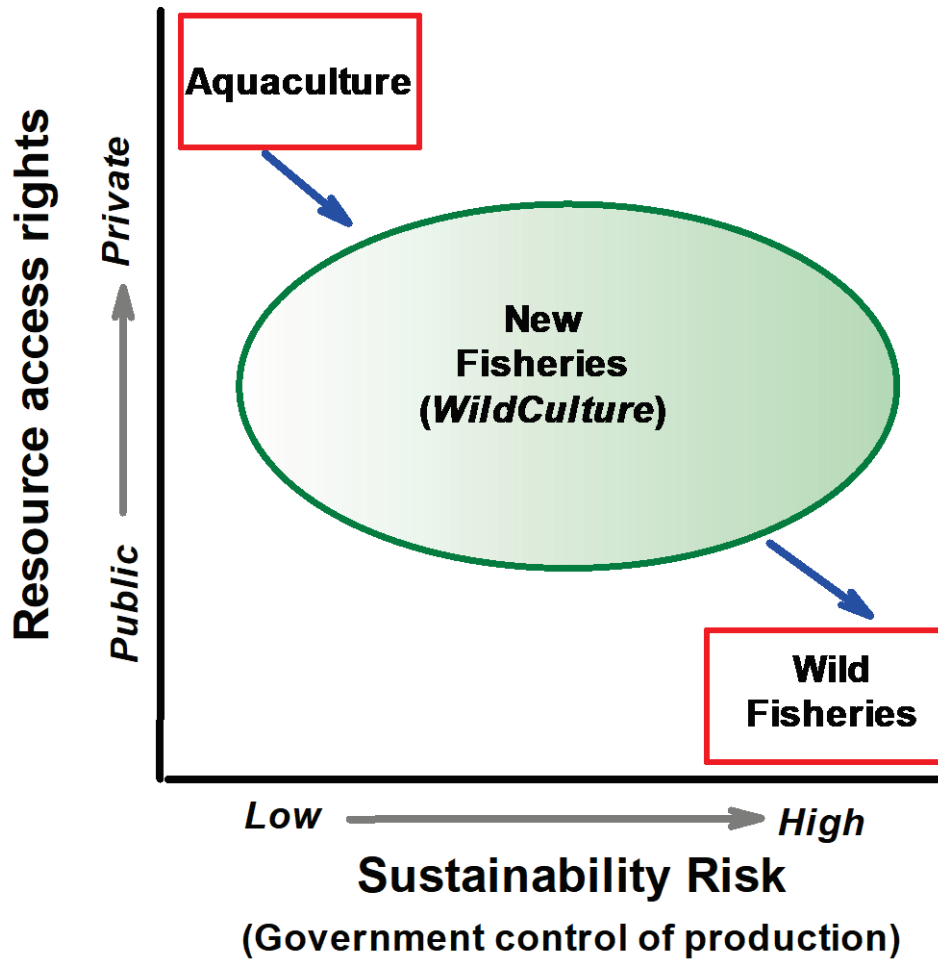


Figure 1. Aquatic resources harvest policy, as represented by trade-offs between sustainability risk (or level of Government control) and the public/private nature of resource access rights. A new fisheries initiative (e.g. *WildCulture*) could be viewed as an intermediate development between the aquaculture/wild fisheries sectors.

3 Results

3.1 Overall

In this report, the intention is to provide as broad interpretation of new fisheries as possible so as to promote the innovation necessary for creating new fisheries. A literature review undertaken during this project identified that the narrowly defined interpretation of a new or “developing fishery” was one of the key roadblocks to success.

For example, in relation to a previous policy in Western Australia, Halmarick (1999) defined a “developing fishery” as *“a fishery within which there is little or no exploitation, there is potential for development, and which is currently subject to a prohibition.”* This interpretation effectively reduced the potential innovation to “commercially viable species which had not been discovered or exploited”. Given that development of major fisheries had been completed by 1980, it was unlikely that there was a large suite of previously unknown but abundant species around which new fisheries could have been created. Some success has however occurred, with blue swimmer crab fisheries in Shark Bay, sea cucumber fisheries, and octopus fisheries all developing since the 1999 policy was created.

Similarly in Canada, an emerging fisheries policy required that new fisheries be *“fisheries involving new species and/or stocks that are not utilised or not fully utilised, and not currently covered by a management plan”* (Anon, 2004).

In the Northern Territory, a policy and rules around the appraisal and administration of development fishery applications defined the administrative process in detail, but lacked definition of the type of operations that could be constituted as developmental fishing beyond a general statement that *“Executive Director of Fisheries may issue permits or licences to conduct trials of new fishing gear, or to harvest aquatic resources not currently utilised by existing fisheries”* (Anon, 2006).

A major review of best practice approaches to the management of new and emerging fisheries within the New Zealand management framework was undertaken in 2007 (MRAG, 2010). This review was wide ranging in its scrutiny of international practice in this area. It examined the approach to new fishery development taken by 13 jurisdictions, including five in Australia, two in the United States, Canada, South Africa, Namibia, the European Union, and the Falkland Islands (MRAG, 2010). A common issue recognised across the majority of jurisdictions was the lack of resources, with many jurisdictions nominating the absence of adequate resources to support new fisheries (especially when competing for funding with more established, socio-economically important fisheries) as a particular challenge (MRAG, 2010). As a result, new fisheries development has not occurred in a substantial manner, despite a large effort over the last 10 -20 years to manage the process from a policy and administrative basis.

Consequently, two main impediments to developing new fisheries were recognised. These are: 1) a too-narrow definition of what constitutes a new fishery, and 2) a lack of resources to improve the knowledge base and implement secure access rights to the fisher. This project

sought to broaden the scope of potential development of new fisheries by mitigating these impediments.

In discussions with stakeholders it was clearly identified that there were many elements to the definition of what might constitute a “new fishery”, but in all cases it had to be a combination of both the fish and the fishing or aquaculture activity: e.g. part time / full time fishing; new species; multi species single operator; existing species new area; existing species enhanced production (e.g. abalone stock enhancement); diversifying/combining existing fisheries (e.g. prawn trawlers accessing blue swimmer crab bycatch).

It was also clearly recognised that a new fishery, was in reality, going to be the end result of a developmental process. Under current fisheries legislation in Western Australia there are many permutations of fisheries under management. In some cases fisheries are created by an exemption instrument, which confers access rights for a specified time and place, but is effectively non-transferable and temporary (FOP, 2011). Substantial commercial enterprises exist as a result of the seafood product generated from these “non-transferable” fisheries. In an ideal policy world such a ‘tenuous’ access right might be considered as a disincentive to investment and development. However in practice some “temporary” exemption instruments in Western Australia have been existence for more than 20 years. They have hindered, but not stopped, the development of new fisheries. At the other end of the scale are TAC managed fisheries with ITQs, TAE fisheries managed with Effort limits and clearly defined and transferable access rights. In Western Australia, the new ARMA (Aquatic Resources Management Act) due in 2019 may potentially free up approaches to developing new fisheries.

The development of a new fishery will begin with the allocation of temporary access-rights, noting that in Western Australia, temporary access rights have not stopped investment in fisheries development, although they have hindered it. More permanent access-rights will be created over timelines commensurate with future industry development and whether the criteria developed in the RAM have been satisfied.

3.2 Decision Tree for New Fishery Proposals (Objective 1)

The flow chart for developing new fisheries is conceptualised as a series of decisions, leading up to the establishment of a new fishery (Figure 2).

In summary, a proposal is first assessed to see if it is a development opportunity (Figure 2, Figure 3). If the development opportunity is accepted, it will be given a set time period to gather information and investigate the possibility of becoming a new fishery. At that point, the opportunity will be assessed against the economic (Figure 2, Figure 4), sustainability (Figure 2, Figure 5), and community issues (Figure 2, Figure 6) decision trees, ultimately arising at a new fishery (Figure 2).

No limits are placed on the nature of project proposals, provided they fall within the purview of harvest and/or culture of a renewable aquatic resource.

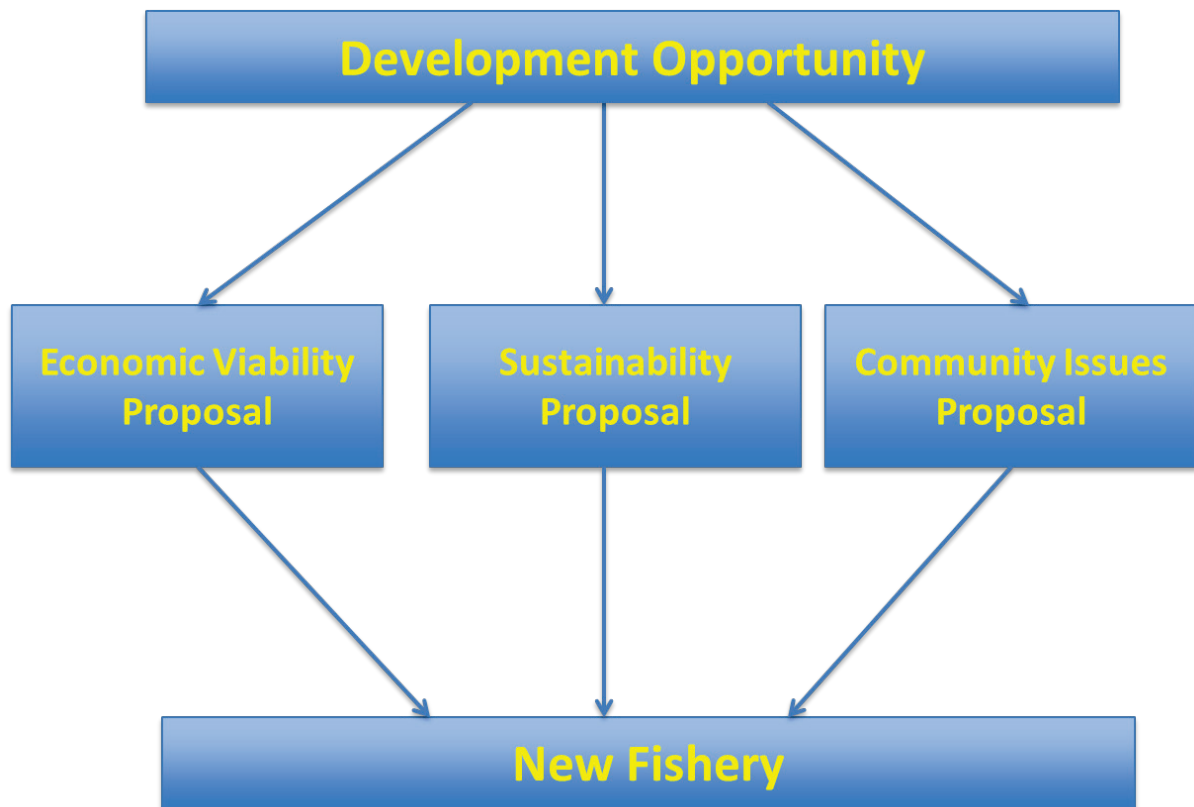


Figure 2. Decision tree depicting the development pathway for creation of new fisheries

3.3 Rapid Appraisal Methodology (RAM) – (Objective 2)

The RAM facilitates an ordered transition for new fishery development proposals. Each proposal is allowed an opportunity to demonstrate its merits and potential, with iterative improvement being a major theme. In the early stages, a proposal has to demonstrate its ability to be a viable ‘pilot’. When sufficient time has elapsed, and information collected, the pilot development may proceed to the next stage of assessment.

Two new approaches were designed to facilitate assessment of new fisheries under the business case, sustainability science and community issues criteria. These approaches, defined as the “Eligibility Test” and the “Renewal Test”, are interlinked assessments which allow for iterative improvement of proposals to create opportunities for new fisheries development (**Figure 3**). The tests detail the specific information and analysis required under the RAM methodology. The intention with these tests is to allow for continuous improvements, noting the potentially innovative nature of proposals may not be revealed at the first attempt.

A failed proposal can, at any time, be re-submitted for a new round of consideration if proponents undertake necessary improvements and pay an application fee.

3.3.1 Eligibility Test and Renewal Test (RAM ‘engine rooms’)

The ‘engine rooms’ of the RAM are the “Eligibility Test” and the “Renewal Test” (see Figure 3 for an example). These provide a first and second assessment against specified criteria. The first assessment determines the pass/fail nature of the application; the second assessment, applied only in the case of a failed proposal, determines whether it could be sufficiently improved to increase its chances of becoming a successful.

Figure 3 provides guidance to the applicants on developing a proposal that would pass the “Eligibility test” to be categorised as a development opportunity. Projects that pass the eligibility test become a development opportunity, while proposals that fail are assessed under the Renewal Test. Projects that pass the Renewal Test may be submitted again as a development opportunity.

When a proposal has been classified a development opportunity, it is eligible to be assessed according to criteria for economic viability, sustainability, and community issues. In general, this assessment will occur after a sufficient time period has elapsed for the proposal to demonstrate a level of viability.

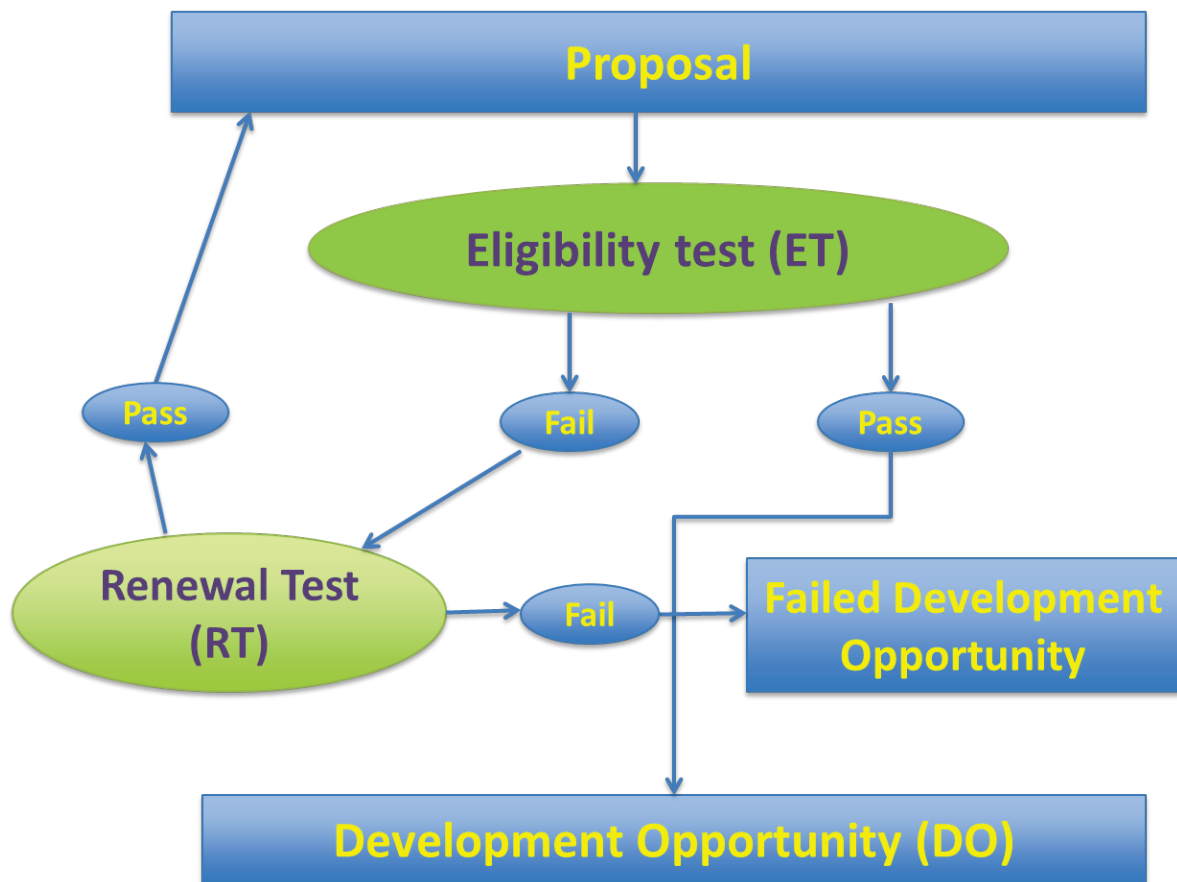


Figure 3. RAM decision trees for the assessment of a potential development opportunity for new fisheries

3.3.2 Economic Viability Proposal

Fisheries assessment and management is complex and expensive. It involves maintaining sustainability, allocating resources between and within sectors, protecting and management of the environment, mitigating biosecurity risks (from introduced pests and diseases), managing protected species interactions with fishing gear, and addressing community concerns and perspectives. This complexity results in a service cost of fishery management in Western Australia of around \$160 to \$180 per hour (DoF, 2015). Currently, managed commercial fisheries are charged an access fee of 5.75% of GVP for access to a community resource. This provides only about 20-30% of the total cost of fisheries management. Consequently, economic viability is the first outcome required of any proposal to develop a new commercial fishery. The RAM decision tree for economic viability is provided in **Figure 4**.

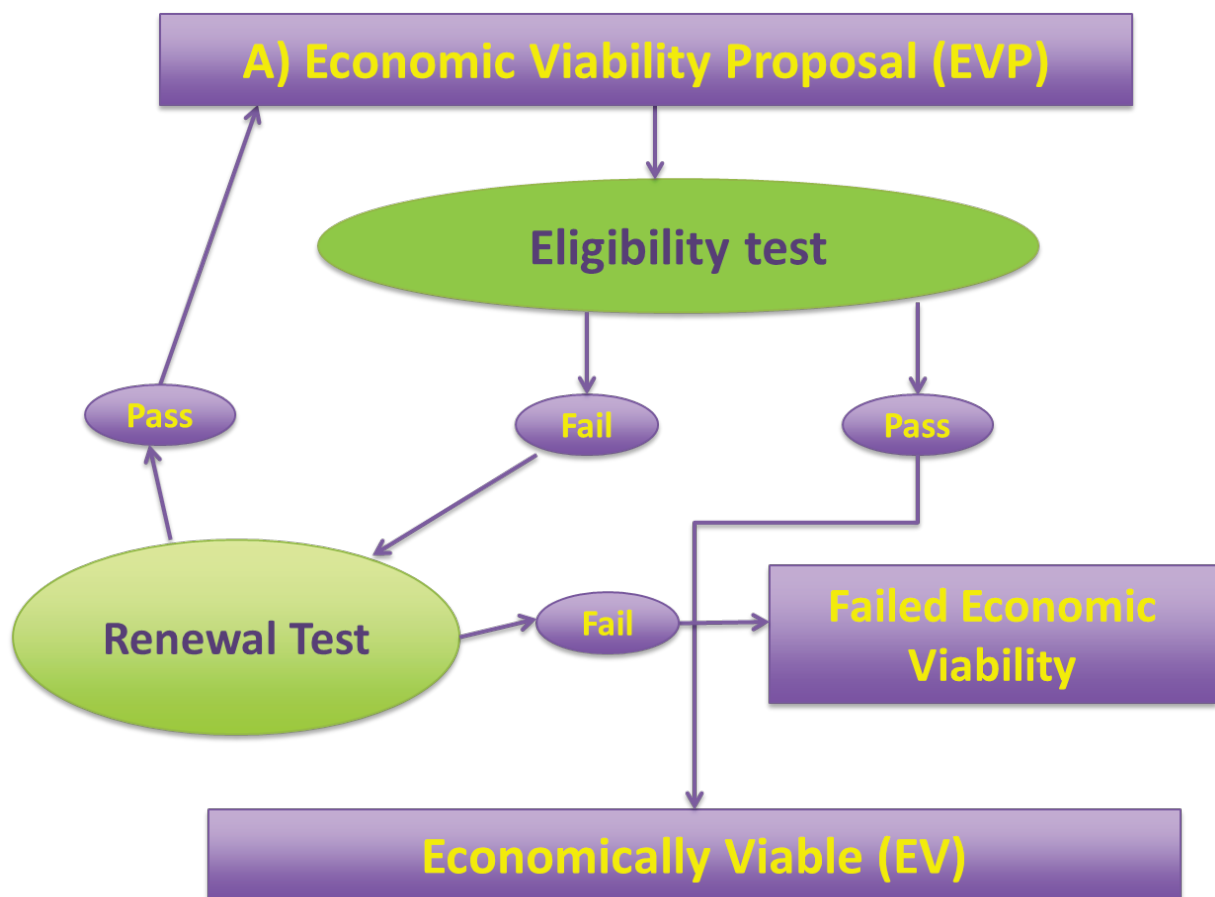


Figure 4. RAM decision tree for the assessment of economic viability of a potential new fishery

3.3.3 Sustainability Proposal

Biological and ecological sustainability are the cornerstones of renewable resource exploitation. The key to biological sustainability is protecting the natural fecundity (total births or fertilised gamete output) and diversity of the wild stock. Fecundity is function of both the species (i.e. its size/age, reproductive strategies) and its adaptations to environmental variability, which promote diversity within and between species. Development opportunities will need to demonstrate how the proposed harvest or production methods protect natural fecundity of the target population and/or species. Protection can be achieved through traditional fishery means (e.g. optimal fishing mortality based on biological reference points associated with mortality and growth; see Quinn and Deriso, 1999) or other means such as use of MPAs (marine protected areas), spatio-temporal harvest strategies (rotational fishing, closed areas), or appropriate breeding strategies under an enhancement fishery proposal. The RAM decision tree for sustainability is provided in **Figure 5**.

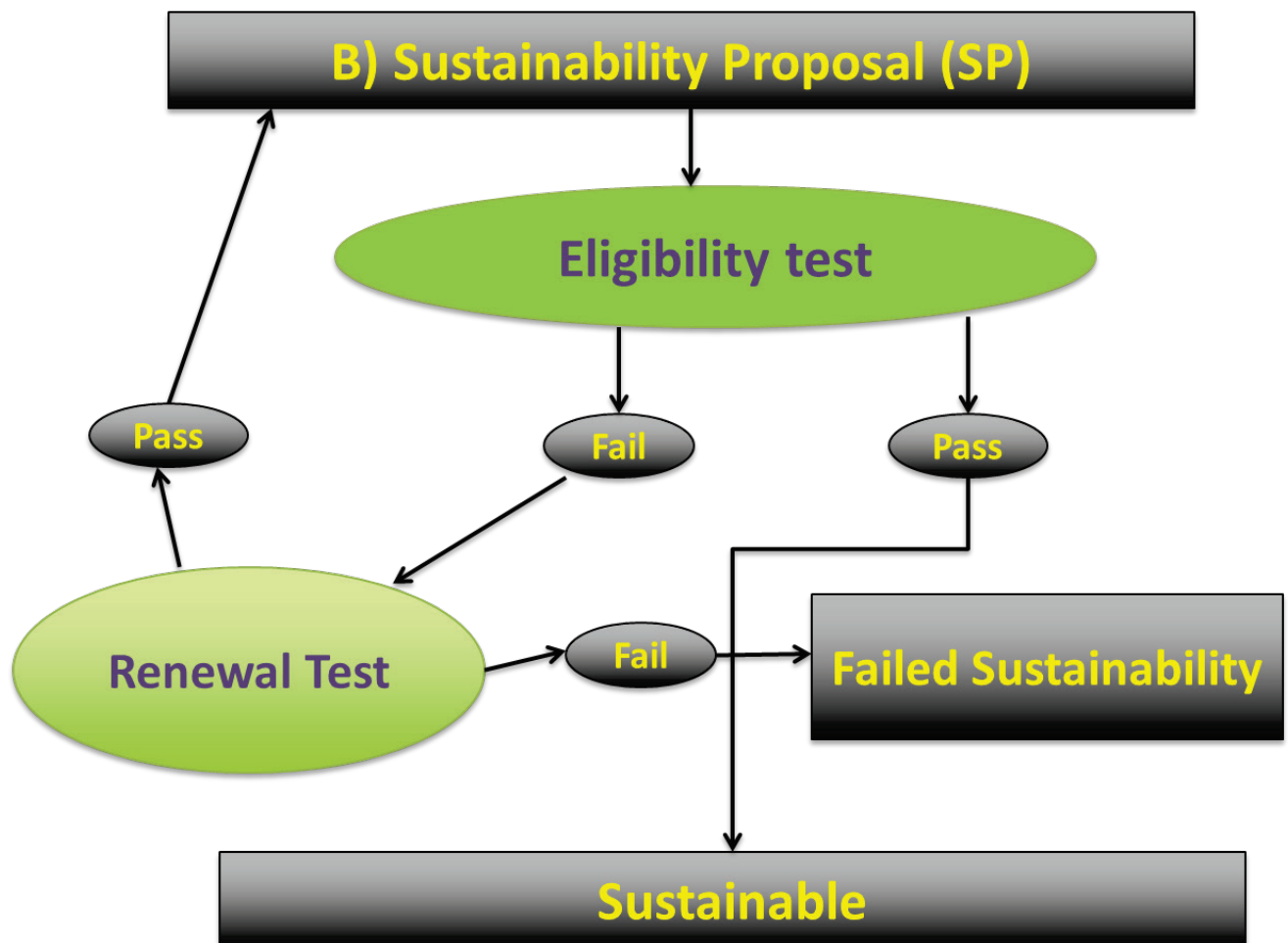


Figure 5. RAM decision tree for the assessment of sustainability of a potential new fishery

3.3.4 Community Issues Proposal

Fisheries in Western Australia (and Australia in general) require a social license to operate. Community perception of fish and fishing was one of the main reasons for the investment by the State Government to provide the opportunity for the State's commercial fisheries to undertake independent 3rd party assessment by the MSC (Marine Stewardship Council). Community issues are diverse, and small-scale, part-time fishing that meets local markets for fresh seafood is considered equally important to broad perceptions of whether fishing is sustainable. Interactions with protected species are a specific community concern, but only one of a variety of community issues relevant to fishing. Developments at the interface of aquaculture and harvest fisheries are increasing and local communities, particular those based in regional areas, desire development of local industry, but at a low/acceptable environmental cost. Local community support is considered crucial, particularly where small-scale or part-time, harvest operations are being considered and provide potential economic and employment opportunities to the local area. The RAM decision tree for community issues is provided in **Figure 6**.

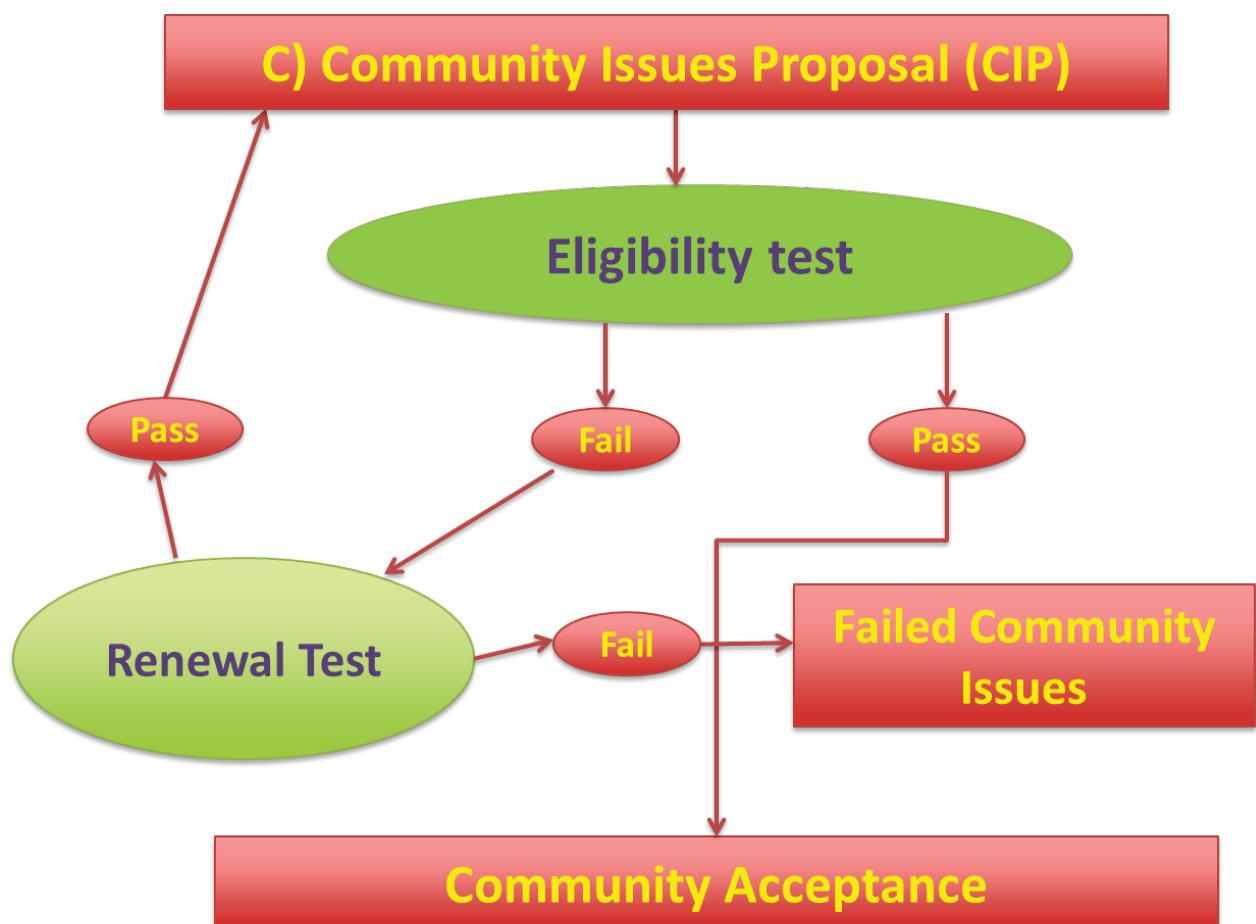


Figure 6. RAM decision tree for the assessment of community issues related to a potential new fishery

3.4 Innovative management and regulatory approaches to facilitate cost-effective growth and productivity (Objective 3)

To facilitate assessment of developing fisheries proposals, including under the possible new *WildCulture* initiative, a concise set of management and regulatory criteria for each eligibility and renewal test were designed (Tables 1 to 8). These 17 criteria provide policy guidance and assessment criteria for proposals, are specific to each eligibility and renewal test, and will be assessed as a yes/no outcome. If enough information has been presented to allow the assessor confidence that the specified criteria have been adequately addressed, a “Yes” score shall be given. If a particular criteria is not addressed, or if information supplied is superficial, a “No” score shall be given. In general, proposals will need to score a majority “Yes” across all 17 criteria to be classified as a development opportunity or new fishery; however there is not a particular “score” required. This flexibility is necessary to accommodate diversity in the nature of proposals being submitted. For example, a proposal may fail if the issues arising from only one of the more important criteria, such as those related to resource access rights or resource sharing cannot be resolved.

3.4.1 Development opportunity and new fisheries criteria

Applicants intending on submitting a proposal must address the eligibility criteria listed in **Table 1**. If the proposal fails the eligibility criteria (**Table 1**), proponents can submit the proposal for a renewal test after sufficient improvements have been made (**Table 2**). When submitting a proposal, applicants should pay particular attention to definitions in the ‘Abbreviations’ and ‘Glossary’ sections of this report. Similarly, assessors need be cognisant of the framework and process of the RAM.

3.4.2 Economic viability criteria

Economic viability is assessed using two broad indicators: (1) Gross value of product (GVP) and (2) Profitability assessment (PA). Proposals approved as development opportunities must address the eligibility criteria for economic viability as listed in Table 3. If the development opportunity fails the eligibility criteria, proponents can submit it for a renewal test (**Table 4**).

3.4.3 Sustainability criteria

Sustainability is assessed using two broad indicators: (1) Gross production (GP) and (2) Protection Plan (PP). Proposals approved as development opportunities must address the eligibility criteria for sustainability as listed in **Table 5**. If the development opportunity fails the eligibility criteria, proponents can submit it for a renewal test, as listed in **Table 6**.

3.4.4 Community issues criteria

Community issues are assessed using two broad indicators: (1) Interactions, for example, with recreational and other sectors, and (2) Local community benefits, for example, through direct or indirect employment or sales to local business and customers. Proposals approved as development opportunities must address the eligibility criteria for community issues as listed in **Table 7**. If the development opportunity fails the eligibility criteria, proponents can submit it for a renewal test, as listed in **Table 8**.

Table 1. Criteria for the Eligibility Test of proposals for a development opportunity in new fisheries

<i>Description of criteria</i>	<i>Supporting Evidence</i>	<i>Assessment</i>
Does the proposal have a clear objective or objectives?	Clear statement of purposes is required (e.g. to develop a wild harvest fishery for species x)	(Y/N)
Is the proposed target <i>species(s)</i> known	Confirmed identification	(Y/N)
Is the species endemic to Western Australia?	Confirmed identification	(Y/N)*
Is there a market for this species?	Sales or supplier correspondence	(Y/N)
Is there an existing development opportunity aligned with this application?	Search results from an investigation of an official record	(Y/N)
Is there an approved harvest or production method? If not, please supply details	Existing local, interstate, or international operations Description of proposed methods and photos/pictures?	(Y/N) (Y/N)
What is the location and proposed area of operations?	Detailed maps of coastline and habitats where development opportunity will occur	(Y/N)
Are there clearly articulated resource access criteria for this development opportunity?	Assess proposal for issues around transferability, security, permanence (refer to FOP 2011)	(Y/N)
Is there support from affected stakeholders (e.g. existing authorization holders) or relevant stakeholder group?	Evidence of consultation, such as surveys, letters of support, etc.	

* This methodology is not intended to apply to proposals to produce/harvest non-endemic species in Western Australia. These activities are covered by Ministerial Policy Guideline No. 5, The aquaculture and recreational fishing stock enhancement of non-endemic species in Western Australia.

Table 2. Criteria for the Renewal Test of proposals for a development opportunity in new fisheries

<i>Description of failed criteria</i>	<i>Extra Evidence required</i>
Does the proposal have a clear objective or objectives?	Objectives need to be clearly stated and linked to the proposed development plan and strategy
Is the proposed target <i>species(s)</i> known.	Museum approved or equivalent identification
Is the species endemic to Western Australia?	Museum approved or equivalent identification
Is there a market for this species?	Details of market sales or trends in similar or related species e.g. international reports or publications such as INFOFISH. Information sourced from Fisheries Library at WA Fisheries and Marine Research Laboratories (Hillarys). Opportunities for creation of new markets need to be examined. Value adding and product diversification on existing fisheries may have potential
Is there an existing development opportunity aligned with this application?	Information which supports the argument that the development opportunity is large enough to sustain multiple proposals.
Is there an approved production or harvest method? If not, please supply details	Details on benthic impacts (fishing gear) or culture methods (hatchery component if applicable). Developmental project funding, other collaborations to develop production methodology
What is the location and proposed area of operations?	Detailed maps of coastline and habitats where development opportunity will occur
Are there clearly articulated resource access criteria for this development opportunity?	If objectives of the proposal fall in the intermediate space between aquaculture/wild fisheries, significant resource access issue may arise. Applicants will need to ensure existing access rights are not negatively impacted by the proposal to be successful against this criterion.
Is there support from affected stakeholders (e.g. existing authorization holders) or relevant stakeholder group?	Evidence of consultation, such as surveys, letters of support, etc.

Table 3. Criteria for the Eligibility Test of economic viability (commercial fisheries only)

<i>Description of criteria</i>	<i>Supporting Evidence</i>	<i>Assessment</i>
Has the development opportunity been investigated?	Activities pertaining to the opportunity have occurred under a formal exemption (section 7 of ARMA – Aquatic Resources Management Act, 2016), or other approved legislation, for a sustained period (> 12 months).	(Y/N)
Is the proposed development likely to return a GVP in excess of \$1 million AUD in the medium term?	Estimated tonnages (from sustainability assessment or existing landings data), market price and sales evidence (existing or related species or fisheries)	(Y/N)
Is there a positive profitability assessment (PA) for this development?	Unit harvest value (HV: \$ per kg) obtained from reliable sources	(Y/N)
	Unit cost of harvest or production (CP: \$ per kg): (a) obtained from reliable sources or (b) rationally evaluated	(Y/N)
	$PA = HV - CP (> 0)$	(Y/N)

Table 4. Criteria for the Renewal Test of economic viability (commercial fisheries only)

<i>Description of failed criteria</i>	<i>Extra Evidence required</i>
Has the development opportunity been further investigated?	Proponents need to obtain formal exemptions or other approved activities under the legislation.
Is the proposed development likely to return a GVP in excess of \$1 million AUD?	Better research and understanding of markets (supply and demand) for the species(s) in question. GVP substitute test: In the event of a failed GVP test (i.e. estimated GVP < \$1 million), are there other reasons (e.g. related to diversification of existing operations, or meeting a small-scale but clear local market) that support this development opportunity?
Is there now a positive profitability assessment (PA) for this development?	Sourcing or development of niche markets with potential for higher harvest value (HV: \$ per kg). Improvements in method of harvest or production leading to lowered costs.

Table 5. Criteria for the Eligibility Test of sustainability

<i>Description of criteria</i>	<i>Supporting Evidence</i>	<i>Assessment</i>
Is there an estimate of harvest (gross production – GP) for this proposed development?	Daily catch rate or other biomass data (e.g. from existing or related species or fisheries)	(Y/N)
Is there a protection plan (PP) for this? (may, rotational fishing, closed areas, additional recruitment from a hatchery/culture /spat collection process, disease testing if relevant, etc.)	Relevant legislation under the ARMA and regulations	(Y/N)
	Proposed fishing regime (e.g. seasonal, weekend, daily, etc.)	(Y/N)
	Gear environmental impact, e.g. effects on protected species, habitat or ecosystems	(Y/N)
	Biological data on age, growth, mortality	(Y/N)
	Ecological data on biomass/density and distribution	(Y/N)
	Evidence of hatchery and disease management processes if culture is an element of the proposed new fishery	(Y/N)
	A protection plan proposed by the applicant	(Y/N)

Table 6. Criteria for the Renewal Test of sustainability

<i>Description of failed criteria</i>	<i>Extra Evidence required</i>
Is there an estimate of harvest (gross production – GP) for this proposed development?	Review of relevant historical information Better research and understanding of biology and ecology (sourcing existing databases; harnessing research projects with Universities etc..).
Is there a protection plan for this species/fishery? (may include size-limits, rotational fishing, closed areas, additional recruitment (from a hatchery/culture /spat collection process)	Literature investigations of appropriate reference point analyses; clearer understanding of likely area fished compared to total area of the fishery

Table 7. Criteria for the Eligibility Test of Community Issues

<i>Description of criteria</i>	<i>Supporting Evidence</i>	<i>Assessment</i>
Are there likely to be interactions with indigenous groups, the recreational sector or general community from the development, including resource sharing impacts?	Information on use of species by recreational and other sectors	(Y/N)
Is the development likely to benefit local communities including indigenous groups, either via direct employment, or sales to local business or customers? ‘Local communities’ are those which identify with the location where the development occurs	Description of possible supply chains, letters of support from businesses	(Y/N)
Is there support from WAFIC, Recfishwest or other community representative groups as relevant	Documents (e.g. email, faxes, letters) providing evidence of consultation	(Y/N)

Table 8. Criteria for the Renewal Test of Community Issues

<i>Description of failed criteria</i>	<i>Supporting Evidence</i>	<i>Assessment</i>
Are there likely to be interactions with the recreational sector or general community from the development, including resource sharing impacts?	Information surveys, published recreational fishing statistics	(Y/N)
Is the development likely to benefit local communities either via direct employment, or sales to local business or customers? 'Local communities' are those which identify with the location where the development occurs	Evidence from any market surveys	(Y/N)
Is there support from Recfishwest or other community representative groups if relevant	Documents (e.g. email, faxes, letters) providing evidence of consultation	(Y/N)

3.5 Schedules and Timelines

A new *WildHarvest* development will take some time as it is an iterative process with feedback loops. However it is also necessary that a maximum time period is an aspect of the development assessment. This will provide the necessary confidence for applicants to begin the process. An indicative schedule and outline is provided in **Table 9**. From start to finish, it is expected that a successful new fishery development will require between 3 to 5 years minimum.

Table 9. Proposed new fishery development approval timeline (inclusive of the *WildCulture* initiative).

Task	Responsibility	Timeline
Proposal preparation in a new fisheries initiative (e.g. <i>WildCulture</i>)	Applicant	as necessary
Proposal		
Proposal Assessment against the RAM (Rapid Appraisal Methodology) criteria for a development opportunity	Assessor	2 months
Proposal score (Pass/Fail), Applicant informed		1 week
Pass – Applicant granted a 1-3 year development opportunity to progress their new fishery initiative	Applicant	
Fail – Applicant may prepare and resubmit proposal for a renewal test	Applicant	2-4 months
Renewal test score (Pass/Fail), Applicant informed		1 week
Development Opportunity		
Development opportunity proceeds according to specified conditions on the license instrument	Applicant	1-3 years
Proposal preparation and submission for a development opportunity to be assessed against the RAM (Rapid Appraisal Methodology) criteria for new fisheries	Applicant	2-4 months
Development opportunity assessment against the RAM criteria	Assessor	2 months
Development opportunity score (Pass/Fail), Applicant informed		1 week
Pass – Applicant granted appropriate access criteria for their new fishery	Assessor	As stipulated on the license instrument
Fail – Applicant may prepare and resubmit for renewal test	Applicant	2 months
Renewal test score (Pass/Fail), Applicant informed		1 week
New Fishery	Assessor	As stipulated on the license instrument

3.6 Evaluation of RAM with simulated new fisheries developments

The intention of the RAM is to provide a clear and concise process to enable new fishery development. Having established the mechanisms and criteria against which proposals and development opportunities can be assessed, it is necessary to provide examples to guide applicants and assessors. The objective of this section is to supply a range of scorecards for *simulated* development proposals to allow prospective applicants insight into the nature of both unsuccessful and successful applications. These simulations are broadly based on actual proposals and species; however their scoring is designed to illustrate the operation of the RAM, rather than to be true and accurate assessments. Consequently, the scoring quoted should not be interpreted as such.

3.6.1 Two species bivalve fishery in Shark Bay



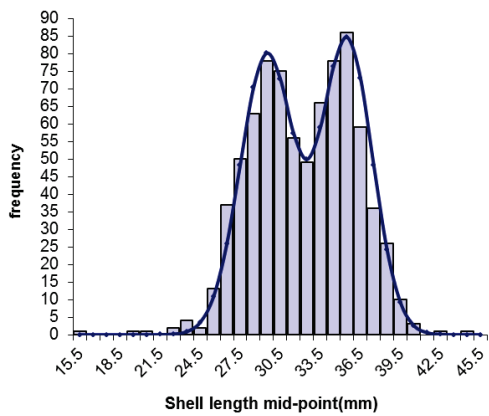
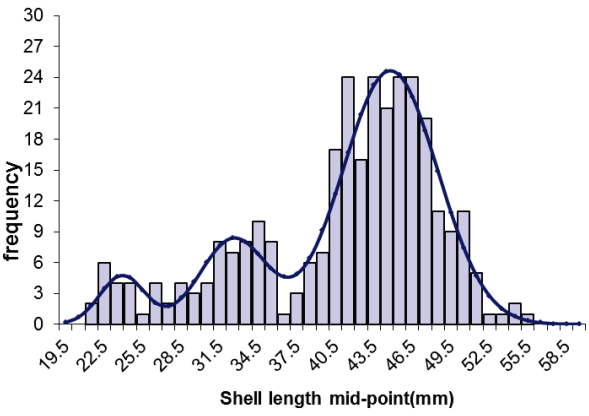
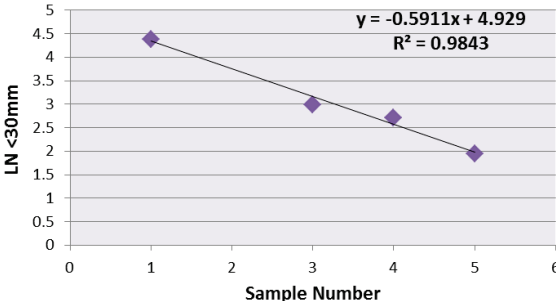
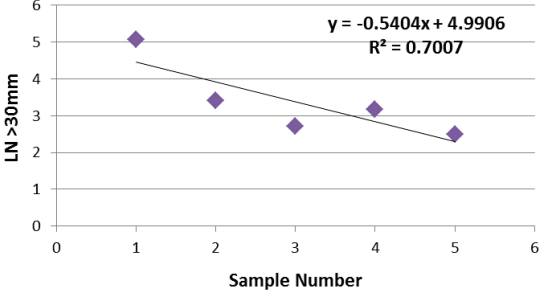
As a test case for new fisheries development, exemptions to establish a small scale bivalve fishery in Shark Bay, Western Australia were approved. Fishers were granted a 3 year exemption, rather than the usual one-year exemption, but on the conditions that fine-scale spatial information would be provided to the (then) Department of Fisheries to enable a rapid development of a biomass assessment methodology. Catch and effort information was supplemented by a planned scientific experiment to calculate mean densities and fishing efficiency.

The scientific experiment integrated species identification, morphometrics, age and growth analysis, density, catch rate, and fishing mortality estimates to produce an estimate of sustainable harvest. This was displayed as a rapid assessment scorecard to capture essential biological information and key parameter estimates required to ascertain the likely sustainable yield (**Figure 7**). In the example given of a specific species by area estimate, the likely sustainable yield came out at between 10 and 11 tonnes (Figure 7).

A simulated assessment was made against the original objectives of the proposal and associated research plans. The four eligibility tests are found in the following tables: development opportunity (Table 10); economic viability (Table 11); sustainability (Table 12); and community issues (Table 13).

Overall, the proposed Shark Bay cockle fishery met every criterion except one associated with economic viability which asked the question ‘Is the proposed development likely to return a GVP in excess of \$1 million AUD?’ (Table 11). Such a failure is not necessarily a hindrance, as the profitability criteria was passed, and the fishery is proceeding as a part-time, small-scale activity. The use of a minimum GVP of \$1 million is designed to minimise red tape and ensure sufficient support can be provided to manage the new fishery. The pragmatic reconciliation of policy with practice dictates that the onus is on proposals to clearly demonstrate a desire to maximise economic yield, as this will generally ensure sustainability criteria are automatically met.

Figure 7. Shark Bay cockle fishery. Species-specific information (from rapid assessment scorecard)

Species (a) – <i>Gomphina undulosa</i>	Species (b) – <i>Callista impar</i>
	
Size-age-structure	
<p>Gomphina estimated age classes</p> 	<p>Callista estimated age classes</p> 
Fishing mortality estimate	
<p>Gomphina Depletion (LN<30)</p> 	<p>Gomphina Depletion (LN>30)</p> 
<p>Stock Conclusions and Score</p> <p>The size and age-classes were slightly different between each species. <i>Callista impar</i> was the larger, older species, with evidence of up to 4 age classes, whereas only 2 or 3 were present in <i>Gomphina undulosa</i>. The stock depletion experiment, carried out on a 3.52 m² area, showed that fishing mortality was quite high, approaching an F of 0.6.</p> <p>Based on an estimated density of 100 per m² (from depletion experiment), and an estimated area of</p>	

0.5 km², the total population of *G. undulosa* in the target area was 5.0 million. At an average weight of 9.4 g, this translates into a biomass of 47 tonnes. A conservative estimate of sustainable yield is calculated as $0.75 * B * M$, where B – biomass, and M is natural mortality (assumed at 0.3 or 30% per year). This results in MSY = 10.5 tonnes. A 10.5 tonne fishery with market price of \$14.20 per kg results in a GVP of \$149,100. At the experimental fishing rate of 125 kg per day reveals a viable daily GVP of \$1775, with the fishery expected to take, on average, about 70 fishing days to catch the 10.5 tonne target. Cost of fishing was estimated at \$11.50 per kg. Profit assessment (\$14.20 - \$11.50) was positive. Fishery likely to be viable only as a part-time activity.

Table 10. Simulated eligibility test to determine if the proposed Shark Bay cockle fishery satisfies the development opportunity criteria.

<i>Description of criteria</i>	<i>Supporting Evidence</i>	<i>Assessment</i>
Does the proposal have a clear objective or objectives?	Stated in proposal	Y
Is the proposed target <i>species(s)</i> known	<i>Gomphina undulosa</i> and <i>Callista impar</i> (see photos)	Y
Is the species endemic to Western Australia?	Yes	Y
Is there a market for this species?	Weekly wholesales purchases of bivalves at seafood markets	Y
Is there an existing development opportunity aligned with this application?	No	Y
Is there an approved harvest or production method? If not, please supply details	Tow Sled Design (see attachment A)	Y
What is the location and proposed area of operations?	Maps and approved areas (see attachment B)	Y
Are there clearly articulated and viable resource access criteria for this development opportunity	Species are not currently subject to a management plan or other explicit commercial access right. No resource access conflicts are expected to arise.	Y
Is there support from the Western Australian Fishing Industry Council	Attachment C	Y

Table 11. Simulated eligibility test to determine if the proposed Shark Bay cockle fishery satisfies the economic viability criteria.

<i>Description of criteria</i>	<i>Supporting Evidence</i>	<i>Assessment</i>
Has the development opportunity been investigated?	Applicant's trialled the fishery over a 3 year period, submitted a spatially resolved catch and effort logbook, liaised with research to gather biological and fishing information, and submitted a market report.	Y
Is the proposed development likely to return a GVP in excess of \$1 million AUD?	The fishery appears to be very seasonal and catch records were confined to October to December. Average annual catch of 3.5 tonnes over the 3 year period at \$14.20 per kg, shows no indication of meeting this criteria. This is supported by independent research analysis of biomass (see Supporting information and scorecard)	N
Is there a positive profitability assessment (PA) for this development?	Unit harvest value (HV: \$ per kg) was estimated at \$14.20 per kg, based on fishing method and costs information supplied by applicant. Unit cost of harvest (CP: \$ per kg) was estimated at \$11.50 per kg, based on fishing method and costs information supplied by applicant PA = HV – CP (> 0)	Y Y Y

Table 12. Simulated eligibility test to determine if the proposed Shark Bay cockle fishery satisfies the sustainability criteria.

<i>Description of criteria</i>	<i>Supporting Evidence</i>	<i>Assessment</i>
Is there an estimate of harvest (gross production – GP) for this proposed development?	Daily catch rate data from spatially explicit log books combined with experimental fishing and habitat areas estimates suggested around 10 tonnes.	Y
Is there a protection plan (PP) for this fishery? (may include minimum or maximum size-limits, rotational fishing, closed areas, additional recruitment from a hatchery/culture /spat collection process, disease testing if relevant, etc.)	<p>Species are generally prohibited for commercial fishing</p> <p>Proposed fishing regime is a 70 day fishing season based on existing data</p> <p>Gear was highly efficient (F estimated at 0.6), but small, hand held sleds targeting a very small area of Shark Bay (< 1 km²) means overall low impact</p> <p>Size-frequency data supplied showed potential age classes; potential monitoring tool</p> <p>Ecological data provided was estimates of density and distribution based on scientific surveys</p> <p>Evidence of hatchery and disease management processes if culture is an element of the proposed new fishery</p> <p>A protection plan proposed by the applicant - a closed season proposal for only spring/summer fishing (4 months) was provided.</p>	<p>Y</p> <p>Y</p> <p>Y</p> <p>Y</p> <p>Y</p> <p>NA</p> <p>Y</p>

Table 13. Simulated eligibility test to determine if the proposed Shark Bay cockle fishery satisfies the community issues criteria.

<i>Description of criteria</i>	<i>Supporting Evidence</i>	<i>Assessment</i>
Are there likely to be interactions with the recreational sector or general community from the development, including resource sharing impacts?	No other sector currently accesses these species. Shark Bay is a world Heritage area, but proposed fishery only access < 1 km ² (or 0.01%).	Y
Is the development likely to benefit local communities either via direct employment, or sales to local business or customers? 'Local communities' are those which identify with the location where the development occurs	See attached letter from Denham fisheries cooperative; applicants reside in Denham, hence are local businesses	Y
Is there support from Recfishwest or other community representative groups if relevant	See attached letter from owners of Monkey Mia dolphin resort, who have allowed the fishers access from their boat ramps.	Y

3.6.2 Area 3 abalone enhancement fishery

In 2010 the then Department of Fisheries in Western Australia (now DPIRD) received a proposal from Area 3 Abalone license holders to undertake commercial-scale stock enhancement [see Lorenzen et al. (2010) for definitions of ‘stock enhancement’]. The stated objective of the proposal was to increase the commercial harvest of greenlip abalone in Area 3. Under the criteria proposed within this report, it was a potential new *WildCulture* fishery. The proposal was innovative in that it requested the creation of a new access license that would be distinct to the existing licenses. Units of access would be attributed to the new licenses based on a formula submitted with the proposal. As this formula had no precedent it provided significant challenges according to the relevant legislation at that time.

The expectation of increased harvest from stock enhancement was based on a 10 year science programme undertaken with the Department of Fisheries which showed it was possible to sustainably increase biomass through assisted recruitment. The scientific findings and potential policy outcomes from these experiments have been discussed thoroughly in the scientific literature (see Hart, 2015; Hart and Strain 2016; Hart et al., 2013a; 2013b; 2013c; Sandoval-Castillo et al., 2016).

A simulated assessment was made against the original objectives of the proposal and associated research plans. The four eligibility tests, based on the original proposal submitted in 2010, are found in the following tables: development opportunity (**Table 14**); economic viability (**Table 15**); sustainability (**Table 16**); and community issues (**Table 17**).

The original 2010 proposal failed the ‘development opportunity’ test because it did not meet the ‘*clearly articulated and viable resource access criteria for this development opportunity*’ (**Table 14**). Also, the proposal was eventually not considered due to withdrawal of support by abalone industry members. However as a consequence, a number of initiatives were completed to support future proposals. These were two formal risk assessments (Jones and Fletcher 2012; Stevens, 2012), a stock enhancement policy (DoF, 2013), and a revised abalone aquaculture policy that explicitly included a risk-based approach to genetic management (DoF, 2016). This was based on cutting edge population genomic research for greenlip abalone (Sandoval-Castillo, 2016). Additionally, in the intervening years, the Area 3 license holders created a new business structure within the industry. This new business platform is designed to support innovative approaches to enhancing productivity in abalone fisheries.

This particular proposal exemplified the type of innovation being sought by the *WildCulture* initiative, underpinned by the RAM. If a proposal of this nature were to be received again, the existence of a new fisheries policy that uses the methodology proposed in this report would greatly increase its chances of being realised.

Table 14. Simulated eligibility test to determine if the proposed Area 3 abalone enhancement fishery satisfies the development opportunity criteria.

<i>Description of criteria</i>	<i>Supporting Evidence</i>	<i>Assessment</i>
Does the proposal have a clear objective or objectives?	Stated in proposal	Y
Is the proposed target <i>species(s)</i> known	<i>Haliotis laevis</i>	Y
Is the species endemic to Western Australia?	Yes	Y
Is there a market for this species?	There world market for abalone is in excess of 50,000 tonnes	Y
Is there an existing development opportunity aligned with this application?	No	Y
Is there an approved harvest or production method? If not, please supply details	Fishery harvest methods are well established for this species Aquaculture production and stock enhancement techniques are developed	Y Y
What is the location and proposed area of operations?	Area 3 Greenlip fishery	Y
Are there clearly articulated and viable resource access criteria for this development opportunity	Proposal has presented an untested form of resource access and harvest based on experimental stock enhancement data only. Significant uncertainties exist.	N
Is there support from the Western Australian Fishing Industry Council	Unanimous support from Area 3 license holders was originally received, but withdrawn after resource access and disease issues were raised.	N

Table 15. Simulated eligibility test to determine if the proposed Area 3 abalone enhancement fishery satisfies the economic viability criteria.

<i>Description of criteria</i>	<i>Supporting Evidence</i>	<i>Assessment</i>
Has the development opportunity been investigated?	Applicant's trialed the fishery over a 3 year period, in conjunction with a \$900,000 research grant to commercialise the techniques. A range of scientific analyses were published, and 1 million animals were released .	Y
Is the proposed development likely to return a GVP in excess of \$1 million AUD?	Supplied data by applicant, plus detailed bioeconomic analyses found in Hart et al., (2013c) suggest a multimillion dollar industry is possible, with GVP in excess of \$20 million.	Y
Is there a positive profitability assessment (PA) for this development?	Unit harvest value (HV: \$ per kg) was estimated at \$40.20 per kg for 2015, based on fishing method and costs information supplied by applicant and other sources. Unit cost of harvest (CP: \$ per kg) was estimated at \$12 - \$15 per kg, based on fishing method and cost information supplied by applicant and other sources PA = HV – CP (> 0)	Y Y Y

Table 16. Simulated eligibility test to determine if the proposed Area 3 abalone enhancement fishery satisfies the sustainability criteria.

<i>Description of criteria</i>	<i>Supporting Evidence</i>	<i>Assessment</i>
Is there an estimate of harvest (gross production – GP) for this proposed development?	Proposal aims to double existing TAC within the fishery	Y
Is there a protection plan (PP) for this fishery? (may include minimum or maximum size-limits, rotational fishing, closed areas, additional recruitment from a hatchery/culture /spat collection process, disease testing if relevant, etc.)	<p>Species has a management plan</p> <p>Proposed fishing regime is current practice</p> <p>No change proposed to existing fishing gear and its environmental impact</p> <p>Existing survey method and information for stock assessment will be applied.</p> <p>Published ecological data provides evidence of current and likely densities obtained under an enhancement programme.</p> <p>Formal published risk assessments (x 2) completed, and abalone aquaculture policy has been reviewed to incorporate expected developments in the area</p> <p>As well as existing methods, proposal has presented three new aspects of stock protection for this fishery. Scientific analysis underlying these aspects can be sourced from Hart (2015), and Hart et al (2013a; 2013b; 2013c; 2016) and others. The three aspects are:</p> <ol style="list-style-type: none"> 1) Increased stock biomass arising from enhancement process 2) Variable size limits 3) Creation of multiple marine protected areas (MPAs) based on minimum effective population size principles. 	<p>Y</p> <p>Y</p> <p>Y</p> <p>Y</p> <p>Y</p> <p>Y</p> <p>Y</p>

Table 17. Simulated eligibility test to determine if the proposed Area 3 abalone enhancement fishery satisfies the community issues criteria.

<i>Description of criteria</i>	<i>Supporting Evidence</i>	<i>Assessment</i>
Are there likely to be interactions with the recreational sector or general community from the development, including resource sharing impacts?	Increased fishery production will be available to the recreational sector, i.e. enhanced animals are not to be exclusively owned. Proposal also contains an innovative way to increase the number of MPAs (Marine Protected Areas) for this fishery.	Y
Is the development likely to benefit local communities either via direct employment, or sales to local business or customers? 'Local communities' are those which identify with the location where the development occurs	The proposal will result in both increased aquaculture production, and increased fishery production for regional areas in the state. Letters from the aquaculture producer have been received	Y
Is there support from Recfishwest or other community representative groups if relevant	A letter from Recfishwest supporting this proposal has been received.	Y

4 Discussion

4.1 Overall

This project has provided a methodology (RAM) for rapid appraisal of fisheries development projects. Taken purely from this viewpoint, RAM appears to satisfactorily meet the objectives of facilitating an ordered and timely process for assessment and review of proposals. Ultimately, it is the choice of individual criteria applied in the “Eligibility” and “Renewal” tests which will determine the usefulness of the RAM, and policy makers need to ensure each criterion is relevant and required. The 17 criteria chosen to illustrate the workings of the RAM (see Tables 1, 3, 5 and 7) were intended to be representative rather than exhaustive.

Beyond the methodology however, the project has identified some far ranging issues with fisheries development, not least of which is the definition of what constitutes a new fishery. The proposition put forward was to expand the concept of new fisheries, and brand the initiative to explicitly declare its innovatory and strategic intent. The example put forward was the *WildCulture* brand. The brand of a new fisheries development initiative will need to be unique enough that is both differentiated from previous attempts at creating new fisheries, but also connected with the growing role of aquaculture in sustaining and enhancing seafood production worldwide. Ideally, this image would become associated over time with the level of credibility and quality aspired to in the mission statements of organisations tasked with the difficult of objectives of both natural resource management and enhancing seafood production.

However this presents a further range of challenges, such as the issue of fisheries access rights. A recent review in Western Australia concluded that the narrow scope in which fisheries access rights have been defined represent a significant weakness in the strength of their propriety nature (FOP, 2011). It is likely that unless substantial progress is made in the definition of a new rights management structure for fisheries, any attempts to innovate in the area of fisheries and aquaculture development will become impractical when facing the high level of complexity and inconsistency in rules governing the access right. A detailed summary of this issue is found in FOP (2011).

In particular, work is needed to enshrine spatial access rights and rules in practical policy instruments to avoid this issue being a major stumbling block to any successful new fisheries development. An example of a spatial use process designed to manage the competing rights of different stakeholders (commercial fishing, recreational fishing, conservation, and aquaculture) is provided in Hart (2015). The species in question is one that is currently produced by wild fishery and aquaculture in Western Australia (Greenlip abalone – *Haliotis laevigata*).

4.2 Conclusion

Overall, the project delivered a methodology (RAM) which met the three objectives. The process developed under the RAM methodology provides a clear opportunity for aquatic resource managers to innovate in areas of seafood production. However further work is needed on articulation of supporting policy, particularly in the details of integrated fisheries and aquaculture and harvest for both human and non-human consumption such as pharmaceutical development and bioprospecting. In particular, work is needed to enshrine spatial “use” rights and rules in practical policy instruments to avoid this issue being a major stumbling block to any successful new fisheries development.

Ultimately this project was a small pilot project, but showed significant potential. For the RAM process to be applicable in an aquatic resource management context, it needs to be supported by accompanying policy to guide both applicants and assessors.

5 Implications

Modern fisheries and aquaculture management is complex and expensive, with the average service cost of \$160-\$180/hr to the community (DoF, 2015). The high cost is due to the complexity of services, which include maintaining sustainability in managed fisheries and aquaculture operations often in remote/regional locations, allocating resources between and within sectors, protecting the environment, mitigating biosecurity risks (from introduced pests and diseases), managing protected species interactions with fishing gear, addressing community concerns and perspectives, and potentially supporting other processes (e.g. HACAP, AQIS, Marine Stewardship Council, Aquaculture Stewardship Council, .

The RAM process directly addresses this complexity and high cost by ensuring the economic viability criteria are part of the first considerations. Assessors such as the DPIRD, or any other entity, need to be confident that a proposal submitted provides a genuine development opportunity for a sustainable business to evolve in the area of renewable aquatic resources.

Overall however, the main implication identified from this study is the uncertainty of the resource access right. The logical outcome of a successful new fisheries initiative, as conceptualised in this report, is the simultaneous use of a finite spatial resource by numerous entities. Spatial use “rights” and rules need to be enshrined in practical, streamlined and modern policy instruments to avoid this issue being a major stumbling block to any successful new fisheries development. An example of a spatial use process designed to manage the competing rights of different stakeholders (commercial fishing, recreational fishing, conservation, and aquaculture) is provided in Hart (2015). The species in question is one that is currently produced by wild fishery and aquaculture in Western Australia (Greenlip abalone – *Haliotis laevigata*).

6 Recommendations

The RAM process devised in this study provides a methodology to underpin a new fisheries development initiative. However it identified a number of issues which will forestall any initiatives in this area. These issues have led to the following recommended areas of future policy development in Western Australia.

- Develop a new fisheries policy that adopts the innovative and strategic intent of the Act that underlies the RAM methodology
- Develop practical, streamlined and modern policy instruments under the new Act that will be cognisant of the spatial dimension and multiple-use scenarios likely to arise in a new fisheries initiative
- Develop innovative ways to manage and distribute access rights fairly and equitably, noting that ‘historical use’ may not be the per-eminent quantity.

7 Extension and Adoption

Key research and outcomes of this project have been disseminated to the target audience. In response, the Department of Primary Industries and Regional Development in Western Australia has received a number of proposals for innovative new fishery developments. These will be addressed by the RAM methodology devised in this report.

8 Project materials developed

Scientific manuscript published by the journal *Marine Policy*

Hart AM (2015). Commercial scale invertebrate fisheries enhancement in Australia: experiences, challenges and opportunities. *Marine Policy*. 62: 82-93

Abstract

Stock enhancement or “assisted recruitment” for fisheries management in Australia is at an experimental R&D phase. Development of the science has focused largely on recreational finfish; however it is considered that high value invertebrates will be the best candidates for commercial scale fisheries enhancement. Three main ingredients are required; technical capacity, governance capability, and the ‘correct’ species. The technical capacity needed is in the area of hatchery production and wild release methodologies, whilst the governance capability needed is informed policy that accounts for the complexities and interdisciplinary nature of stock enhancement. In particular, the appropriate articulation of policy to support economic development and integration into wild fisheries is currently lacking. If successful stock enhancement is implemented, the nature of fisheries management changes because the recruitment side of the fisheries equation is under substantial control, rather than just the production side. Management responses will require significant innovation, with a renewed emphasis on understanding the stock, rather than policing the fishers. By way of illustration, recent initiatives and key challenges encountered in Australian invertebrate fisheries are investigated through case studies. An example of a commercially-viable enhancement fishery that reflects solutions to the key challenges is also presented. The review ends with an argument to re-establish the context of stock enhancement in the discipline of ecological enhancement. This is a crucial and positive step forward for it recognises that, in principle, any renewable aquatic ecosystem has the potential to be enhanced instead of just depleted

9 Glossary

This report is concerned with rapid appraisal of development applications in the field of primary production industries based on renewable aquatic resources. Key definitions which summarise detailed processes are as follows.

Applicant: *An applicant is the party submitting a proposal to develop a new fishery. It is intended that the rapid appraisal methodology (RAM) provide guidance for both assessors and applicants in a new fishery development process.*

Assessor: *An assessor is the party reviewing a proposal to develop a new fishery. It will generally be the Department of Fisheries, Western Australia, although from time to time, independent assessors may be called upon.*

Decision tree: *An element of the Rapid Assessment Methodology (RAM). Decision trees provide explicit pathways for assessment of applications for new fishery development in Western Australia.*

Development opportunity: *A proposal, identifying a development project (species, market characteristics, production method [culture and/or harvest], harvest gear, and location), that is eligible to be assessed against the business case, sustainability science, and community issues decision trees for new fisheries.*

Eligibility Test: *The ‘engine rooms’ of the RAM are the “Eligibility Test” and the “Renewal Test”. The “Eligibility” test provides the first assessment of a proposal against specified criteria and determines the pass/fail nature of it. See also “RAM” and “Renewal Test”.*

New fishery: *A new fishery is a development opportunity that has been fully assessed against the business case (economic viability), sustainability science, and community issues decision trees, and passed the scoring criteria.*

Proposal: *A submission to the Department of Fisheries outlining a new fishery development. The first assessment of a proposal is to determine if it is a development opportunity. The second assessment is to determine if the development opportunity becomes a new fishery.*

RAM: *Rapid Assessment Methodology – acronym for the overall methodological approach used to assess applications for new fishery development in Western Australia. The ‘engine rooms’ of the RAM are the Eligibility Test” and the “Renewal Test”. These provide respectively, a first and second assessment of proposals against specified criteria.*

Renewal Test: *The second assessment of a proposal against specified criteria. It is undertaken if the proposal fails the Eligibility test. Its main objective is to allow iterative improvement of proposals to increase their chances of passing the Eligibility test*

10 Appendices

10.1 Intellectual Property

The results of this project have become public domain and will be published, widely disseminated and promoted with training and extension provided if required. There is no intellectual property associated with this research report and it is not anticipated that any patents will arise from this project

10.2 List of researchers and project staff

The following Research Scientists conducted this project: Dr Anthony Hart

The following Management and Policy Officers conducted this project: Ms Heather Brayford, Dr Lindsay Joll

The following people contributed significantly to this project in discussions and perspectives: Mr Jamin Brown, Mr Angus Callender, Mr Frank Fabris, Dr Brett Molony, Mr David Murphy, Mr Richard Stevens, Dr Lachlan Strain, Dr Rick Fletcher

The following people reviewed the report: Dr Lynda Bellchambers, Dr Nick Caputi, Mr Patrick Cavalli, Dr Brett Molony, Dr Lachlan Strain.

10.3 References

- ARMA (2016). Aquatic Resources Management Act of Western Australia. - https://www.slp.wa.gov.au/legislation/statutes.nsf/law_a147142.html
- Anon (2006). Policy for the appraisal and administration of Northern Territory Development Fishery Applications. <http://trove.nla.gov.au/work/25333448?>
- Anon (2008). New Emerging Fisheries Policy, Canada. www.dfo-mpo.gc.ca/fm-gp/policies-politiques/efp-pnp-eng
- CoA, 1992. National Strategy for Ecologically Sustainable Development - Part 1 Introduction. <http://www.environment.gov.au/about-us/esd/publications/national-esd-strategy-part1>
- DoF (2016). Abalone Aquaculture in Western Australia. Principles and considerations relating to management of abalone aquaculture in Western Australia. Fisheries Occasional Publication No. 132, Department of Fisheries, Western Australia. http://www.fish.wa.gov.au/Documents/occasional_publications/fop132.pdf
- DoF (2015). Annual report of the Department of Fisheries for the year ending 30 June 2015. http://www.fish.wa.gov.au/Documents/annual_reports/Annual%20Report%202014-15.pdf

- DoF (2011). Improving commercial fishing access rights in Western Australia. Access Rights Working Group Report to the Hon Norman Moore, MLC Minister for Fisheries. Fisheries Occasional Publication No. 102.
http://www.fish.wa.gov.au/Documents/occasional_publications/fop102.pdf
- DoF (2013). Policy on restocking and stock enhancement in Western Australia. Fisheries Management Paper [Western Australia] No. 261; 8p.
<http://www.fish.wa.gov.au/About-Us/Publications/Pages/Fisheries-Management-Papers.asp>
- Fletcher, W.J., Wise, B.S., Joll, L.M., Hall, N.G., Fisher, E.A., Harry, A.V., Fairclough, D.V., Gaughan, D.J., Travaille, K., Molony, B.W. and Kangas, M. (2016). Refinements to harvest strategies to enable effective implementation of Ecosystem Based Fisheries Management for the multi-sector, multi-species fisheries of Western Australia. Fisheries Research
- Halmarick L (1999). Developing new fisheries in Western Australia. A guide to applicants for developing fisheries. Fisheries Management Paper No. 130. Department of Fisheries, Western Australia.
- Hart A, Travaille KL, Jones R, Brand-Gardner S, Webster F, Irving A, Harry AV (2016). Marine Stewardship Council Report Series No 5: Western Australian silver-lipped pearl oyster (*Pinctada maxima*) Industry. Department of Fisheries, Western Australia. 316pp.
http://www.fish.wa.gov.au/Documents/wamsc_reports/wamsc_report_no_6.pdf
- Hart AM and Strain LWS (eds) (2016). Bioeconomic evaluation of commercial-scale stock enhancement in abalone. Australian Seafood CRC Report No. 2009/710. Fisheries Research Report No. 269. Department of Fisheries, Western Australia.
- Hart AM (2015). Commercial scale invertebrate fisheries enhancement in Australia: experiences, challenges and opportunities. *Marine Policy*. 62: 82-93
- Hart AM, LWS Strain, F Fabris, J Brown and M Davidson (2013a). Stock enhancement in greenlip abalone part I: long-term growth and survival. *Reviews in Fisheries Science*, 21(3-4): 299-309
- Hart AM, F Fabris, LWS Strain, M Davidson and J Brown (2013b). Stock enhancement in greenlip abalone part II: population and ecological effects. *Reviews in Fisheries Science*, 21(3-4): 310-320.
- Hart A M, LWS Strain, A. Hesp (2013c). Stock enhancement in greenlip abalone part III: bioeconomic evaluation. *Reviews in Fisheries Science*, 21(3-4): 354-374.
- Lorenzen K, Leber KM, Blankenship HL (2010). Responsible Approach to Marine Stock Enhancement : An Update. *Reviews in Fisheries Science*;18:189. doi:10.1080/10641262.2010.491564.
- Jackson, J.B.C., et al., 2001. Historical overfishing and the recent collapse of coastal ecosystems. *Science* 293, 629–638.

- Jones, J B and WJ Fletcher (2012). Assessment of the risks associated with the release of abalone sourced from abalone hatcheries for enhancement or marine grow-out in the open ocean areas of WA. Fisheries Research Report No. 227, Department of Fisheries Western Australia, 24p.
- MRAG (2010). Starting from scratch: Best Practice Application of New Zealand's Fisheries Management Framework to Developing Fisheries. Report submitted to the Ministry of Fisheries, New Zealand. MRAG Asia-Pacific.
<http://www.mragasiapacific.com.au/Recent-Publications>
- Quinn TJ, Deriso RB (1999). Quantitative Fish Dynamics. Oxford University Press. New York.
- Sandoval-Castillo, J., Robinson, N., Strain, L.W.S., Hart, A.M., Beheregaray, L.B. 2016. Stock enhancement in Greenlip Abalone :(5) Population Genomics. *In*: Bioeconomic evaluation of commercial-scale stock enhancement in abalone, eds. A.M. Hart and L.W.S. Strain, *Fisheries Research Report No. 269*, Department of Fisheries, Western Australia, 148 pp
- Stevens RN (2012). Disease risk assessment for abalone stock enhancement. Final report to Fisheries Research and Development Corporation on Project no. 2011/046. Western Australian Fishing Industry Council. 32p.
<http://frdc.com.au/research/final-reports/Pages/2011-046-DLD.aspx>