Defining the legacy from the CRC's research in Future Harvest

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Non-Technical Summary

2012/739: Defining the legacy from the CRC's research in Future Harvest

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PROJECT OBJECTIVES:

1. To determine how the extension and adoption of projects can be improved
2. To determine the extent of cultural change in Australian fisheries with willingness to consider / use enhancement and bioeconomic modelling - and how this willingness can be increased.
3. To identify any constraints to achievement of CRC outcomes and propose strategies to address these.

OUTCOMES ACHIEVED

All projects run through the Future Harvest Theme (FH) were reviewed including through meetings with each research provider. The majority of these projects have produced outputs that could result in substantial benefits to commercial fisheries. However these projects also universally faced barriers to full adoption of results. In many cases it was possible to identify common problems across different projects in extending research. A range of extension activities for overcoming these barriers are proposed and the intent of these proposed activities is to not only increase benefits from current projects but to create a lasting legacy from the suite of investments in the Future Harvest Theme**.**

The seafood production sector, and in particularly wild fisheries, are notoriously conservative and resistant to innovation in all but a few cases. Even where there are clear benefits at a fishery level from adopting approaches based on economics or enhancement, gaining even majority agreement to implement such approaches is difficult. Achieving change has been generally more successful through evolutionary approaches involving learning, understanding and 'bringing industry along' through informed dialogue. This approach is suggested in most of the recommendations. However, there does come a point when political courage is necessary to take the hard decisions in the face of inevitable opposition. Hence, gaining the understanding and support of senior fisheries managers, heads of agencies and, most significantly, policy makers, will be vital to creating a significant legacy from the research carried out under the Future Harvest theme.

LIST OF OUTPUTS PRODUCED

Bioeconomics projects

The FH projects are making a substantial contribution in moving beyond using economics as a factor in the ‘weight of evidence’ approach to setting catch and other fisheries management settings and towards using economics in ‘hard wired’ decision rules.

The FH projects are making a substantial contribution nationally towards increasing both profitability and sustainability in Australian wild harvest fisheries. FH

researchers are achieving this by using models and other methodologies to identify areas where increased production and profitability are available, and subsequently working with industry and Government to ensure adoption. This review has considered how this contribution or legacy can be enhanced.

Enhancement Projects

Stock enhancement does not have a good reputation globally, due mainly to several poorly conceived projects failing. However, stock enhancement is now increasingly being put forward as an alternative management tool in certain circumstances, such as in the event of severe stock depletion due to overfishing or environmental change. It is considered particularly appropriate in areas where natural recovery and recruitment are unlikely to rebuild stocks within acceptable time frames, if at all. Another novel use of enhancement is where natural systems inhibit yield from a fishery, such as in areas of limited food, or where there is competition for space. In such circumstances an increase in yield can occur as a result of shifting animals into more productive habitats. Future Harvest research has provided technical information on the potential benefits from enhancement in abalone, rock lobsters and sea cucumber, in some cases extending this to proof of concept. Implementing successful enhancement programmes will require well-designed business structures and realistic financial targets, based on thorough feasibility studies that consider both biological (including biosecurity) and economic issues.

Governments have been wary of fisheries enhancement, mostly, it appears, due to opposition from the wild fishery sector which generally views this activity as a threat. Some of the extension issues have been addressed by the fisheries enhancement policy development under FH activities, elements of which have been implemented or are under consideration in NT and WA.

The principal outputs from this project include:

a) a review of outputs and pathways to their adoption from individual research projects carried out under this theme, including, where appropriate, recommended actions.
b) Identification of specific cross-cutting extension activities that will enhance the overarching legacy from research under the FH theme

Cross-cutting legacy recommendations from which a Future Harvest extension program will be developed were:

1. A review and analysis of current economic data collection methods.
2. A project-based extension programme aimed at industry owners (primarily in the capture sector) to extend research projects and outcomes.
3. Roadshow of research leaders and industry leaders visiting key fisheries representative bodies.
4. A handbook and videos on fisheries economics.
5. A one-day round table workshop targeting the heads of agencies on advances in fisheries economics.
6. Commission of a journal paper (e.g. Marine Policy) debating some of the roadblocks to the adoption of economics in fisheries policy and management in Australia.
7. Commission reviews from SRL translocation, abalone enhancement and sea cucumber ranching, NZ abalone, North American salmon enhancement and other relevant examples.
8. Re-establishment of the annual fisheries management workshop dealing with bioeconomic modelling and enhancement in the first instance.
9. Conduct a session showcasing the FH projects at the 2014 IIFET

Conference.

10. Undertake a review of training opportunities for fisheries managers, with particular reference to fisheries economics, fisheries governance, access rights and resource sharing.
11. Presentation of FH research programme at Seafood Directions, including success stories.

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1. Introduction

1.1 Project Background

As at March 2013 the Australian Seafood Cooperative Research Centre (CRC) had invested $6.79 million into research projects in its Future Harvest research theme to broadly address the issue of 'fishing for profit'. The theme has two key areas of research. These are:

i) **Bioeconomic modelling and improved management systems**, using a combination of biological and economic analyses to enable stakeholders, including fishery managers and industry, to make decisions about their fishery, with the goal of enhancing profitability. To take full advantage of these analyses requires an understanding of the role and value of economics and minimum effective levels of management.

ii) **Stock enhancement**, including reseeding and translocation, to recover depleted stocks or increase economic returns above those that would be possible using standard fisheries management approaches.

The overall outcome and benefit of this legacy project is the improved application of research from the Future Harvest (FH) theme and a legacy that outlasts the CRC. The objectives of the project are:

- to determine how the extension and adoption of projects can be improved;
- to determine the extent of cultural change in Australian fisheries with willingness to consider / use enhancement and bioeconomic modelling - and how this willingness can be increased; and
- to identify any constraints to the achievement of CRC outcomes and proposed strategies to address these.

1.2 Project Methodology

Visits were made to Queensland, South Australia, Western Australia and Canberra (Australian Fisheries Manager's Forum – AFMF). For each project at least the following stakeholders were interviewed either in person or by telephone, with follow-up email communication:

- Principle Investigator (and some or all co-investigators)
- The fisheries manager(s) responsible for the fishery
- Director of Fisheries or equivalent
- The relevant industry association
- Industry

A range of other relevant stakeholders was contacted. Much of the liaison occurred on the back of other tasks and travel undertaken by the PI, which resulted in considerable efficiencies.

The PI and Caleb Gardner made a presentation to senior fisheries executives of all states and the Commonwealth at the Australian Fisheries Managers' Forum (AFMF) on the 6th December. The discussion was based on a paper produced for AFMF members, which provided an update on FH projects and suggested a number of areas of legacy activities. Some useful feedback was received, which is incorporated in the analysis that follows.

It is intended that a presentation on the work of the FH theme based on this review will be given to the Seafood Directions Conference, which will be held in Port Lincoln 27-30 October 2013. This Conference offers a valuable opportunity to showcase the FH work and continue the dialogue on change across the industry.

For the bioeconomics group of projects a summary legacy report for each project was drafted and provided to the PI, relevant fisheries manager and industry association for comment before finalisation. A similar process was followed for the stock enhancement projects. The 'other projects' were covered using an abbreviated process and then summarised more briefly.

The project reports are provided in full as attachments to this document and include a SWOT analysis of each project and its adoption strategies. The reports are intended to provide a basis for discussion between the CRC Secretariat, Theme Leader (Caleb Gardner) and the PIs for each project. These discussions should focus on responses to the detailed recommendations for improving project outcomes and legacy provided.

It should be noted that each project has substantial strengths, which will support the realisation of identified opportunities to improve profitability; these are not discussed extensively in the body of the document and are included in the attachments.

The body of the report is set out in two major sections. The first section provides

- a brief overview of each project;
- key constraints to adopting the outcomes of the research;
- conclusions as to the likelihood of legacy outcomes if no further interventions are made; and
- recommendations to address constraints and increase legacy outcomes.

The second section considers key cross cutting activities that could be undertaken to improve extension and adoption of project outcomes and thereby the FH legacy.

2. Constraints to adoption and recommendations

2.1 Bioeconomic modelling and improved management systems

Projects have been completed or are in progress on three key species groups/fisheries in states with CRC participant organisations. These species groups are prawns, abalone and rock lobster. This research engages with the leading national specialists in fisheries bioeconomic modelling and key industry stakeholders. In addition, there are three associated projects that are not associated with these species groups; i) fisheries economics capacity building

through 'Master class' training; ii) optimising business structures in fisheries and iii) risk based management and minimum effective regulation.

2.2.1 Southern Rocklobster (Project 2009/714.20)

The project uses and extends the fishery population model used for rock lobster stock assessment in Tasmania and South Australia[1], combined with economic modelling, to provide economic guidance for the management of rock lobster fisheries in these states.

The overall momentum created by the CRC suite of RL projects under the Future Harvest theme, combined with complementary activities by state fisheries administrations and researchers, is highly likely to result in a legacy that will see explicit incorporation of economic decision rules in the harvest strategies for both the SA and Tasmanian fisheries.

Constraints to adoption

SRL recruitment has had periods where it has been well below long-term averages due to processes that are not well understood, and resulted in fishery production that was at the bottom end of the range predicted by current models. This has tended to undermine industry confidence in the use of these models to set catches or develop economic analyses. Similarly, there is a lack of confidence in the economic data available to modellers and the extent to which the models represent reality. The creation of accurate and meaningful bioeconomic models is made harder due to the variables associated with the current pricing structure, weather, size limits, weights of lobsters and market access.

The benefits of adopting an economic decision rule within SRL harvest strategies needs increased promotion and more sophisticated selling points than simply citing increased net present values (NPVs). Bioeconomic modelling requires specialised knowledge and well-established links with industry. The latter is also vulnerable to staff changes and sufficient resources to effectively conduct and communicate economic analyses, and their associated potential benefits.

Some elements of the rock lobster fishing industry are inherently resistant to change of any nature and are prepared to mount considerable opposition, even where the analysis is clear concerning potential benefits. This resistance may result in slowing the adoption of specific economic decision rules, since decisions are often taken by consensus or at least rely on majority decisions by a large group (e.g. Tasmania). A related issue concerns confusion as to the role of government, and in particular fishery scientists, in setting economic targets.

In Australian Commonwealth Fisheries the Government has been forceful in increasing economic yield of industry by setting economic targets for fisheries but in the state-based fisheries in the CRC this decision has been left with industry to a greater degree. Industry in these fisheries has tended to resist management that targets higher economic benefit and thus research that measures economic yield. A consistent problem here is that industry has great

[1] The project proposal included Victoria, but this state is no longer included in the research.

difficulty in seeing the relevance of the economic targets for the fishery to the profitability of individual fisheries enterprises.

Conclusions

The overall momentum created by the CRC suite of RL projects under the Future Harvest theme, combined with complementary activities by state fisheries administrations and researchers, is highly likely to result in a legacy that will see explicit incorporation of economic decision rules in the harvest strategies for both the SA and Tasmanian fisheries. Once agreed, this will effectively legislate against short-term decision making based on maximising catch and shift focus onto a more economically rational approach based on maximising long-run economic efficiency.

While industry is cautious concerning the timeline for introduction of an economic decision rule, economic indicators are influencing decisions in the meantime, despite not being formally included.

SA fisheries (Northern and Southern Zones) have a current RL management plan that already includes an explicit harvest strategy and decision rules well suited for targeting economic yield. Once industry and managers gain confidence, the framework and mind set for adopting higher economic yield as a target are present. In Tasmania, considerable efforts by researchers, managers and industry has led to a decision process that targets economic yield with TAC setting with the use of a catch rate target. Bioeconomic analysis is also used to inform decisions on management measures such as closed season and size limits.

Recommendations

Note – where appropriate, these recommendations will be identified with proposed cross cutting legacy activities (see section 3.2)

i) Continue to bring industry along in the process by ensuring responsiveness to requests from the MAC and other advisory bodies to trial various harvest strategy scenarios (SA).

ii) Provide an opportunity for industry to ground truth inputs to the model in terms of price and cost information prior to it being run - this could be incorporated into a formal process and would serve to build industry confidence.

iii) Build the capacity of fishers to understand the implications of MEY and how estimates/predictions of stock level, catch rate, NPV etc. are calculated.

iv) Fishers / stakeholders involved in advisory bodies such as the MAC should be exposed to the outputs of the modelling ASAP. The outputs should then be incorporated into a broader program of extension to the wider industry via port meetings and regular updates to build confidence in the new indicator(s), ultimately leading to their inclusion into the strategy once confidence has been built.

v) Test economic decision rules alongside the existing CPUE harvest strategy to build confidence, with the objective of incorporating an economic decision rule in the next management plan (SA).

vi) Model the impacts of proposed marine parks and expansion of SA WZ fishery into historical fishing areas (deep water and far west) (SA);

vii) Consider running a workshop(s) in conjunction with TRLFA meetings and/or use port meetings as the most effective way to communicate face to face with industry (TAS).

viii) Increase interaction between Rock Lobster fisheries in Australia adopting MEY approaches, at both the level of managers and industry, noting the success of the current informal interstate fisheries management meetings organised by Hilary Revill (DPIPWE, Tasmania).

ix) Free up any IP associated with the bioeconomic model to enable free exchange of ideas/innovations between states associated with CRC and other fisheries within Australia and overseas.

x) Present the information from the modelling in a way that somehow relates better to the individual fisher, as, like most business owners, the question of 'how will this benefit me?' is generally the most pressing.

xi) Establish the collection of an economic data set to monitor changes in cost structures, markets and prices to inform bioeconomic modelling (Tasmania).

2.2.2 Decision-support tools for economic optimization of Western Rocklobster (Project 2009/714.10)

The project, now complete, used a biological model combined with economic data to undertake an assessment of a range of values for maximum economic yield (MEY) for the Western Rocklobster fishery. The model was used to examine various conditions of recruitment, discount rates, market price, and costs of capture (fixed and variable).

The project will create a substantial legacy by allowing data and analysis to be provided to the Department and industry to inform the development of a harvest strategy decision rule and future TACC setting.

Constraints to adoption

The current model, which assumes a relatively strong puerulus count/recruitment (to the fishery) relationship, does not deal with the on-going cause of low levels of puerulus settlement and recruitment. While there has been some work on links between recruitment and seasonal rainfall/temperature, no firm conclusions have been drawn. The absence of formal economic data collection on model inputs such as costs, markets and prices provides a weakness in the ability of the model to make sufficiently accurate predictions of economic performance, should the new MEY decision rule be adopted.

The proposed harvest strategy is complex and together with the introduction of quota, represents a significant change in management approaches. While there is support from industry leaders for economic and other factors to be taken into account when setting catches the majority of fishers will need convincing to gain their support. This ability and willingness to further consider economic approaches has been hampered by the current dispute over how stock interactions between zones should be treated when setting zonal TACCs. This

issue is now being considered as one of equity and in the short term at least, is threatening to slow down consideration of 'bigger picture' issues under the proposed new harvest strategy, including economic considerations.

Conclusions

The project will create a substantial legacy by allowing data and analysis to be provided to the Department and industry to inform the development of a harvest strategy decision rule and future TACC setting. While many of the benefits currently being enjoyed by the fishery have resulted from action necessitated by the recruitment decline, coupled with the introduction of quota, a hard wired harvest strategy will contain any industry desire to increase catch beyond what has been agreed as part of the harvest strategy decision rule once (and if) recruitment and biomass increase. However before concepts such as MEY can be discussed objectively by industry, the current impasse in relation to 'equal' allocation will need to be overcome.

It is relevant to note that despite many years of consultation, the move to quota was made by an interested and committed Minister making a difficult decision, in circumstances far short of consensus among industry. In the final analysis a similar approach may be necessary to introduce an economic decision rule.

Recommendations

i) Continue to bring industry along in the process by pursuing and being responsive to requests to trial various harvest strategy scenarios. This is particularly important as industry has asked for a number of scenarios in relation to harvest strategy (alternate modelling options) but reportedly these have not materialised as yet; (these were agreed to be assessed for the 2014/15 TACC assessment).

ii) Build capacity of fishers to understand the implications of MEY and how estimates/predictions of stock level, catch rate, NPV etc. are calculated;

iii) Use fisher-to-fisher dialogue to promote change, e.g. by inviting NZ and SA rock lobster stakeholders to provide presentations and through port meetings.

iv) Establish the collection of an economic data set to monitor changes in cost structures, markets and prices to inform bioeconomic modelling.

2.2.3 Economic management guidance for Australian abalone fisheries (Project 2009/714.30)

The project will collect data to enable an economic assessment of the five Australian abalone fisheries (Tasmania, Vic, NSW, SA and WA), which when combined with biological data, will provide bio-economic analysis tools to test a range of scenarios using a management strategy evaluation (MSE) framework developed under a previous FRDC project.

Once appropriate economic data collection and analysis is complete, and if industry can be convinced of the potential contribution of bioeconomic modelling to improving profitability, the project will contribute substantially to fishery management decision-making.

Constraints to adoption

The targeted 50% increase in the performance indicator of economic yield as a result of management reforms associated with projects in this theme is less feasible for abalone than for other fisheries. Given the state of global economics and the rise of aquaculture a more realistic target may be to maintain current profitability and increase economic stability.

Collecting economic data is proving to be challenging as a result of limited industry cooperation and scepticism as to the likely benefits of the project to individual businesses; a secondary issue is the on-going collection of that data once the project has been completed. To be most effective, some form of biological modelling will be required to look at, for instance, TAC and size limit combinations, especially at fine spatial scales. Unfortunately a relatively small proportion of the abalone fisheries under consideration are covered by the required length based models.

Stock assessment models and even data analysis does not have a good track record of acceptance by the abalone industry. As with rock lobster fisheries, there is an absence of widespread support for this work and an associated lack of confidence in inputs, which may reduce the uptake of opportunities to improve economic outcomes.

Similarly, there is a lack of understanding of economic principles, particularly where the results are counter-intuitive or might impact on cash flow. Selling uncertain future gains against the known cost of foregone short-run profit through conservative catch or size limit decisions will be challenging. Abalone industries, despite the efforts of the ACA, can tend to be very parochial and may not adopt potential efficiencies arising from the project if they are not tailored to individual fishery circumstances. ACA, while supportive of the project, seem unlikely to provide the leadership necessary to get industry thinking in a business-like manner about their fishery decisions due to other commitments/priorities, and its general misgivings about the ability of the project to deliver tangible outcomes.

Conclusions

Once appropriate data collection and analysis is complete, and if industry can be convinced to participate in bioeconomic modelling to improving profitability, the project will contribute substantially to fishery management decision-making.

Of the three sectors abalone is perhaps the toughest nut to crack with respect to introducing economics into decision-making. The greatest single issue to be resolved to enhance the legacy of the project will be to convince a sufficient number of industry leaders in the abalone sector that the use of economic analysis and adoption of management decisions that explicitly take in to account economic outcomes can yield tangible benefits. Although the project was initiated by the ACA, this body was slow in supporting the project once it was developed and the membership will need to be convinced of its benefits. The ACA have been enthusiastic about basic economic monitoring data but less keen on research, which involves analysis of that data and using it for targeting higher profit. WA industry was particularly sceptical of this project and beyond the survey, is not engaged. Once this is achieved, it will be relatively easy to get

agreement from managers, who, for the most part constrain their major activities to addressing sustainability and let industry take the lead on economic matters.

Getting the ACA on board and fully supportive of the project will be pivotal to the project getting traction with industry.

Between FRDC and CRC there have been a number of abalone projects dealing with a range of issues including growth, marketing, spatial management, co-management, performance indicators, management strategy evaluation and performance indicators. There is a deal of uncertainty about how these projects fit together when viewed from an industry perspective. At an individual enterprise level, the tangible benefits become even more uncertain. As a result, there is resistance by some in industry to further research. In particular, there is a view from hardened professionals who have run successful businesses that decisions affecting economics and profitability are not the business of governments or researchers. This view is contrary to the Acts in each State.

Unfortunately, the timing of Tim Ward's project (2009/715 *Optimising business structures and fisheries management systems for key fisheries)* has been such that it has yet to cover abalone.

In developing the bioeconomic model, it is important to undertake extensive 'ground truthing' of input data with industry (harvesting and processing sector) to gain confidence in model outputs.

Recommendations

i) Produce a brief publication that places all recent (say last 20 years) abalone projects in an overall context, showing how they interact to deliver benefits at the individual enterprise level, as well as across whole fisheries.

ii) Work closely with the ACA Board to address concerns and demonstrate how long term benefits can result from consideration of the economic implications of management decisions.

iii) Increase the engagement of the project team with management advisory committees and resource assessment groups, or their equivalent, in addition to the steering committee.

iv) Ensure engagement with processors and marketers to obtain information such as the price brackets for different size live/canned abalone and the volume of abalone in size groups the market is looking for.

v) Strengthen linkages with the current fine spatial scale suite of projects[2], where key decision on TACs and size limits are evolving as a result of comprehensive data logging and analysis;

vi) Establish additional focus on key management and marketing issues such as:

[2] These projects, funded by FRDC, are based on research into the use of logger data in the spatial management of blacklip abalone fisheries by Craig Munday in Tasmania, Duncan Worthington in NSW and Harry Peeters in Victoria (Western Zone).

- potential loss of revenue from delaying critical decisions on TAC decreases, and conversely, the short term loss vs. the long term gain of delaying putting TAC up;
- size limits and the longer term economic consequences of changes; and
- timing of harvest (following on from the Ben Stobart SA Geenlip study)[3].

vii) As with SRL, run comparative analysis alongside existing TAC and size limit setting processes, both where harvest strategies exist and are yet to be developed.

2.2.4 – Harvest strategy evaluations and co-management for the Moreton Bay Trawl Fishery (Project: 2009/774)

The project, which was completed in October 2012, was initiated by the Moreton Bay Seafood Industry Association (MBSIA) in response to the falling profitability of the Moreton Bay trawl fishery. The project was based on the idea that improved decision-making based on bioeconomic analysis, coupled with an improved system of governance, could improve economic yield and restore prospects for the fishery.

While identifying a range of constraints and opportunities, the process of restoring profitability will remain challenging. The legacy of the project, considered in isolation and without further intervention, is likely to be very limited. However, the fishery is the beneficiary of a wide range of CRC projects and other activities, which, if coordinated effectively and implemented, could combine to provide a substantial long-term legacy in terms of improved profitability.

Constraints to adoption

The outputs of this work, while impressive, are far-reaching, complex and in a number of areas are incomplete, presenting a challenge to industry and managers in deciding on a future management and industry development directions. This is exacerbated by the difficulties that have been experienced in identifying and prioritising management objectives.

While some fishers are pro-change and are prepared to enter into discussion with researchers and government concerning new governance arrangements and other initiatives there is little unity within industry. A wide range of views is held on the dynamics and condition of the resource and what actions are necessary to restore economic viability. Getting the level of industry agreement (i.e. consensus) on the issues necessary for government to act will be difficult to secure. Similar comments apply to the development of prospective new governance arrangements.

The current stock assessment strongly suggests that the brown tiger prawn biomass in Moreton Bay has recovered well from years of chronic (and probably

[3] Maximum yield or minimum risk: using biological data to optimise harvest strategies in a Southern Australian molluscan fishery. Stobart, B., Stephen Mayfield & Richard McGarvey (2012). Manuscript submitted for publication.

recruitment) overfishing in the 1980s and 1990s. Now that effort in the Bay has fallen to record lows, stock assessment scientists consider it likely that reduced effort is the driver behind the significant increase in biomass and the current high catches and catch rates. Industry contends that these changes could be the result of one or more environmental changes and/or changes in fishing practice, but current research has found no evidence of this. The conflict over the stock assessment and related advice i.e. what the problem is, makes moving forward with tangible solutions to the problem very difficult. In the opinion of researchers, there is a need for industry to take responsibility for the impact of their fishing effort levels on this stock, and especially brown tiger prawns. A view by industry is that effort is low and never likely to increase. Catches are high – but cannot be sold at a good price. Most of the product is fresh and there is no longer a supply chain that can deal with large pulses of fresh product, even though the quantities are low by historical standards.

In a more buoyant economy, some contribution to a strategy to improve the status of the fishery by government would be a strong consideration but it is clear that the Department of Agriculture, Fisheries and Forestry (DAFF) is in survival mode with many essential (to effective fisheries management) services under threat as a result of budget cuts. With a gross value of around $5 million it is unlikely that the FRDC or other institutions will be persuaded to fund extensive additional research to resolve some of the ambiguity in the assessment and to undertake further economic analysis.

The on-going high levels of competing products is severely impacting price, particularly of the increasingly abundant greasyback. The competing supplies are made up of cheap imported prawns and Australian–caught product which used to be exported but is now sold nationally due to the high Australian dollar. There is a clear need to improve the value of the product in key markets, as is being successfully achieved by the Tunnel Net fishery.

Considerable uncertainties exist within the stock assessment model for tiger prawns , including estimates of mortality, catchability and effort. This uncertainty, combined with complex links with other commercially significant target and by-product species is constraining industry implications for management changes. The degree to which industry wishes to pursue links to environmental drivers and reduce uncertainty before 'buying on' to recommendations may present a major barrier to achieving realistic short-term gains via more pragmatic approaches.

Under recent government cuts, many positions in the Department of Agriculture Fisheries and Forestry within DPI have been lost, reducing the capacity of Government to assist the fishery.

Conclusions

Taken at face value, the Moreton Bay Trawl fishery seems to have a number of features that would make the introduction of innovations to improve economic returns possible. These would include co-management, cooperative approaches to marketing and, possibly, some form of corporate governance structure. There is a relatively small number of fishers, an active industry association (MBSIA) and good linkages between stakeholders. Added to this is the existence of a

population base of over two million consumers on the doorstep of the fishery, demanding fresh local seafood.

However, considerable barriers to progress persist, most of which are related to fisher behaviour and capacity to agree and implement change.

Currently the fishery is the beneficiary of a wide range of CRC project and other activities, which, if coordinated effectively and implemented, could combine to provide a substantial long-term legacy in terms of improved profitability.

SeaNet officers have worked very effectively with industry to develop promotional/motivational media to promote the MB fishery and associated seafood products and assisted in the development of codes of best practice. While outside the scope of the project under review, it is clear that these officers, should SeaNet be refunded, have a role in the future development of the Moreton Bay Prawn Fishery.

Recommendations

i) Undertaking a brief project to design an action plan for the Moreton Bay fisheries drawing together and highlighting the linkages between this project and other relevant projects (including 2010/777 - Identification of the core leadership group and network structure of East Coast Trawl to develop, implement and evaluate strategic opportunities and 2008/793 - Optimising quality and value in domestic prawn value chains).

ii) Gaining an improved, and more importantly common, understanding of the complexity of fisheries production, including the effects of environmental factors, which would enable industry to have effective input into decisions concerning production and associated marketing to achieve maximum value for the product. This may be best addressed by a mediated discussion between researchers, managers and industry 'champions', including David Sterling.

iii) Boosting the spatial resolution of the information system thereby gaining confidence in the stock assessment. Given the resource restraints, this will only occur with a strong working relationship between industry and fisheries managers and a workable collaboration on this issue

iv) Using improved temporal/spatial knowledge of the fishery, well thought out appropriate harvesting and marketing strategies should be determined to maximize production and value, and keep a check on sustainability and acceptable environmental/social impacts.

v) Provide support for a proposed collaborative (MBSIA, QUT and DAFF) follow-up project currently being presented for funding under the framework of the Industry Doctoral Training Centre; this work should include the establishment of the size of prawns in the catches, particularly in the part of the season where there is the most interest in "beneficial" closures to avoid growth overfishing.

vi) Revisit the industry M2 boat replacement strategy on the basis that economic analysis within this project has shown that the benefits of the proposed M2 replacement policy are high and that the most likely outcome is an effort reduction (not an increase).

vii) Seek funding elsewhere, or use agreement on resource status and an action plan as a leverage for additional FH funding, to support initiatives that have been suggested through the project outcomes and subsequent discussion

viii) Capitalise on the early findings of project 2010/777 to communicate options for development more effectively and in particular, identify and use networks and leadership groups to drive change.

2.2.5 Bioeconomic model for SA prawn trawl fisheries (Project: 2011/750)

The project was developed in response to reductions in prawn prices and reduced profitability for SA Western king prawn fisheries in the Spencer Gulf (SGPF) and Gulf St Vincent (GSVPF). The project will use and adapt an existing Eastern king prawn bioeconomic model to develop optimal fishing /harvest strategies. Upon completing the model its outputs will be extended to other Australian prawn trawl fisheries.

Given the cost/price pressures on Australian prawn fisheries and growing recognition among industry and managers of the need for change, the potential legacy arising for this project, if successful, is substantial.

Constraints to adoption

Coverage of economic data sets requires expansion to enable robust interpretations of economic performance. The major gaps lie in coverage of different vessel types (especially in GSV) and prawn prices by grade. While bioeconomic models offer much promise in measuring and improving economic performance, in practice dealing with economic efficiency issues in an input controlled fishery is notoriously difficult due to factors that include input substitution and effort creep. Convincing fishers that the model, which is based on the East coast, is a reasonable representation of reality will present a key challenge.

Prawn catches in the GSV have been low for some years and are less stable than those in the SG and, given the level of conflict often present in the fishery, it will be difficult to reach agreement on the measures that will be necessary to rebuild and restore the fishery to optimal economic performance. Transition costs of fleet reduction will be substantial, especially in the GSVPF. From an industry perspective, the current main constraint on the project is the available modelling expertise within the country to ensure the model can reach its full potential.

Conclusions

While the project seeks to develop a bioeconomic model and identify and develop and implement improved harvest strategies, it is very clear that the path to uptake and the associated strategies will be very different between the two fisheries. For both fisheries, achieving industry understanding, support and buy-on will be pivotal, and considerable effort has been planned in this regard. The project is not clear on how optimal fishing strategies will be 'sold' to fishers and this activity will be pivotal to gaining acceptance and deriving a project legacy.

The ability of the project to provide an economic focus and demonstrate economic losses (and ways to address them) is evident. To achieve acceptance of the project outcomes, it will be necessary to demonstrate the model's capacity to effectively reflect fishery behaviour and with a high degree of accuracy reflect the financial drivers for operators' businesses.

While committed to the project, there can be a tendency for researchers to assume that adoption will occur because the benefits have been demonstrated; in the final analysis, they are not responsible for adoption. The project must demonstrate a clear benefit for industry, at both individual and fishery levels. Once this is achieved the chance that industry will become innovators, adopters

and drivers will be increased substantially. Getting buy-on from managers, once industry is engaged and supportive of the process, will be relatively easy.

Some specific conclusions concerning the two Gulfs are drawn below:

Spencer Gulf

The SGPF appears to be well placed to be the key beneficiary of the project. Since 1993/94 catches have been relatively stable and stakeholders have demonstrated responsibility and capacity to take on new ideas. The key initiative arising from project 2009/715, to establish the SGPF Economic Optimisation Working Group and consideration of two future options for management of the fishery under tradable units (quota or effort) is illustrative of the progressive nature of this fishery.

The culture of the fishery is to adapt and try new information. However there will need to be a period of time where the output from the models can be tested against actual outputs from the Gulf. Industry has stated that once the model has been tested and proven to provide a high degree of certainty, the fishery will consider the data developed by the model as one of the tools available to them in the process of making decisions.

A sub-committee of the Fisheries Council including industry, PIRSA and SARDI, has been delegated to oversee the development of the new management plan and the included harvest strategy. For the SG the research sub-committee is developing fishery a management framework. The framework will incorporate performance indicators that define stock status and guide fishing strategies throughout the year, based on measures of biomass using survey data in the short-term and model outputs in the long-term. Ideas developed by the sub-Committee will then be taken to industry for wider discussion, prior to more detailed development of the harvest strategy.

Gulf Saint Vincent

As discussed above it is hard to draw particular conclusions and recommendations at this time as to how the project legacy will eventuate in the GSVPF, or inform the outcomes of the current review of management. The Review will, however, define the principles for the harvest strategy, including how outputs from the model will be integrated.

It is somewhat encouraging that the fishery agreed to a form of transferrable nights in 2011/12, a first step towards addressing some of the very clear economic inefficiencies apparent in the fishery. The project outputs have the potential to drive change while providing a framework for improved management process. Further, it will be possible to identify pathways to generate optimum economic returns from catches under a rebuilding strategy and inform performance indicators to guide decision-making.

Recommendations

i) Clearly outline how: industry will be engaged in the project; support for optimal fishing strategies will be achieved; and the results of the research will be extended to industry.

ii) Demonstrate how harvest strategies developed under the project will

address the current economic losses being incurred by the fisheries, at both fishery and operator level.

iii) Increase the role of industry associations in evaluating benefits and promoting an economic approach to management to the fishers.

iv) Ensure adequate industry participation in developing model inputs to ensure outputs reflect fishery behaviour and financial drivers for operators' businesses with a high degree of accuracy.

v) Provide an early indication of what economic control rules might look like and work in practice to help industry obtain a better vision for the project and thereby provide support for its outcomes.

vi) Present the outputs from the bioeconomic model in ways that fishermen can understand, e.g. catch rates, TACC and profit.

2.2.6 Future Harvest Master Class (Project 2010/714)

The first phase of the Project, which developed and delivered a one-day Master Class training programme for industry (including fisheries managers and researchers) has been completed. The programme provided an understanding of key concepts associated with economics and fisheries economics, as a means of increasing awareness and acceptance of FH project outcomes. A project extension to develop an on-line Master Class and refine course materials has been favourably considered by the CRC and is about to commence.

The material and learning strategies developed by the project (and its extension) will provide a legacy to increasing the capacity of future industry participants to understand and, as appropriate, adopt MEY and other economics-driven approaches to fishery management.

Constraints to adoption

The teaching materials developed by the project, while generally meeting the needs of participants, are in need of further development both in terms of material and means of delivery. In particular, courses are not sufficiently tailored to jurisdictions and specific fisheries. Expecting a high rate of retention from a one-day course beyond a general awareness of concepts is unrealistic. Similarly, to expect an audience of fishers and higher degree qualified fisheries managers/researchers to find a single level of course delivery sufficiently informative and challenging while not being overly complex is somewhat optimistic.

On-going funding and continuation of economic capacity building within industry once the CRC is complete is an issue.

Conclusions

The demand for capacity building in fisheries economics continues to be a priority. This is becoming evident as fisheries management becomes more sophisticated and harvest strategies and control rules in management plans become widely used.

Short courses in economics are effective in raising understanding of opportunities for better fisheries management, but need to be more than the

single national tour delivered under the initial project. While the response to the courses was excellent, including from industry leaders and people with strong business experience, participation of stakeholders from different groups was variable, with some sectors very hard to engage in discussion on managing fisheries more profitably.

General concepts are better explained with examples from individual fishers and under the project extension, Master Class outputs will be tailored to jurisdictions and the economics of specific and relevant fisheries, which will make the courses considerably more attractive. The availability of an online course will make the content widely available and reduce the time commitment, which will help alleviate a significant constraint for working fishers and fisheries managers.

Recommendations

The project was reviewed at the end of 2011 and a range of recommendations made to the CRC Secretariat for the extension of the current programme (see Attachment 1), which have subsequently been approved.

2.2.7 Optimising business structures and fisheries management systems for key fisheries (Project 2011/750)

Declines in the economic performance of fisheries are driving the need to examine and resolve the structural factors that impede the maximisation of profitability in many Australian fisheries. The project works with industry to identify these factors and generate a vision, cultural change and integrated solutions towards improving this performance. The project covers selected Seafood CRC participant fisheries, i.e. prawns, rock lobster and abalone. There are strong links between this project and the other CRC projects, which are developing economic decision support tools.

The project, of itself, will not create a legacy. It will, however provide a vital catalytic role as a precursor to the implementation of other FH projects and their results, all of which will create substantial legacy outcomes.

Constraints to adoption

While comprehensive and integrated in approach, the Anderson and Anderson indictors system developed for the World Bank to measure wealth generation in fisheries appears somewhat ahead of its time in relation to forming a basis for decision making by industry and managers as suggested in the project document. While mentioned in the project document, it is unclear how social issues are to be addressed.

Even where barriers to economic performance have been identified, Governments have been slow in taking concrete steps to develop economic and social objectives or act proactively regarding management for economic efficiency. Where action has occurred it is usually based on industry consensus, which can tend to lead to lowest common denominator outcomes. At the operator level there remains significant confusion between individual financial performance and overall fishery efficiency, and decisions on issues such as optimum levels of effort are seen to be the business of industry, not research departments.

A number of fisheries in most need of change (e.g. Qld East Coast Prawn) are in dire economic circumstances and lack the industry government resources to change. In these circumstances, the project will leave a questionable legacy in terms of adoption.

Conclusions

Where industry has the capacity (financial and otherwise) to take responsibility for identifying the improvements needed in their fishery, the project has the potential to make progress towards management and economic reform. Examples of this reform are to be found in the Gulf prawn fisheries in South Australia. One of these fisheries, the SGPF, has taken the project outputs and moved part way to the proposed phase two of the project and has established a process for economic reform. The Gulf St. Vincent fishery was predictably more difficult. It has long been challenging to manage, and with the recent, largely unexplained, decline in stocks and revenue, getting consensus on reform will be difficult. The project did, however, raise awareness of options (as per its objectives) and tradable nights were introduced in 2011/12 – with the resulting increase in economic efficiency. It should be noted that these are relatively simple fisheries, dealing with well-understood stocks and, in the case of Spencer Gulf, with a long history of cooperation, collaboration and innovation.

The East Coast of Queensland appears to be a case where the issues have been identified, the tools are ready (or are almost ready) to be applied, but there is a lack of industry leadership and government capacity to implement the level of reforms necessary to achieve the available benefits. Further investment to take the issues identified by the project to the level envisaged by phase two of the project would not seem to be justified.

The abalone sector has already expended considerable R & D effort on improving spatial management (and marketing), with limited work on industry structure, particularly in respect of lease and owner divers. Some discussion and suggestions for improving industry structure, both by fishery and, comparatively, across fisheries, would be very valuable, as would analysis aimed at showing how the quality, quantity and value of abalone catches could be improved by optimising the timing of harvest. Developing linkages between this project and project 2009/714.30 – Economic management guidance for Australian abalone fisheries, will be as important as it will be for corresponding projects on prawns and rock lobster.

Rock lobster would seem to present a major opportunity for further work; again examining issues around business structures and increased opportunities for cooperation.

Recommendations

i) For rock lobster and abalone, further developing links with and support and input of the industry bodies (ACA and SRL Ltd), and their respective boards.

ii) Develop clear linkages between this project and the economic decision-making tool projects (prawn 2011/750; abalone - 2009/714.30, rock lobster 2009/714.10 and 2009/714.20.

iii) Consider an increase funding for the project to ensure adequate resources to complete workshops in the remaining fisheries. The work on prawns has been a relatively resource-hungry process and ~50% of the project funding has now been expended.

2.2.8 Policy shift to risk-based fisheries management Project: (2010/766)

The project is using a risk-based approach to analyse the regulatory frameworks (essentially the current management plans) used in seven selected fisheries, each of which have varying levels of complexity. Biological, economic and social risks will be covered under the analysis. Project implementation has been slower than expected, due to a combination of the complexity of the work involved and staffing resources.

The project, when completed, will provide a substantial legacy in terms of efficiency of management arrangements and the application of minimum effective regulation principles. This will reduce costs, improve compliance and increase profitability.

Constraints to adoption

The reviews of regulation within the trial fisheries stand the risk of becoming overly complex and difficult to interpret. 'Trading off' economic, social and biological risks under an EBFM framework will be a constraint, since WA Fisheries has a primary focus on delivering sustainable fisheries and does not have an explicit process for such an activity. There is no clear indication of the costs and benefits of achieving 'a minimum level of regulation that maximises social benefits'. The emergence of the Draft Act and the transition of Resource Use Plans has the potential to change substantially the intended direction of the project and its extension and adoption.

Conclusions

There is broad agreement that many of the current management plans would benefit from review and regulatory reform with a view to streamlining, standardisation (where possible) and removing unnecessary regulation. The project will develop a robust and comprehensive framework for assessing risk and reducing unnecessary regulation, apply it to a number of candidate fisheries and extend its use to all WA fisheries. The resultant MER regime will reduce the cost burden of fisheries/resource management to the Department, the commercial industry and the community as a whole.

The commitment by the Department to use the results of the project is clear, and WA has a long track record of the application of risk-based approaches to fisheries management.

Progress with project implementation has been problematical and communication with the CRC Secretariat has been intermittent at best. It is understood that this issue and issues and constraints raised during the review have begun to be addressed.

The ability of the project to provide a legacy for Australian fisheries depends on its ability to create change in WA and then to have effort placed into communicating this to other jurisdictions.

Recommendations

The proposed variation to project 2010/766 should address the following:

i) Sign-off by the steering committee on the final form of the risk-based process for reviewing and determining change to current fisheries regulation frameworks.

ii) Agreement on a revised and simplified risk assessment workshop process.

iii) Process for the continuation of adaptation of workshop processes; rather than running all seven in close sequence, suggest run a second pilot, analyse and modify, then run the remainder.

iv) Closer links with senor WA Fisheries staff dealing with fisheries policy reform.

v) Clarification of how the outputs of the project can be integrated into the new regulatory structure envisaged under the new act, including resource use plans, the introduction of devolved decision making and use of Annual Catch Entitlement (ACE).

vi) Determination of benefit cost associated with regulatory reform to encourage uptake and participation.

vii) Communication of the process to other states with examples of successful application.

2.2 Overall conclusions – Bioeconomic projects

The economic performance gap (lost profit) in Australian fisheries has been estimated at 36-46%. The Future Harvest theme attempts to recover this loss and assumes that half of this gap in economic performance (i.e. $200 million p.a.) occurs in CRC fisheries (i.e. is proportional to their contribution to the total GVP of Australian fisheries).

Generally, having economic objectives in a fisheries management framework is becoming the norm rather than the exception as it was 10-20 years ago. The Commonwealth has led the charge with the introduction of MEY-based target reference points and explicit harvest strategies and decision rules. South Australia, WA and Tasmania are now using economic considerations in the design and implementation of harvest strategies. The FH projects are making a substantial contribution to moving beyond using economics as a factor in the 'weight of evidence' approach to setting catch and other fisheries management settings and towards using economics in 'hard wired' decision rules.

The seafood production sector, and in particularly wild fisheries, are notoriously conservative and resistant to innovation in all but a few cases. It is widely accepted that even where there are clear benefits at a fishery level from adopting approaches based on economics or enhancement, gaining consensus or even majority agreement among fishers to implement such approaches is difficult. Achieving change in fisheries has been generally more successful through evolutionary rather than revolutionary approaches, involving learning, understanding and 'bringing industry along' through informed dialogue. It is this approach that is highlighted in most of the recommendations provided.

However, there does come a point when political courage, (especially to deal with those fishers or owners that do not want change) – is necessary to take the hard decision and in the face of the inevitable opposition from naysayers. Hence, gaining the understanding and support of senior fisheries managers, heads of agencies and, most significantly, politicians will be vital to achieving the scale of gain suggested by bioeconomic analysis.

The FH projects are making a substantial contribution nationally towards increasing both profitability and sustainability in Australian wild harvest fisheries. FH researchers are achieving this by using models and other methodologies to identify areas where increased production and profitability are available, and subsequently working with industry and Government to ensure adoption. This review has considered how this contribution or legacy can be enhanced.

2.3 Stock enhancement

The stock enhancement element of the FH program is aimed at increasing yields from wild stocks within existing fisheries. The projects cover:

- the development and economic evaluation of translocation protocols for moving low value, deep water, southern rock lobsters into higher yielding, higher value, shallow water fisheries;
- a biological and economic feasibility study on the translocation of Roe's abalone to recover a WA reef fishery decimated by a marine heat wave.
- the development of protocols for enhancement of WA green lip abalone fisheries through stocking of aquacultured juveniles and analysis of its economic viability (complete); and
- the development and economic feasibility analysis of hatchery production and ranching of high value sea cucumbers in NT.

Project 2009/744 – Propagation and sea-based grow-out of sea cucumber stocks in the Northern Territory

The initial focus on improving yields from the wild fishery and post-harvest processing systems has now shifted under this project to seeking innovative ways to increase the overall production capacity of sea cucumbers at Tasmanian Seafoods Pty. Ltd. (TSF).

TSF seeks to increase the viability of harvesting, processing, and marketing of sea cumber in Australia through the release of cultured juveniles into the wild population. This activity will augment the natural supply of juveniles and optimise harvest by overcoming recruitment limitation. A commercial hatchery and nursery facility in Darwin will have the capacity to produce 300,000 animals per annum and year round spawning and two releases of juveniles has been achieved. Contribution of the releases to the local population was detected, with promising growth rates. Post release mortality has yet to be ascertained.

The Darwin Aquaculture Centre has improved the settlement and survival of juvenile sea cucumbers through experimentation with different settlement substrates and larval diets. Preliminary work and a workshop on a bionomic model for sea cucumber ranching operation have been completed.

Given the strong position of TSF in respect of the wild fishery, including the harvesting, processing and marketing sectors and subject to gaining the necessary agreements with government a strong legacy of the commercial enhancement of sea cucumber is achievable.

Constraints to adoption

The new NT Fisheries Enhancement Policy states that stock enhancement will be considered only where other fisheries management methods have been demonstrated to be ineffective at meeting fisheries management goals. Currently, there are uncertainties concerning low recruitment vs. overfishing as a driver of stock condition of sandfish, which may reduce the ability of the project to obtain the necessary license to operate. After 12 months, there has been a tendency for animals to lose their markers, making it difficult to discriminate between wild and enhanced stock (a well-known problem with sea cucumber research).

The aims of the project appear increasingly to be technically feasible, although the commercialisation of the project continues to present challenges. These include the cost of production of juveniles and competition from other aquaculture producers. While TSF currently owns all licences to harvest sandfish and other sea cucumber species, there remains the possibility of the establishment of leased operations for the (preferred) ranching of sea cucumbers.

Conclusions

The project has produced encouraging results and most significant issues appear to be linked to commercial feasibility, and the need for increased clarity on the degree to which the NT Government will support stock enhancement if the decline in sandfish populations has been more a result of overfishing than reductions in recruitment. Ensuring that project outcomes and subsequent commercialisation aligns with the needs and aspirations of aboriginal communities is critical to obtaining government support.

The matter of commercialisation is primarily a matter for TSF and it is difficult to make recommendations in this regard.

Recommendations

i) Clarification of the extent of natural of sandfish recruitment.

ii) Clear statements by TSF concerning plans for community engagement and involvement as commercialisation occurs.

Project: 2009/710 Bioeconomic evaluation of commercial scale stock enhancement in abalone

The project is a true enhancement exercise, looking to increase production on reef that is suitable for holding greenlip abalone but receives little juvenile supply due to prevailing current movements. The project sought to use purpose-built hatcheries built on a cost-sharing basis (industry/CRC) to enhance the wild population, building on previous trials. It was shown that the project was technically and economically feasible. The outbreak of AVG in Victoria and later in Tasmania caused industry to turn away from the project and withdraw support due to perceived risks to the wild fishery. Subsequent studies have shown this risk to be of very low likelihood but with potentially catastrophic consequences.

There is a substantial legacy available from this project, should Government be prepared to take the lead and revisit the proposal. Currently, it appears unlikely that this will occur without industry support.

Constraints to adoption

The risk assessments conducted by the Department and WAFIC identified some high risks associated with abalone stock enhancement under current management arrangements. That said, it has been generally accepted that the risks also exist in the wild harvest sector, particularly where abalone are retained under stressful conditions. Industry consider that while the benefits of enhancement would be considerable, the possible cost in associated losses in the event of an AVG outbreak outweighed the benefits, making the risk, in their view, unacceptable.

Although policy development and measures are under consideration to reduce risk to acceptable levels, there remains strong biosecurity and genetic concerns among industry. While there are indications that the risk of a disease outbreak exists in wild populations, in holding facilities and aquaculture farms, the costs associated with a disease outbreak in the marine environment, whilst considered remote, are likely to be borne disproportionately by the wild harvest sector. This situation reflects the current status of the abalone wild harvest sector, which is considered a mature and well-developed fishery; whereas, whilst highly prospective, abalone aquaculture in Western Australia can be characterised as an industry in an earlier stage of development.

Conclusions

The risk assessments show that while likelihoods of the AVG virus occurring in a hatchery range from “negligible to “low” should no additional management measures be applied, and the consequences of detection (including biological, economic and environmental) are generally “High”, the resultant risks were considered “unacceptable” in two areas under current legal management requirements. The primary concern is that the virus could become established in a hatchery facility and then be more likely to infect wild stock through the release of hatchery released juveniles into the oceanic waters. The likelihood of this outcome occurring has been assessed as very low. This assessment is based on the hatchery management measures suggested by the risk assessment review to mitigate the risk to an acceptable level being adopted. Protocols are already in

place to ensure that any emergence of AVG in a hatchery would be detected. The placement of grow-out structures and juvenile releases could also be planned in a manner to both minimise the likelihood of transmission to wild stocks and limit the spread of any infection.

Recommendations

There are no specific recommendations made for this project; see overall stock enhancement conclusions at Section 2.4.

Project: 2011/762 Recovering a collapsed abalone stock through translocation

Following a catastrophic mortality of Roe's abalone in a portion of Western Australia coast during the summer of 2010/11 and a subsequent fishery closure, industry requested that the possibility of assisted recovery through translocation/stock enhancement be investigated. The project seeks to establish founder populations of Roe's abalone in areas of mass mortality, evaluate the genetic structure of existing and founder populations, compare natural and assisted recovery rates, and evaluate the genetic contribution of existing and founder populations to stock recovery.

It is not possible to comment meaningfully on the likely legacy associated with this project.

Constraints to adoption

The primary weaknesses of this project are the extreme logistical issues associated with the study area. The affected reefs are the most remote abalone reefs in Australia, being 700km North of Perth, and the weather conditions needed to carry out the translocation are extremely rare. Consequently the opportunities are few. To date there have been five attempted translocations, but in each case conditions were not ideal.

Climate change predictions suggest that there are likely to be recurrent warm water events, which are likely to undermine efforts to reseed stocks in affected areas. While feasibility of the method may be proven there remains considerable resistance to the use of re-seeding by other states, which will limit the uptake of results.

Conclusions

The project faces considerable logistical challenges, which are offset to some degree by the strong track record of WA fisheries in abalone stock enhancement/ recovery using translocation, stocking and restocking methodologies. The work has been requested by industry, which for its part, has agreed to support the closure essential to recovery efforts. The controversy in WA surrounding greenlip and the risk of AVG, which was sufficient to halt a technically feasible commercial initiative, is not present in this project. This is because translocation, based on local wild stocks, is considerably less controversial than hatchery-based stock enhancement.

The reef ecosystems that supported healthy populations of Roe's abalone still exist and retain their productive potential. The research provides an important

opportunity to test if the establishment of founder populations will be a viable tool for fishery restoration, including stocks that have been impacted by the increasing frequency of extreme water temperature events now being experienced.

There are no specific recommendations made for this project; see overall stock enhancement conclusions at Section 2.4.

Project: 2005/029 Factors limiting resilience and recovery of fished abalone populations

The project (now complete) provided direction on the feasibility of using translocated black lip abalone to enhance the recovery of severely depleted stocks. The project results were somewhat equivocal in that while the translocation was relatively successful at relatively low cost and achieved a clear increase in the density of abalone, a number of factors resulted in the conclusion that there was limited likelihood of the method being widely used in the future. The key problems were identified as: movement of translocated abalone away from the release site; little evidence of increased recruitment associated with translocation; the relatively small spatial scale of benefit of enhancement resulting in the conclusion that rebuilding depleted stocks beyond discrete reefs, using the methods explored under the project, would not be viable as an industry funded commercial venture; and the difficulties associated with securing a supply of wild abalone for translocation surplus to requirements of the fishery.

The project added to the knowledge base on the translocation of abalone but did not provide a clearly identified legacy.

Constraints to adoption

The project faced substantial difficulties following a successful translocation. These included a storm event which severely impacted some of the sites, tag loss making identification of translocated abalone for the purposes of determining survival rates and level of emigration difficult. As with many of these types of projects, identifying project outcomes within the life cycle of the project was difficult.

In Tasmania, a number of other factors including the loss of kelp and ingress of the long spined sea urchin, Centrostephanus, has reduced the productivity of a number of reefs on the East Coast and shifted the focus of abalone research interest in restoring depleted areas. The economic viability of commercial translocation is very unclear and there is no definitive cost/benefit analysis of translocation available on which to base investment or management decisions. If translocated from areas of slow growth (i.e. mature abalone below the minimum size) costs will be minimal, but if commercial sized abalone are used, the economics of the operation become questionable.

Conclusions

The project added to the knowledge base on the translocation of abalone but did not provide a clearly identified legacy.

Stock enhancement of depleted abalone stocks has proved to be a challenging task. The recent international Abalone Symposium (2012) held in Hobart underlined the inherent difficulties, generally concluding that the best management option was not to allow stocks to be depleted to levels where natural recruitment, even with no fishing mortality, would be unable to recover the fishery in a reasonable period of time. A similar conclusion was drawn by a group of abalone specialists advising Victorian fisheries on rebuilding options for the Victorian abalone fishery, which among other advice, recommended:

i) A mix of rebuilding options. The most cost effective and widespread stock rebuilding outcomes will come from the contribution of appropriate fisheries management actions that includes flexible and enforceable size limits, and closures that ensure a spawning biomass adequate to meet fishery management objectives is developed and maintained.

ii) In areas where there is no natural recovery or where natural recovery is unlikely to occur within acceptable timeframes, spatially focused stock enhancement strategies (i.e. seeding and translocation) warrant consideration.

iii) Where increasing stock biomass on a small scale (i.e. reef code or smaller) is required and local abalone stock are available, translocation should be considered.

There are specific recommendations made for this project; see overall stock enhancement conclusions at Section 2.4.

Project: 2011/744 Commercialising translocation of Southern Rocklobster

The project builds on previous FRDC/Seafood CRC work, which established the commercial feasibility of translocation and identified a range of other benefits to the broader coastal ecosystem. The concept is simple and involves shifting small lobsters from an area of very high density, where they do not contribute to the harvest because their growth is stunted by competition for food, to places where they were depleted and high growth rates can be achieved.

The project aimed to move a total of 100,000 lobsters per year from three stock assessment areas off Western Tasmania to areas to the north along the same coastline. This was eventually achieved (with some difficulty) by March 2013. Letting the contract for translocation has proved to be difficult with social pressure applied on potential applicants by some fishers who object to the project.

The TACC on 2012/13 was maintained at a higher level (50 tonnes) than would have been the case if translocation had not been supported by the TRLFA and industry and gone ahead. The cost to industry per quota unit was $10 which provided them with an increase in quota of 5 kg per unit, which can be leased at $20/kg. Thus the industry funding of translocation provided a ten-fold return on investment.

Implementation of the project relies heavily on industry cooperation, which can be fickle. Industry has a number of misunderstandings and misgivings about the project some of which have been translated into misinformation in an attempt to undermine the project. As a group, rock lobster fishers, while quick to see the

benefits of translocation to the fishery as a whole, are frequently unable to translate that benefit into the enterprise level. Government support for the operational and governance frameworks that will need to sit within the management of the fishery will also be required.

Particular concerns include the impact of removing rock lobsters from areas on catch rate and a concern that areas of translocation releases will attract fishers and overly deplete stocks in those areas. Both are perceptions rather than realities in a fishery where total catch is limited. As discussed above, it has been difficult to get significant interest in undertaking translocation and a greater incentive (100% more, $2 per lobster) was required to complete the second part of the first translocation.

Conclusions and recommendations (to enhance uptake and contribute to FH legacy)

The project is only just at the half way mark. As the intention of the project is to allow managers of the fishery and the industry to assess whether translocation is a useful tool and to make decisions on the wider fishery in the context of translocation, the scope for comments about ways to improve adoption of the outcomes are limited as the detailed outcomes are yet to be determined. The potential of the project is clear and while substantial uncertainties exist they relate more to perceptions, governance issues and operational procedures rather than technical feasibility.

Keeping the industry fully engaged, informed and supportive will be pivotal to the success of the project and eventual adoption of translocation as a regular part of maximising the productivity of the Tasmanian rock lobster stock. The potential for a relatively small minority of industry to undermine support for the project through misinformation and social pressure (on radio, industry meetings etc.) is very real.

Recommendations

i) Listen closely to concerns at an early stage and proactively provide contrary evidence.

ii) Focus on "how" to explain / provide contrary evidence to concerns, at an individual fisher level, and similarly for "selling the benefits", determine and provide information that is meaningful for an average fisher and how such information can be best presented.

iii) Increase the remuneration provided to make translocation operations a desirable activity (relative to say, lease fishing); this will mean industry may have to pay more, increasing the need to make the cost/benefit argument clear.

iv) Provide business mentoring for the industry, which will need to manage the operations themselves, once the CRC withdraws.

2.4 Overall conclusions – Stock Enhancement projects

In the past, stock enhancement has not had a good record of success, due mainly to several ambitious but poorly conceived projects failing. However, stock enhancement is now increasingly being put forward as an alternative

management tool in certain circumstances, such as in the event of severe stock depletion due to overfishing or environmental change. It is considered particularly appropriate in areas where natural recovery and recruitment are unlikely to rebuild stocks within acceptable time frames, if at all. Another novel use of enhancement is where natural systems inhibit yield from a fishery, such as areas of limited food, or where there is competition for space. By shifting animals into more productive habitats, an increase in yield can occur. Implementing successful enhancement programmes will require well-designed business structures and realistic financial targets, based on thorough feasibility studies that consider both biological and economic issues.

The science of stock enhancement is usually more complex and less developed than fisheries science because of the need to know much more about the ecology and productivity of localised stocks, as well the genetic, aquaculture and biosecurity aspects. Consequently, it is generally long-term strategic work and to be effective, requires commitment to sufficient trials and studies to get to grips with complex, poorly understood systems.

In the case of the Tasmanian abalone example, the research was essentially a one-off pilot study using a release of 6,000 abalone, the equivocal results of which were somewhat confounded by the loss of kelp beds (and possible reduced productivity), severe storms and a short time period over which to observe any increase in recruitment. The WA greenlip work was based on four separate releases of 30,000 abalone into a 'best functioning' habitat with post-release surveys detecting a sustained density increase. This led on to a potentially successful project that was halted for political/administrative reasons rather than technical feasibility. Similarly with the rock lobster translocation trial and the second, commercial pilot stage which is already considered (from the results of modelling) to be contributing to productivity within the fishery.

As suggested in the opening paragraph of this section, the potential of fisheries/stock enhancement is increasingly being discussed, but its development is somewhat constrained by the wild fishery paradigm based on controlling harvest and thereby maintaining adequate breeding biomass to achieve relatively constant productivity. This is not necessarily true, with a recent published review of well known fisheries (n = 230)[4] finding that around 40% of fisheries are shifting their productivity constantly, presumably in response to something unrelated to abundance or fishing.

Additionally, governments have been wary of fisheries enhancement, mostly, it appears, due to opposition from the wild fishery sector which generally views this activity as a clear threat rather than an opportunity. Subsequent AVG outbreaks have served only to enforce their views concerning the former. For fisheries enhancement to succeed, it appears there is a need for:

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[4] Katyana A. Vert-pre et al. *Frequency and intensity of productivity regime shifts in marine fish stocks.* PNAS 2013, 110 (5), 1779-1784

- acceptance that a long-term, strategic view is necessary to achieve cost-effective approaches;
- acknowledgment by government that that fisheries enhancement is an important fisheries management tool (an assisted recruitment process), to be supported by effective policy and education;
- clear policy statements confirming the point above;
- strategies to show how an enhanced or restocked fishery would be managed, what changes in governance would be required and how interactions with the wild harvest fishery would be managed;
- clarification of access rights, particularly in relation to quota fisheries;
- hatchery production systems designed for and geared to enhancement rather than aquaculture; and
- use of 'success stories' to increase support.

Some of these issues have been addressed by the fisheries enhancement policy development under FH activities, elements of which have been implemented or are under consideration in NT and WA.

2.5 Other projects

Five additional projects were funded under Future Harvest. These projects were not analysed to the same level of detail as the bioeconomic and stock enhancement projects.

2.3.1 2009/746 Could harvests from abalone stocks be increased through better management of the size limit / quota interaction?

Tasmanian Seafoods (TSF) has consistently emphasised the need to consider which areas of the fishery would be better managed using simple indicators based on classification of shell traits (new, medium and old shell) and the proportion of abalone within 5mm of the size limit. Interest in these alternative indicators has been driven by observations of landed catch from certain areas in the fishery that can have predominantly old/fouled shells, darker meats, lower meat yield and poorer survival in freight. It is argued that excessively low harvest rates and inappropriate size limits have not removed these allegedly old, poor quality and 'stunted' animals, reducing potential yields from the fishery. Put another way, the size limit/quota (catch) balance is, in the view of TSF, set incorrectly for these areas. Further, TSF considers that if these areas were 'thinned out', density dependent factors will result in faster growing, cleaner and more valuable abalone. This hypothesis is not shared widely across the fishery, but there is agreement and support of this project as a means of resolving the issue.

For the project to drive change in the fishery, there will be a need for the research to demonstrate i) robust evidence and scale of increase in productivity with thinning out of abalone; and ii) evidence that shell attributes reflect population density; and iii) that basing management decisions on shell data would not expose the fishery to recruitment overfishing risk.

The project began in mid 2012. A field program at Hunter Island, North West Tasmania commenced in August 2012, aimed at comparing sites with normal and high levels of fishing pressure (impact sites). The impact sites will be more heavily fished at a reduced size limit so that the benefits of reduced density on fish quality, growth rates and meat quality become apparent. It is hoped that this density manipulation by fishing can be completed by the end of March 2013. 200 abalone shells from each of six sites have been graded by TSF.

When the project is completed, it will resolve a long-standing controversy that there is substantial foregone yield to the fishery in areas of small, slow-growing abalone due to allegedly incorrect size limits and catch settings. If the TSF hypothesis is true, a legacy of improved yields and increased revenue will result. If not, the areas in question will be confirmed as having low productivity, and the risk to the fishery of unsustainable fishing under inappropriate catch and size limit settings will be avoided.

The results of the research will be fed directly into the scientific and management advisory committees in Tasmania, which provide advice to the Minister on issues such as catch and size limits. Having some form of relatively rigorous and scientifically defensible information on this issue will guide management decisions into the foreseeable future.

The general results of the project will have some applicability to other Australian blacklip abalone fisheries where there are similar controversies.

It is believed there are no other legacy issues associated with the project.

2010/740 AS-CRC PDRF Project - Fisheries Economist

This project provides funding for a post-doctoral research fellow (PDRF) now employed by the CRC to assist on several specific projects within the FH theme, including contributing to the economic evaluation of past and future projects.

The position is required since providers in the CRC have only sparse coverage of staff with resource economics training and every project in the FH theme involves fisheries economics to some extent. Accordingly, this individual provides additional support and is contributing widely to theme activities.

Specific allocations of PDRF time is included within the SRL and abalone projects, with around 40% each being allocated to each, with the balance of time on other FH projects and their analysis and extension

In terms of legacy, the position is also expected to contribute to the development of seafood industries in Australia beyond the life of the CRC. The FRDC have previously noted the shortage of fisheries economists in Australia and have funded a major project in this area at UTAS[5]. Work in this project includes the creation of "FishEcon" which is a new network of researches and institutions working on Australian fisheries economics. Development of fisheries economics expertise will contribute to reducing the gap between current and best performance in Australian fisheries.

[5] Project 2008/307: Building economic capability to improve the management of marine resources in Australia.

2010/704 Maximising value by reducing stress-related mortality in wild harvested abalone

This project addresses the problem of post-harvest mortality in wild caught abalone, and how harvesting transport and holding practices could be improved to increase economic yield. By agreement, this project was not reviewed.

2008/900 Improving profitability in the Western Rocklobster fishery using a new rock lobster trap

Under this project, which is now complete, three new pot designs were evaluated. It was concluded that one particular pot design (side entrance batten pot with a broad base) was particularly effective if used for longer pot soaking times during the whites phase of the Western Rocklobster fishing season. Under these conditions, use of this pot was found to have the potential to increase the catch for a similar number of pot lifts made using a standard pot by 50%, and to catch fewer under-sized lobsters. The conclusion was that the introduction of the pot could lead to "multi-million dollar savings in fishing costs" and a "reduction in the handling of sub legal discarded lobsters, running into hundreds of thousands of animals", which in turn would have a beneficial flow-on effect in terms of future catch through reduced discard mortality rates. It was noted that it was necessary to qualify these statements by obtaining more data to provide greater confidence in these results.

While the project did find a pot that under specific circumstances was better than that currently employed as indicated above, the poorer performance of the new design under other conditions meant that fishers would need two sets of gear, and the costs of this appear to outweigh the benefits. The project therefore failed to produce a pot that has increased the economic efficiency of the industry.

However, as the fishery has switched to an output control (quota) system, where the unit of effort is less important for management purposes, there is likely to be on-going quest for ways and means of increasing efficiency. The outcomes of this project will contribute to that quest. The WA Department of Fisheries remains interested in pot development and may allow fishers to start experimenting under "controlled conditions" via the small mesh pot program. A number in industry have expressed interest in examining larger pots, an aspect not covered in the previous project. Any 'new' pot that is going to be widely used would have to be calibrated against the standard pot currently used.

While the use of better pot designs and, in general, unlimited numbers of pots, appears obvious under quota, regulations covering these issues remain complex and comprehensive in most states. The most significant barriers to the introduction of measures to allow these changes are associated with a resistance to change within industry.

The project seems unlikely to have significant legacy for the short term but fisheries should be expected to move to more efficient gear through time. WRL have shown a pattern of willingness for slow steady changes in their quota management system and this may extend to gear restrictions at some point. Enforcing the use of inefficient pots implies regulated increase in fuel

consumption and community pressures to reduce emissions may become important at some point.

2006/220 Spatial management of Southern Rocklobster fisheries to improve yield, value and sustainability

This project was the forerunner for Project 2011/714 above and was transferred from FRDC funding to the CRC, and is now complete. Three approaches to the spatial management of a fishery with large-scale geographic variation were evaluated with all appearing to provide opportunity for sustainable increase in the value of harvests.

It was shown that regional size limits better suited to local growth rates could increase yield, especially in areas that are growth-under fished. However, difficulties in agreeing on boundaries within the fishery and the greater attractiveness of other options has meant that this initiative has not been progressed to date although it remains an issue for the fishery with a discussion again scheduled for their next annual meeting.

The relative attractiveness of shallow-water 'red' rock lobster results in relatively high harvest rates in inshore and other preferred areas of the fishery in Tasmania. The off shore 'white' or 'strawberry' animals are relatively lightly exploited. The use of additional catch/quota as an incentive to drag a portion of the catch into deep water was implemented with some success although record low recruitment into the fishery and general lack of industry support for the approach has led to a hiatus in this initiative after two years of trials.

Of the options examined, greatest gains were considered possible through the translocation of lower yield and value lobsters from deep water to shallow water to increase yield and value as evaluated through a large-scale pilot experiment under the project. The success of the experiment led directly to project 2011/714 (see above).

While the other two options (size limits that reflect growth rates in different parts of the fishery and incentives to better distribute effort across the fishery) remain on the table and will continue to inform the debate on improvements to manage the fishery.

The changes in size limit that were examined seem likely to be reinvigorated by trends in the market. In early 2013 fishers were receiving up to $40 extra per kg for small lobsters in NZ than in Tasmania, which means benefits from spatial management is now far greater.

3. Cross-cutting legacy activities

3.1 Key issues

Change management in what is an extremely conservative industry is a major challenge. The review has highlighted a number of key issues that need to be addressed to increase the FH legacy. Most significant of these relate to the effective communication of what are, in many cases, complex concepts.

- **Use of success stories.** Promotion of positive change in the culture of fisheries management by taking success stories from bioeconomic and

stock enhancement projects and using these to promote the same approach in other fisheries, using a variety of mechanisms. Wherever possible and appropriate, industry advocates and industry channels of communication should be used to extend project outputs and outcomes.

- **Engagement of management agencies**. Greater cooperation amongst fisheries management agencies in different jurisdictions will avoid 're-inventing the wheel' and promote the use and adaptation of existing bioeconomic projects/management strategies wherever possible. The CRC has been successful in creating interaction between different jurisdictions and the challenge is to maintain momentum. Gaining the support of fisheries managers and heads of fisheries agencies will essential to achieving legacy outcomes.
- **Education focus.** Increased use of bioeconomics and economic decision support tools has created a need/demand for education to address knowledge gaps and promote economic thinking across all levels in fisheries. These include fishers and enterprise owners, many of who remain to be convinced that project outcomes have the potential to make their operations more profitable.
- **Deal with legislative/management barriers.** There has been some momentum in novel fisheries management approaches that affect production but this could easily stall between development of the tools/strategies and their adoption and formal use in fisheries management plans and other similar instruments. The investments in enhancement and translocation have prompted change in policy in some jurisdictions but an additional effort will be required to deal with the highly restrictive legislation and systems that are a barrier to new approaches.
- **Clarify the role of government**. Jurisdictions are frequently reluctant to take the lead on management decisions based on economic indicators and most consider biological sustainability as the key role of Government. Fisheries officials and ministers are increasingly wary of the political consequences of unpopular decisions and are only prepared to make decisions that directly effect economic efficiency where there is support by industry consensus.
- **Improved reporting.** Collection of economic data from fisheries other than those in South Australia has been inconsistent, sporadic and at times non-existent. Long-term, cost effective and innovative economic data collection, agreed with industry is necessary to support a future legacy for the use of bioeconomic models and associated decision-making tools.
- **Use of industry groupings/associations.** Industry talking to industry about the potential benefits of economic initiatives can be more effective than efforts by economists, researchers or mangers who may be seen to be biased in their promotion.
- **Use of Industry leaders.** Industry leaders, and in particular some young fishers see the value of MEY approaches and have a better understanding of cost structures, profitability and the impact of exploitation and catch

rates. This vision should be harnessed in legacy activities and used to change the mind-sets of the conservative fishers.

- **Involve industry in modelling exercises.** There is limited industry faith in all forms of models, generally based on the fact that predictions do not always match reality, even where the changes are clearly outside the parameters of the modelling exercise. Ensuring industry engagement in 'ground truthing' inputs and involvement in deciding on candidate model scenarios are important actions to break down mistrust in models. Providing the outputs from the bioeconomic model in ways that fishermen can understand, e.g. catch rates, TACC, profits etc. will be highly useful to the discussions and fishers will see the benefit in the models, understand what the models can be used for, and then get on board to use models more widely.

3.2 Legacy activities

The following cross-cutting activities are recommended for consideration as additional CRC activities to increase the legacy from FH projects.

Economic report cards and economic monitoring framework

There has been recognition (e.g. at AFMF meeting, December 2012) that economic, and, to a lesser extent biological, reporting from states has been at best inconsistent and at worst, non-existent. There is increasing interest in developing basic frameworks for the collection and reporting of fisheries economic data. Such reporting could be used in future versions of the national fisheries status report. The current EconSearch methodology as used in SA and in current FH projects, while effective, is unlikely to be funded in its current form in all states requiring this data.

At the state level, effective economic performance monitoring and reporting will be essential as MEY-based approaches and associated target reference points are increasingly incorporated in fisheries management plans and harvest strategies.

Recommended Activity 1
A review and analysis of current economic data collection methods, to include recommendations for achieving minimum data collection standards and the development of innovative and cost effective data collection methods.

Outputs

- A standardised template for the collection and reporting of key economic data on major fisheries.

Outcome

- State governments committed to the collection of standardised economic data sets for major fisheries (e.g. rock lobsters, abalone), at least every two years.
- Fisheries management decisions based on robust, reliable and current economic data.
- Fishery performance tracked with economic data.

Extension plans

This review has found that there is significant gap between researchers and industry and fishers will need to be convinced that bioeconomic modelling and fisheries enhancement hold tangible benefits. Very few researchers are charged with, or are capable of, conveying a convincing message to industry concerning bio-economic advice. In some cases individual researchers are willing and able to act as advocates but this is the exception rather than the rule. As a result we have:

- ***research outcomes*** that increasingly demonstrate lost economic opportunities,
- ***industry sectors*** that are focused on short-term tactical issues and are divided so that it's difficult to address larger changes to their operations, with factions that are inherently suspicious of bioeconomic models and fisheries enhancement and the changes in management they suggest; and
- ***management agencies*** who are supportive of industry driven initiatives to improve economic efficiency (and increasingly fisheries enhancement initiatives), but are generally reluctant to force increases in economic yield by taking the lead.

The key will be to showing how individual enterprises could gain from implementing the sorts of changes suggested by bioeconomic modelling and fisheries enhancement. This requires significant effort to be applied at the owner level where there is a need to engage in dialogue, using examples of the gains possible from basing decisions on longer term economic outcomes. It needs to be clear that increases in economic yield flow to the owners of the quota fisheries, not the operators.

Some of the FH projects have planned for workshops and various publications to be produced, which, combined with the range of activities suggested below will assist in extending the research. For each project however, there is a need to re-examine the extension strategy and issues raised in this report and consider how to best implement and coordinate project based and program (FH) based extension activities.

Recommended Activity 2

Development and delivery of a project-based extension programme aimed at industry owners (primarily in the capture sector) to extend research projects and outcomes. The development of these programmes should involve an appropriate team including the Principal Investigator for each project, the relevant fisheries manager and industry executive officer (e.g. TRLFA CEO). The Team will review the current project extension plan and make changes as appropriate.

Outputs

- A revised project extension plan that recognises issues within industry concerning the use of research outputs and reviews the recommendations made in this review.

Outcome

- Researchers, industry and fishery managers aware of the specific road-blocks to making the changes suggested by FH projects.
- Greater uptake of FH project outcomes.

Industry exchange programme

Learnings from case studies or instances where MEY and other approaches aimed at improving economic outcomes are not well promulgated to industry. The best medium for achieving effective transfer of knowledge and experience is by using industry leaders/innovators to share their experiences and successes first hand. e.g. Northern prawn industry leaders talking at Abalone industry meetings or WA rock lobster fishers talking at SRL industry meetings. The participants of the exchange beneficiaries should be selected grass roots fishermen rather than industry leaders.

Recommended Activity 3

Roadshow of research leaders and industry leaders visiting key fisheries representative bodies (e.g. leaders/reps of Northern Prawn fishers, WRL and Cray 8, Caribbean lobster visiting abalone, SRL and prawn fishers in Hobart, Adelaide, WA, QLD) including web casts.

Outputs

- A series of thought provoking and targeted presentations based on peer experience of initiatives to improve the economic outcomes of fisheries.

Outcome

- Communication between fishers and new perspectives established.
- Industry is more receptive to, and supportive of moving to MEY approaches.
- Industry support for change, including the inclusion of economic decision rules in harvest strategies.

Handbook for fishers/managers

While the Master Class (Project 2010/714) has been very useful for promoting a greater emphasis on economics in fisheries management, there is a need for a document with a wide industry reach to provide the basics of fisheries economics, tied closely to real-world examples. In particular, success stories, including those associated with FH projects, should be used together with a liberal assortment of photos and direct quotes from fishers. Where there is clear evidence of improved economic (and, usually, biological) outcomes such as the SBT and Northern prawn fisheries and FH fisheries, this should be included. Associated with this handbook, a video should be produced, along the lines of that developed under FRDC project 2010/306 '*Empowering industry through improved understanding of stock assessments and harvest strategies'.* The handbook and video proposed for FH could be promoted by the SeaNet extension team.

Recommended Activity 4

Produce handbook and videos on fisheries economics (using research and industry leaders identified in previous activity) to be introduced and launched at roadshows and Heads of Agency workshop (see below).

Outputs

- Handbook and associated media outlining the benefits of incorporating economic objectives in fisheries.

Outcome

- Industry is more receptive to, and supportive of moving to MEY approaches.
- Industry support for change, including economic decision rules included in harvest strategies.

Heads of Agencies round table

There is considerable value in peer-to-peer interaction between fisheries jurisdictions. Discussion of the value of, and government role in, the introduction of management approaches based on MEY at the heads of Agency level where key policy decisions are taken would be particularly valuable. These individuals are, however, under considerable pressure and any forum to discuss MEY/bioeconomic approaches would need to be highly targeted, relevant, and most importantly, supported by Heads of Agencies.

In recognising time constraints on senior executives it is acknowledged that this activity may not proceed, but rather than dismiss the initiative out of hand, it is suggested that it would be more appropriate to raise the possibility with AFMF to determine support. The round table workshop could be run before or after an AFMF meeting or, if preferred, as a stand-alone meeting.

If this workshop was successful, and the demand was determined, a similar meeting on fisheries enhancement could be conducted.

Recommended Activity 5

Propose (to AFMF) a one-day round table workshop that would target the heads of agencies and present the experience gained through FH projects and other advances in fisheries economics. This would be a participatory workshop at which heads of agencies and FH researchers would exchange ideas and initiatives, highlight lost opportunities and show how progress can be made. Discussion between participants and an exchange of experience, particularly at the fisheries policy level would be particularly valuable. Such a workshop could provide an opportunity to launch the handbook for fishers/mangers (see Activity 3 above).

Outputs

- A cross-jurisdictional high-level workshop for fisheries executives.

Outcome

- Heads of Agencies aware of the current suite of economic approaches to fisheries management.

- Fisheries policies reflect the experiences and innovation arising from FH and other fisheries economics initiatives.

Journal paper

The FH projects have been particularly valuable in demonstrating the challenges and opportunities associated with implementing bioeconomic approaches to fisheries management. Much of the discussion of these issues has been confined to technical reports and other project-linked documentation with limited material appearing in the refereed literature.

While industry-based initiatives tend to place little value in journal papers, a thorough examination of the process of change management in Australia towards the increased use of economics in fisheries management would be of value. Such a paper would include examination of the importance of clear fisheries management objectives (economic vs. social/environmental) the collection of economic data and how this can be included in assessing fishery performance, building economics into management targets/harvest strategies, and how targets respond to changing costs and prices.

This activity would be achieved by making an offer (say $3-4,000) to a motivated and highly competent graduate student studying in a relevant field. That student would produce the paper under the supervision of one or more FH PIs.

Recommended Activity 6

Commission of a journal paper (e.g. Marine Policy) that debates some of the issues that cause roadblocks to the adoption of economics in fisheries policy and management in Australia, and suggestions for dealing these issues.

Outputs

- A paper published in a refereed journal.

Outcome

- Awareness of policy/implementation aspects of FH initiatives to a wide audience of peers.
- International exchange of ideas and initiatives.

Policy and business case reviews for stock enhancement.

Stock enhancement appears to be at a crossroads in terms of political acceptance. Opposition by the harvest sector aided by the severe impacts of abalone viral ganglionitis (AVG) have successfully 'headed off' what, on paper are potentially successful stock enhancement approaches, the WA abalone sector being a case in point. Despite this, there is growing interest in enhancement within the states, and a number of policy documents have been recently developed. There is a need to draw together the current issues, and experience as a means of moving forward. These issues include access rights and links between wild and enhanced/ranched fisheries; sharing the risks and liabilities; the 'free rider' problem; and who funds, seeds and harvests?

Business case reviews of enhancement will help obtain economic insights into the benefits of continued translocation (e.g. SRL), fisheries enhancement (e.g. abalone and sea cucumber). The goal would be to promote success stories in enhancement to state agencies and fishing industry. The medium would be in the form of a handbook dealing with fisheries enhancement pitched at a similar level to the successful handbook by Tor Hundloe on *Valuing Fisheries; An economic Framework*[6].

The outputs of this activity could be used to initiate a discussion thread 'Conversation', which is a website that kindles discussion of amongst other things, environmental policy issues, at a relatively informed level. The issue would be the use of parts of the marine estate as MPAs (marine production areas), to be enhanced in much the same way as one would in terrestrial farming situations.

Consideration should also be given to linking the handbook to:

- *The* 5th International Symposium on Stock Enhancement and Sea Ranching *due to be held in Sydney in 2015; and*
- The recent review of marine stock enhancement and sea ranching in Australia[7]

Recommended Activity 7

Commission reviews from SRL translocation, abalone enhancement and sea cucumber ranching, NZ abalone, North American salmon enhancement and other relevant examples.

Outputs

- A handbook of case studies to illustrate the benefits and challenges associated with stock enhancement

Outcome

- Awareness that fisheries enhancement 'works'.
- Increased use of fisheries enhancement as a means of increasing production/productivity.

Re-establishment of the annual fisheries management workshop

Researchers and industry are generally well served by existing forums at which FH issues can, and are, discussed on a relatively regular basis. There is no such forum for on-going exchanges and meetings between senior fisheries managers, other than an ad-hoc arrangement that brings together SRL fishery managers. If the annual fisheries management workshop was re-established, it would provide a valuable avenue for the promotion and discussion of key FH issues, including the role of economics in fisheries management and stock enhancement.

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[6] Hundloe, T. 2002. 257pp. University of Queensland Press, St Lucia, Qld.

[7] Loneragan R, et al (in press) Stock enhancement and sea ranching in Australia: future directions and a synthesis of two decades of research and development.

The aim would be to make the workshop self-funding following 'seed' funding by the CRC (with agencies providing some funding support for travel and accommodation). FRDC may also provide funding for international speakers.

As with Activity 4, confirmation of support from AFMF should be obtained. AFMF advice on how best to integrate this activity with the AFMF Fisheries Management Committee should also be sought.

Recommended Activity 8

Create a project to run one or two forums dealing in the first instances with CRC issues (bioeconomic modelling and enhancement) and gain commitment from heads of agencies (AFMF) to support continuation of the workshop beyond the life of the CRC.

Outputs

- One or two workshops dealing with contemporary fisheries management issues, with focus sessions on bioeconomics, fisheries enhancement and capacity building.

Outcomes

- Line fisheries managers are informed about, and supportive of, the explicit application of economics to fisheries management.

Session/involvement in 2014 IFFET Conference

The International Institute of Fisheries Economics & Trade (IIFET) was founded in 1982 to promote interaction and exchange between people from all countries and professional disciplines about marine resource economics and trade issues. It is an international group of economists, government managers, private industry members, and others interested in marine resource issues. IFFET members from over 60 countries work in, and exchange information concerning marine resource economics, fisheries management, seafood trade and markets throughout the world, aquaculture economics, and fisheries development. IIFET holds a major international fisheries economics conference every two years. Australia, led by CSIRO, has put together a successful bid to host the IIFET conference in 2014. With Australian fisheries management in the spotlight given the current focus on economic objectives and associated management strategies, this conference will provide an outstanding opportunity for Australia to showcase the work of the FH projects and other developments.

Recommended Activity 9

Express in-principle support to sponsor a session showcasing the FH projects at the 2014 IIFET Conference, and develop a funding application for CRC funds.

Outputs

- Presentation of FH successes at the premier global fisheries economics forum.

Outcomes

- Awareness of global initiatives in the application of economics to fisheries

management decision-making and the commercial aspects of fisheries enhancement.

- Management of FH fisheries (abalone, rock lobster and prawns) enhanced and improved.

Training for fisheries managers – the next generation

FRDC initially funded short course training for fisheries management at the AMC, which subsequently morphed into graduate course offerings. These provided an excellent avenue for training and upgrading the skills of fisheries managers. Other than the Australian Maritime College (AMC) degree and post-graduate courses in fisheries, which have been continuously downgraded and diluted over the last 10 years, there are no dedicated fisheries management courses available in Australia. As a consequence fisheries managers now tend to learn on the job. While probably outside the general remit of the FH programme, there is a clear need to increase the capacity of fisheries managers to be aware of, understand and, as appropriate, use the bioeconomic and fisheries enhancement products arising from FH projects.

Recommended Activity 10

Undertake a review of training opportunities for fisheries managers, with particular reference to fisheries economics, fisheries governance, access rights and resource sharing. The review should incorporate the results of FRDC project 2008/306. *Building* economic capability *to improve the management of marine resources in Australia*

Outputs

- A review of current training needs and opportunities for fisheries managers including gap identification and recommendations for building appropriate capacity.

Outcomes

- Line fisheries managers are aware of the policy, legislative and regulatory associated with the application of:
    - fisheries economics via harvest strategies and decision rules; and
    - fisheries enhancement.

Presentation to Seafood Directions

Seafood CRC could sponsor a session at upcoming Seafood Directions Conference (Port Lincoln, 27-30 October 2013) including a presentation on the work of the FH programme, with a focus on:

- fisheries where decisions have been taken based on bioeconomic information and profitability has been increased; and
- the development of stock enhancement policies as an essential precursor to commercial activity.

In addition, two industry leaders could present individual success stories (e.g. rock lobster translocation and abalone/sea cucumber enhancement).

It will be necessary to approach Seafood Directions organisers as soon as possible to negotiate sponsorship of a presentation or session at the conference.

Recommended Activity 11

Presentation of FH research programme, including success stories, constraints to implementation of recommendations arising and plans for overcoming them.

Outputs

- Presentation to Seafood Directions Conference 2013.

Outcomes

- A wide range of industry stakeholders are aware of the of the work of FH, its potential and roles of researchers, industry and fisheries managers in improving the profitability and productivity of the target fisheries.

Attachment: Project Reports

Project Reports

A. Bioeconomic modelling and improved management systems

1. Project 2009/714.20 – Bioeconomic decision support tools for Southern Rock Lobster

Project status:

This project has used and extended the fishery population model used for stock assessment in the three States, combined with economic modelling, to provide economic guidance for the management of rock lobster fisheries. The project has been unable to effectively engage the Victorian industry due to low returns to the economic survey. Consequently, Victoria will not be included in the project in terms of specific scenario testing. However the fact that a common stock assessment model is now used across the three states means that developments made by the project could be applied to Victoria at a later date should their industry want to become involved. The Tasmanian response to the survey, while poorer than expected, was sufficient to allow economic analysis to proceed. South Australia, having a good time series of economic data is in a better position.

The initial form of the bioeconomic model is now complete and provides managers and stock assessment scientists with an ability to test a wide suite of proposed management strategies and compare their economic performances, most usefully in terms of NPV. By updating the model code, the project will be able to run multiple strategies at the same time (e.g. comparisons of size limits and catches/fishing mortality).

The project is proceeding at different ways in the two states involved; a brief summary is provided below:

Tasmania

The model has been used extensively to provide economic projections based on various management measures, including changes in catch level and minimum sizes and area/time closures. These projections have been developed at the request of a sub committee of the industry association (Tasmanian Rock Lobster Fishermen's Association – TRLFA) and the RL Fisheries Advisory Committee. These committees have, in effect, acted as steering Committees in Tasmania.

The acceptance by industry and government in Tasmania of using outputs from the bioeconomic model, had made progress and reached a peak in 2009 when the majority of industry voted on a three year series of TAC cuts to implement a harvest strategy based on bio economic modelling, with key indicators being a CPUE target and associated improvement in NPV. This harvest strategy was supported by the Department and Minister of the day as it was also in line with agreed performance measures and fishery management objectives.

However, in 2010 and 2011, the continuing declines in recruitment resulted in more severe adjustments to the TAC than those envisaged under the three-year industry harvest strategy. This led to a perceived loss of confidence in the model by industry and questioning as to the validity and robustness of the inputs. While

IMAS researchers expended considerable effort into trying to explain this to industry it can be an uphill task to change fisher perceptions.

Modelling work under the project extends the capacity to look at additional management options where fixed and variable costs respond differently. The most important application is for examining options for season openings/closures where shorter seasons better target periods of high price but capital is deployed less efficiently.

In industry's view, achieving the full legacy of the project will be a long process due to the reluctance in some instances for fishers to accept change.

South Australia

While the model has been completed, the project is at a much earlier stage in South Australia. The newly formed Rock Lobster Fisheries Management Advisory Committee is acting as the steering committee for the project. While there is no explicit economic reference point in place within the current harvest strategy, the general intention is to move towards one within the next three years when the management plan is due for review. There is a view by industry that adoption of an explicit reference point in an SA harvest strategy within the next three years may be an overly optimistic target. Accordingly, the suggestion is that fishery should work on 'exposing' the concept and its practical application to industry over a period of time with the ultimate goal of inclusion into a harvest strategy. The current harvest strategy includes an implicit biomass target, which is economic but not based on bioeconomic analysis. This provides a structure that could be refined through the project. While this may be achieved at the first review of the management plan, it may be more effective to 'hasten slowly' and reduce the risk of rejection of the concept by industry in attempting to meet an arbitrary timeline.

Proposed pathways to adoption (completed project)

The project proposes to drive change resulting from the results of the research using three key strategies. These are:

- use of the project steering committee, meeting quarterly in the second year of the project to:
    - serve as champions of the research;
    - ensure communication with stakeholders; and
    - nominate management strategies to test using the modelling tools.
- Industry workshops in the last months of the project, in which direct discussions among fishers and steering committee members, and provide forums for communicating project results.
- production of a professional publication in the form of a glossy brochure, to explain and summarise harvest strategy options evaluated in the project, highlighting the best performing strategies, and where there are opportunities for change.
- Workshops to promote project results, possibly using change management professionals to facilitate the process

Discussion

The biological model used by the SRL project has been continuously developed over as many as 8 or 10 prior (mostly) FRDC projects. It is now considered to be a reasonable representation of reality and offers a valuable simulation tool, to enable the testing of a wide suite of proposed management strategies to compare their performance, particularly in terms of estimating net present value. There has been excellent cooperation between modellers in Tasmania (IMAS and CSIRO), South Australia and until recently, Victoria. They have worked closely to improve and enhance the model, which has been re-written in a more accessible code. With these links well established, the legacy of the project in terms of continued updates of the model are assured. Overall, there is generally good cooperation between industry and researchers and recognition that bottom-up (or, in some cases, top down) approaches to the introduction of economic targets and indicators are unlikely to succeed. South Australia has a long track record of collecting economic data but requires this next step of bioeconomic modelling to use the data for making fisheries management decisions.

In common with other rock lobster fisheries, SRL recruitment has been well below long-term averages due to processes that are not well understood. This will have implications for future bioeconomic predictions based on long-run average recruitment if recruitment has permanently shifted to lower levels. Industry has some concern that economic inputs are not sufficiently realistic and that there is a need to build in greater responsiveness/consideration of price. The benefits of adopting an economic decision rule within SRL harvest strategies need increased promotion. To date, the key 'selling point' has been to examine how NPV changes over time and to select management options that maximise NPV.

There is a desire by industry (SA) to use more sophisticated approaches. Bioeconomic modelling and application to state lobster fisheries requires specialised knowledge and well-established links with industry. It is thus vulnerable to staff changes or reduction in time commitments to conduct and communicate economic analyses, and their associated potential benefits. In the case of the latter, considerable effort is required to gain the necessary momentum for change and overcome resistance. The many variables with the current pricing structure, weather, size limits, weights of lobsters and market access all combine to make the issue of creating accurate and meaningful bioeconomic models harder.

There is general agreement amongst the more progressive fishers and by fishery managers that there is a substantial gap between optimal and current fisheries performance. There is an opportunity to promote and adopt approaches based on more conservative harvest rates which could build biomass, increase catch rates and reduce costs of fishing. The role of industry bodies/advisory committees will be pivotal in the adoption of new economic harvest control rules and these are well established in Tasmania and SA. They will also have the potential to help address the considerable scepticism and a lack of understanding concerning the potential benefits of pursuing benefits identified by bioeconomic analysis. As with most contemporary fisheries models, there is much to be gained from the free flow of information concerning model design

and development. Given that many organisations and individuals have contributed to the current suite of models in use it is likely that there is more to be lost by pursuing IP than may be gained by continuing with the strong and effective cooperation that currently exists.

Industry is uncertain as to the benefits of applied economic analysis and are concerned that current models are inadequate reflections of reality, mainly due to the model inputs. There is a view that if industry is supportive of the inputs, there is a significantly greater chance they will be supportive of the outputs. There are also concerns and some confusion as to the role of government, and in particular stock assessment scientists, in setting economic targets both in Tasmania and SA. Finally, [8]there is also confusion as to the benefits of setting economic targets/using economic decision rules for the fishery as a whole, and the decisions made by individual fisheries enterprises. Some elements of the fishing industry are inherently resistant to change of any nature and are prepared to mount considerable opposition, even where the analysis is clear concerning potential benefits. This resistance may result in slowing or preventing change since decisions are often taken by consensus or at least rely on majority decisions by large groups. This threat is particularly evident in organisations where the voting structure is not proportional to ownership of quota (TRLFA).

SWOT analysis and review of current project and adoption strategies

Strengths	**Opportunities**
• Bioeconomic model now developed and operational • Excellent cooperation across SRL researchers, combining world-class modelling expertise from CSIRO, IMAS and SARDI with considerable experience of implementation • Willingness to use industry to drive scenario testing via the MAC (SA) • Good time series of economic data and familiarity/acceptance by industry of the value of such data (SA)	• Gaps between optimal and current SRL fisheries performance • Promotion of common approaches across SRL • Re-establishment of MAC in SA (SARLAC) and existence of FAC/SPOC in Tasmania • Increased project legacy if modelling IP could be loosened to permit free use of it subsequent (and during) the project • Ability to test the new economic harvest control rules alongside current harvest strategy (SA); harvest strategies to be reviewed in there years following implementation of new management plans (June 2013).

[8] Maximum yield or minimum risk: using biological data to optimise harvest strategies in a Southern Australian molluscan fishery. Stobart, B., Stephen Mayfield & Richard McGarvey (2012). Manuscript submitted for publication.

Weaknesses	Threats
• Recent anomalies in recruitment providing issues for stock projections • Difficulties in obtaining up to date economic data, particularly on price. • Need for a more sophisticated case to be made to industry for the adoption of economic reference points i.e. beyond increasing NPV over time. • Vulnerable to staff changes or reduction in time commitments for key researchers.	• Continued suspicion from industry that models are poor representations of reality, including economic inputs (e.g. price data). • View by industry that economics is not the business of government • Industry confusion over economic optima for individuals vs. the fishery as a whole. • Resistance to change of any nature by industry in part because decisions rely on consensus from large groups and/or voting processes.

Conclusions

The overall momentum created by the CRC suite of RL projects under the Future Harvest theme, combined with complementary activities by state fisheries administrations and researchers, is highly likely to result in a legacy that will see explicit incorporation of economic decision rules in the harvest strategies for both the SA and Tasmanian fisheries. Once agreed, this will effectively legislate against short-term decision making based on maximising catch and shift focus onto a more economically rational approach based on maximising long-run economic efficiency.

While industry is cautious concerning the timeline for introduction of an economic decision rule, economic indicators may influence decisions in the meantime despite not being formally included.

Of the two states, SA fisheries (Northern and Southern Zones) are more likely to adopt such a rule first, since the current RL management plan already includes an explicit harvest strategy and decision rules. Once industry and managers gain confidence, the framework and mind set for adopting higher economic yield as a target are present. In Tasmania, despite considerable efforts by researchers and managers, industry has been somewhat resistant to explicit decision rules so the development of an explicit MEY target is more difficult.

Recommendations

i) Continue to bring industry along in the process by ensuring responsiveness to requests from the MAC and other advisory bodies to trial various harvest strategy scenarios (SA).
ii) Provide an opportunity for industry to ground truth inputs to the model in terms of price and cost information prior to it being run - this could be incorporated into a formal process and would serve to build industry confidence.

iii) Build the capacity of fishers to understand the implications of MEY and how estimates/predictions of stock level, catch rate, NPV etc. are calculated.

iv) Fishers / stakeholders involved in advisory bodies such as the MAC should be exposed to the outputs of the modelling ASAP. These outputs should then be incorporated into a broader program of extension to the wider industry via port meetings and regular updates, with hopefully more importance placed on the new indicator(s) each time, ultimately leading to inclusion into the strategy once confidence has been built.

v) Test economic decision rules alongside the existing CPUE harvest strategy to build confidence, with the objective of incorporating an economic decision rule in the next management plan (SA).

vi) Model the impacts of proposed marine parks and expansion of SA WZ fishery into historical fishing areas (deep water and far west) (SA);

vii) Consider running a workshop(s) in conjunction with TRLFA meetings and/or use port meetings as the most effective way to communicate face to face with industry (TAS).

viii) Increase interaction between Rock Lobster fisheries in Australia adopting MEY approaches, at both the level of managers and industry, noting the success of the current informal interstate fisheries management meetings organised by Hilary Revill.

ix) Free up any IP associated with the bioeconomic model to enable free exchange of ideas/innovations between states associated with CRC and other fisheries within Australia and overseas;

x) Present the information from the modelling in a way that somehow relates better to the individual fisher, as, like most business owners, the question of 'how will this benefit me?' is generally the most pressing.

xi) Establish the collection of an economic data set to monitor changes in cost structures, markets and prices to inform bioeconomic modelling (Tasmania).

2. Project: 2009/710 – Decision-support tools for economic optimization of western rock lobster

Project status:

The project has completed an assessment of a range of values for maximum economic yield (MEY) for the WRL fishery under varying conditions of recruitment, discount rates, market price, and costs of capture (fixed and variable), thereby estimating the optimum level of effort that would maximise the net present value (NPV) of profits under input controls. Due to management changes (severe effort reductions) to address recruitment downturns, the project was able to capitalise on a unique opportunity to assess the effects of a fishery moving to an MEY level within two years. In addition, the fishery has moved from input controls to a quota-managed fishery, albeit with the retention of a strong linkage between units (the currency of the fishery) and pots.

Analysis under the project determined that the optimum level of effort under input control management that would maximise the net present value (NPV) of profits over the period 2008/09 to 2013/14, and thereby achieve MEY, was about 30-50% of the 2007/08 effort levels. Harvest rate estimations of MEY under input controls were used in the 2013/14 season (now starting on 15 January) to inform TAC setting while awaiting analysis under the project of MEY estimates under quota (output controls). It is expected that this range will remain valid under the output control analysis.

In the past, the breeding stock threshold was used to drive the fishery. The significant reductions in effort since 2008/09 have given industry the opportunity to assess the economic benefits of effort reductions, first under input controls and more recently under output controls. Under output controls, there is also an incentive for industry to consider economics in the TAC setting process. In 2012, a management discussion paper was released that includes a new target range based on maintaining catch rates achieved in recent years and which were consistent with MEY harvest rates under input controls, as well as a limit and threshold level of breeding stock. The proposal now is for a new set of rules (the Harvest Strategy and Decision Rules Framework – HSDRF) which could include a new economic decision rule. This rule may provide for a total allowable commercial catch (TACC) for the fishery within an optimal legal proportion harvested (LPH) range that would produce catch rates at a level that provide high economic returns from the fishery. While industry leaders are supportive in principle, as yet, industry has not been convinced to explicitly link the harvest strategy to MEY.

The use of a LPH range that falls within the MEY level would allow industry some flexibility in the choice of a TACC that enables them to take into account socio-economic issues within the fishery i.e. they can opt for a higher LPH which provides for higher TACC which would allow more boats to operate but at a lower catch rate, or a lower TACC with less boats and higher catch rate.

Industry, in collaboration with researchers and managers, are interested in exploring a number of management options, including changes in minimum size to capitalise on the market preference for smaller fish, and the taking of setose lobsters. A number of correlations between changes in stock and environmental factors, including water temperature and long term rainfall, have been considered. Exploration of such changes, combined with remaining above the current limit reference point for egg production/spawning biomass will inform future management decisions.

Proposed pathways to adoption (completed project)

As discussed above, the current proposal from government is to develop an additional fisheries management objective which sets a harvest rate below MSY and which could then be expected to deliver better economic outcomes for industry, including the potential for TACCs to be set at levels consistent with MEY. The proposal is to develop management objectives beyond simply managing to MSY. The discussion paper released in 2012 proposed setting a level of legal proportion harvested that will achieve relatively high catch rate, thereby resulting in higher economic returns from the fishery. The results of this project will inform industry and Government in developing and potentially

implementing the HSDR.

Discussion

The Fisheries Research Division, as the implementing agency for the project has a sound track record of applied fisheries management research, particularly in the rock lobster sector.

While there is some concern from industry at the ability of models to predict stock dynamics, the strong overall agreement between the predicted economic effects of effort reduction in relation to achieving MEY and those observed following the effort reduction due to recruitment failure has addressed some of these concerns.

Under previous work and more recently via the CRC project, the Division has developed a two-stage MEY assessment based on i) a range of fixed levels of fishing effort on the catch and catch rate using a stock assessment model and ii) assessing the economic effects on revenue, number of vessels, costs and profits for the different effort levels. The model has generally performed well and includes consideration of the impact of supply (of live lobsters) on price and is now available for exploring various levels of harvest rate and the effect of other measures (e.g. regulated sizes, taking of setose lobsters). Further management strategy evaluation/assessment will enable testing and comparison of the combinations of management measures.

While substantial progress has been made, the current model, which assumes a relatively strong puerulus/recruitment (to the fishery) relationship, does not deal with the on-going cause of low levels of puerulus settlement and recruitment. There has been some work on links between recruitment and i) seasonal rainfall and ii) temperature, and while a working hypothesis has been established, no firm conclusions have been drawn. A FRDC draft report on the low settlement will be submitted in January 2013.

The absence of formal economic data collection on model inputs such as costs, markets and prices highlights a weakness in the ability of the model to make sufficiently accurate predictions of economic performance, should the new MEY decision rule be adopted.

The implementation of a quota management regime in the fishery has offered the opportunity to increase the economic returns from the fishery by lowering the costs of production (increased catch rates), decreasing competition and the incentive for over-investment in vessels and gear, and increasing the opportunities to adapt to market conditions. This, combined with the substantial quota reductions and increase in catch rates/prices has demonstrated to industry the value of maximising profit rather than catch.

The availability of the model to test industry-driven harvest strategies should assist in the development and implementation of the HSDR.

The western rock lobster industry has used a system of port meeting 'road shows' to float new ideas and help to gather industry input and submissions on

new initiatives. These meetings have been successful in driving change over the years.

The proposed HSDRF is complex and coming as it does on top of the introduction of quota, represents a significant change from former management approaches. While there is support from industry leaders for factors other than MSY (including economic approaches) to be taken into account when setting the TACC and for hard-wired harvest strategies, it appears the rank and file will need further convincing to gain their support. It is the view of the Western Rock Lobster Council that the capacity of fishers at grass roots level to adopt new harvest strategies is somewhat limited and further effort, including via the port meetings mentioned above, will be necessary to overcome this.

The ability and willingness of industry to further consider economic approaches has been hampered by the current dispute over how stock interactions between zones should be treated when setting zonal TACCs. This issue is now being considered as one of equity and in the short term at least, is threatening to slow down consideration of 'bigger picture' issues, including economic considerations, under the HSDRF.

The current view of management is that the primary role of government is to ensure long-term sustainability via an egg production objective and reference points. However, under quota, there is greater potential for industry to optimise economic benefits and in consultation with industry, it is hoped that the HSDR will create an environment where industry can achieve these benefits. The results of this project will provide a useful tool when engaging with industry on the HSDR and setting future TACCs.

SWOT analysis and review of current adoption strategies

Strengths	**Opportunities**
• Strong project team with good industry working relationship • Good agreement overall between model predictions and actual outcomes of effort reduction • Bioeconomic model developed and operational • Use of MSE to compare alternative management strategies • Current model takes into account the low settlement in determining MEY	• Implementation of quota system • Change in culture within industry towards maximising profit rather than catch • Regular system of port meetings and an effective peak body • Support for MSC accreditation
Weaknesses	**Threats**
• Some progress has been made on understanding of causes of low settlement but these need to be confirmed. Low	• Capacity of rank and file fishers to understand and take a position in biological and economic targets and associated issues.

settlement has flow-on effects for bioeconomic predictions • Uncertainty over cost structures with move to TACC	• Current dispute/confusion/conflict over a fixed proportional 'allocation' of TACC taking priority

Conclusions

This project appears well on the way to creating a substantial legacy by allowing data to be provided to the Department and industry to inform the development of a HSDR and future TACC setting. While many of the benefits currently being enjoyed by the fishery have resulted from action necessitated by the recruitment decline, coupled with the introduction of quota, a hard wired harvest strategy will contain any industry desire to increase catch beyond what has been agreed as part of the HSDR once (and if) recruitment and biomass increase. However before concepts such as MEY can be discussed objectively by industry, the current impasse in relation to 'equal' allocation will need to be overcome.

Recommendations:

i) Continue to bring industry along in the process by ensuring responsiveness to their requests to trial various harvest strategy scenarios. This is particularly important as industry has asked for a number of scenarios in relation to harvest strategy (alternate modelling options) but reportedly these have not materialised as yet; (these were agreed to be assessed for the 2014/15 TACC assessment).
ii) Build capacity of fishers to understand the implications of MEY and how estimates/predictions of stock level, catch rate, NPV etc. are calculated;
iii) Use fisher-to-fisher dialogue to promote change, e.g. by inviting NZ and SA rock lobster stakeholders to provide presentations and through port meetings.
iv) Establish the collection of an economic data set to monitor changes in cost structures, markets and prices to inform bioeconomic modelling.

3. Project: 2009/714.30 – Economic management guidance for Australian abalone fisheries

Project status:

The project is in its very early stages and is behind with progress due primarily to delays in confirming the project's acceptance, demand for Econsearch services and workload of the key fisheries modeller for the project (Klaas Hartman). Econsearch has collected economic data from the Tasmanian, and SA fisheries and are working on obtaining data from WA, NSW and Victoria.

The project is taking into account factors that are unique to the Australian abalone fisheries (for example the effect on price of being a large supplier, low capital / high license costs of entry, and live/canned product types). Examples of analyses that will be conducted are alternative TAC settings, size limits and seasonal harvest strategies and their effects on sustainable economic yield.

Abalone fisheries provide unique challenges for bio-economic research. There is a limited availability of population models, which need to deal with the fine

spatial scale at which the fishery operates. In addition there is a suggestion that diver participation is not simply a function of industry profitability as divers face barriers to exit (e.g. limited transferability of skills) and high sunk costs.

This project integrates with, and provides support for, other abalone fishery projects, for example, marketing and fishing-to-market projects. These projects are expected to lead to new ideas on abalone harvesting but really require cost-benefit analysis to gain traction for change. This type of feasibility analysis will be possible with the tools to be developed here.

The key aims of the project are to: i) collect data to enable an economic assessment of four abalone fisheries (Tasmania, Vic, NSW and SA), describe their current state and enable change to be tracked ii) combine these data with biological data and develop bio-economic analysis tools to test a range of scenarios using a management strategy evaluation (MSE) framework developed under a previous FRDC project (2007/020 Identification and evaluation of performance indicators for abalone fisheries). This scenario testing will enable the exploration of a number of options for improving sustainable profitability.

A number of papers presented at the recent (May 2012) International Abalone Symposium created considerable interest among stakeholders in this project and the likely outcomes. These included presentations on the underlying abalone assessment models and the economic performance of abalone fisheries.

Proposed pathways to adoption (completed project)

The project proposes to drive change (and create legacy from the project) by using the following mechanisms:

i) use of steering committee(s) to act as champions of the research and to act as 'grass roots' communicators with stakeholders;

ii) production of a professional publication to explain and summarise the most promising harvest strategy options, including combinations of TAC and size limits, evaluated in the project;

iii) workshops to discuss and promulgate the results of the project;

iv) other communications tools, including those suggested by the steering committee, including professional video production.

Discussion

The project is supported by ACA Board, and aligns with specific objectives within the ACA Strategic Plan. While the ACA does struggle at times to bring all states along with a common view, the Council has the ability to provide leadership and cross-jurisdictional industry cooperation. There have been many abalone research projects undertaken in the last two decades, a number of which are close to coming to fruition, especially with respect to dealing with the challenges of spatial management. This project links well with these and will provide a useful platform on which to base a legacy that goes beyond sustainability and catch maximisation approaches. The research team is well qualified and resourced, with excellent links to industry and fishery managers; it also works well across state boundaries and with CSIRO.

The scope and target for the project (a total 50% increase in the performance

indicator of economic yield, through management reforms introduced over a five year period) is very ambitious, given the current status and level of acceptance and use of economics in the management of abalone fisheries, combined with the state of global economics and the rise of aquaculture. In fact, a more realistic target may be to maintain current profitability and increase economic stability. Related to this is the fact that only SA has a track record of collecting economic data, and even this is restricted to cost and a relatively narrow range of price data. It is yet to be seen, given the parlous condition of most state fisheries agencies and reduced industry profitability, if the on-going collection of reliable price/ size/ market data will be accomplished. Caution is needed on the level of expenditure by the project on the collection of data, which is primarily a government responsibility and is not, of its self, research. To be effective, some form of biological modelling will be required to look at, for instance, TAC and size limit combinations, especially at fine spatial scales. Unfortunately a relatively small proportion of the abalone fisheries under consideration is covered by the required length based models.

There is significant potential to incorporate economic analysis and approaches to management decisions and in particular economic yield per recruit approaches. The current management focus on biology, and opinion-based decision-making that tends towards maximising catch in the short term, is frequently questioned, and there appears to be an increased willingness to look at more economically rational, long-term approaches to management. Whilst always controversial, the ability of harvesters to be selective with their catch (hand picked to within millimetres) provides a unique opportunity to capitalise on the biological performance of abalone and market demands. With the exponential growth of aquaculture production, more fully realising this opportunity will be key to retaining and improving economic performance in the abalone sector.

While many industry stakeholders are not familiar with the principles of resource economics, the nature of mature abalone businesses, and in particular owner operators, have considerable financial acumen and a good track history of addressing stock declines (albeit with a lag factor in some cases). This ability provides an opportunity on which to build the sort of economic approaches foreseen under the project. ACA, while supportive of the project, may not provide the leadership necessary to get industry thinking in a business like manner about their fishery decisions.

The 'grass roots' abalone industry, especially in Tasmania, is somewhat sceptical concerning research, much of which it does not see as being able to be translated into substantive benefits for their operations. Lack of provision of economic data by industry at the enterprise level (and in the Tasmanian case, divers) may compromise the project. As with the RL fisheries, if there is not widespread support for this work and the associated confidence in inputs, there will be reduced uptake of opportunities to improve economic outcomes. Similarly, there is a lack of understanding of economic principles, particularly where the results are counter-intuitive (less catch, under various scenarios, can result in substantial increases on profit). There is also an inability to differentiate between enterprise and fishery-wide economic efficiency with a strong (and incorrect) impression by many in industry that economic indicators and

reference points represent government dictating how operators should run their businesses. With the separation of quota from diver entitlements in Tasmania, there has been a substantial increase in the number of non-diving quota holders, a number of whom have little or no practical experience of the fishery or its dynamics. Selling uncertain (in their minds) future gains against the known cost of foregone short-run profit through conservative catch or size limit decisions will be challenging. Stock assessment models do not have a good track record of acceptance by industry. Abalone industries, despite the efforts of the ACA, can tend to be very parochial and may not adopt potential efficiencies arising from the project if they are not tailored to individual fishery circumstances. It will be necessary to acknowledge the clear differences between Australian abalone fisheries including those relating to in industry structure, management and stock dynamics.

SWOT analysis and review of current project and adoption strategies

Note that this analysis goes further than the adoption strategies of the outputs of the project, owing to the current status of the project.

Strengths	**Opportunities**
• Strong support by ACA Board, with links to the ACA Strategic Plan • Links with MSE/biological modelling work being undertaken by CSIRO • Well resourced and qualified research team • Cross-jurisdictional cooperation	• Significant potential to incorporate economic analysis and approaches to management decisions. • Ability to use selectivity (size limits), improved stock assessments and marketing information /projects as tools to increase profitability. • Financial acumen of major industry players
Weaknesses	**Threats**
• Project scope and targets very ambitious • Only SA has a track record of collecting economic data; yet to demonstrate ability to collect and use reliable price/ size/ market data • Limited coverage of stock assessment models due to variability of parameters, e.g. growth. • Insufficient engagement of processors and marketers • Danger of project over-expenditure on data collection	• Resistance by industry, including to the provision of economic data • Lack of understanding of economic principles, particularly where counter-intuitive and to differentiate between enterprise and fishery-wide economic efficiency • Differences between investors', owner-divers' and lease divers' views on the status of resource making agreement hard to reach • Lack of confidence in abalone stock assessment models • Inadequate recognition of

	differences between states • ACA does not take leadership role

Conclusions

The greatest single issue to be resolved to enhance the legacy of the project will be to convince a sufficient number of industry leaders in the abalone sector that the use of economic analysis and adoption of management decisions that explicitly take in to account economic outcomes can yield tangible benefits. While supported by the ACA, this body did not initiate the project and the membership will need to be convinced of its benefits. WA was particularly sceptical of this project and beyond the survey, is not engaged. Once this is achieved, it will be relatively easy to get agreement from managers, who, for the most part constrain their major activities to addressing sustainability and let industry to take the lead on economic matters.

NSW are particularly interested in the benefit of the development of a method (by economists) for a survey that could be repeated cost-effectively by state industry organisations, as needed, and completion of a baseline survey of the whole industry. There is concern in that state that the survey is in danger of becoming 'another modelling project' and a concomitant reduction in the funds available to do a good job on the baseline survey. Conversely, economic surveys on their own are in the "so what" category and, like stock assessments are not considered research in the sense that FRDC and the CRC use. While economic data is necessary to support consideration of the effects of alternative management decisions (minimum lengths, TAC etc.) the real challenge will be to get the abalone sector to think in a business like manner about their fishery decisions.

The conclusion here is that it's a real challenge to get abalone leaders to think about increasing profitability beyond tariff barriers, tonnes and management fees. One option may be to work on giving the ACA more exposure to fisheries that are doing it right but it's clearly a greater challenge in abalone than most.

Between FRDC and CRC there have been a number of abalone projects dealing with a range of issues including growth, marketing, spatial management, co-management, performance indicators, management strategy evaluation and performance indicators. There is a deal of uncertainty about how these projects fit together, when viewed from an industry perspective. At an individual enterprise level, the tangible benefits become even more uncertain. As a result, there is resistance by some in industry to further research. In particular, there is a view from hardened professionals who have run successful businesses that economics and profitability is not an issue for governments or researchers.

Unfortunately, the timing of Tim Ward's project (2009/715 *Optimising business structures and fisheries management systems for key fisheries)* has been such that it has yet to cover abalone. Project 2009/715 has particular value in initiating

debate on the key drivers of economic efficiency and is based on industry engagement and exchange of ideas, which, in the case of Spencer Gulf, has led onto a debate about economic considerations and associated modification of management arrangements.

In developing the bioeconomic model, it is important to undertake extensive 'ground truthing' of input data with industry (harvesting and processing sector) to gain confidence in model outputs.

Recommendations

i) Produce a brief publication that places all recent (say last 20 years) abalone projects in an overall context, showing how they interact to deliver benefits at the individual enterprise level as well as across whole fisheries.

ii) Work closely with the ACA Board to address concerns and demonstrate how long term benefits can result from consideration of the economic implications of management decisions.

iii) Increase the engagement of the project team with management advisory committees and resource assessment groups, or their equivalent, in addition to the steering committee.

iv) Ensure engagement with processors and marketers to obtain information such as the price brackets for different size live/canned abalone and the volume of abalone in size groups the market is looking for.

v) Strengthen linkages with the current fine spatial scale suite of projects, where key decision on TACs and size limits are evolving as a result of comprehensive data logging and analysis;

vi) Establish additional focus on key management and marketing issues such as:

- potential loss of revenue from delaying critical decisions on TAC decreases, and conversely, the short term loss vs. the long term gain of delaying putting TAC up;
- size limits and the longer term economic consequences of changes; and
- time of harvest (following on from the Ben Stobart SA Geenlip study).

vii) As with SRL, run comparative analysis alongside existing TAC and size limit setting processes, both where harvest strategies exist and are yet to be developed.

4. Project: 2009/774 – Harvest strategy evaluations and co-management for the Moreton Bay Trawl Fishery

Project status:

The project was initiated in response to the falling profitability of the Moreton Bay trawl fishery following an initiative instigated by the Moreton Bay Seafood Industry Association (MBSIA). The project was based on the idea that improved decision-making based on bioeconomic analysis, coupled with an improved

system of governance, could increase economic yield and restore prospects for the fishery. The project is now complete, with a final report being provided to the CRC in October 2012.

Key findings from the project were:

- Drastically reduced catches and effort (around two-thirds in both cases) in the fishery since the 1990s.
- Catch and effort reductions as a result of depressed prawn prices (driven by import substitution and exchange rates) and increased operating costs.
- Unsustainable fleet economics in the longer term as owner-operator incomes are below opportunity costs.
- Changes in the mix of prawn species landed, with an increase in more valuable species (brown tigers) – some questions remain concerning the degree to which changes in targeting/effort reduction/stock recovery have driven these change.
- Low profitability and technical efficiency overall with a need to reduce boat numbers – this is also a controversial issue.
- Potential benefits in terms of increased catch value through selected closures (identified using harvest strategy evaluations).
- While challenging, there are opportunities for improved management systems in the fishery, and in particular some form of corporate management similar to the once successful Challenger scallop fishery in NZ in which all fishers are shareholders.

There is a current review of management arrangements for the Queensland trawl fishery, which includes the Moreton Bay sector. The timing of this review is important as a point on which to embark on a reform agenda for the governance of the Moreton Bay trawl fishery. Unfortunately, a lack of cohesion, cooperation and the absence of a united industry vision for the future of the fishery, combined with much reduced Government funding and capacity, are significant stumbling blocks to any future governance reform.

It is clear that understanding the social and interpersonal aspects of the fishery will be essential to developing a lasting legacy. As Vikki Schaffer succinctly puts it ”as people make decisions, understanding the unity between fishery stakeholders is essential to the social, economic and environmental future of this and other fisheries”.

Proposed pathways to adoption (completed project)

The project document was not explicit on how the outcomes of the project would be adopted by industry and government, or the mechanisms for achieving this. A number of communication/extension methods were suggested which would, presumably, increase the prospects for adoption. These were based on ‘industry champions’ who would be involved in i) guiding the project and ii) communicating with their peers. A range of other methods were suggested including websites, newsletters, fact sheets, workshops, port meetings and industry magazines

Discussion

The project was initiated with strong support from MBSIA which had been given a mandate by its board to look at ways to halt and reverse the economic decline in the Moreton Bay trawl fleet. The final report is very comprehensive, and provides evidence of the quality and experience of the research team, which included biological and economic expertise, augmented by industry advocate and researcher, David Sterling. Throughout the project there has been strong industry input, and particularly through the efforts of David Sterling. Being responsive to industry has assisted in gaining some acceptance and understanding of the work of the project and possible future solutions.

The original project scope was somewhat ambitious and was subsequently reduced in some areas (HSE for all species) and increased in others (harvesting patterns, environmental linkages with catches of key prawn species, optimal harvest patterns ,prawn recruitment and movement for tiger prawns, mesh selectivity and development of new governance models). The outputs of this work, while impressive, are far-reaching, complex and in a number of areas incomplete, presenting a challenge to industry and managers as to deciding on a clear path forward. The fact that further work is required is no reflection on the research team but highlights the gap between the extent of the task set and the available funds and resources available.

The difficulties experienced by the project in identifying and prioritising management objectives (rather than a long list of issues) is common to most fisheries. Without explicit agreement on objectives and some means of tracking progress towards meeting them, it is difficult to prioritise realistic research and management activities. Compounding the complexity of managing this fishery are the links with the wider Queensland east coast trawl fishery and the limited history of consideration of economics in fisheries management decision-making in the State. An absence of cost recovery (considered unconstitutional[9]) and lack of a time series of economic data are also weaknesses. Considerable uncertainties within the stock assessment model for tiger prawns remains, including prawn size structure, environmental drivers, and the associated development/evaluation of harvest strategies, which is constrained by the limited understanding of the temporal and spatial patterns of coexistence with other commercially significant target and by-product species.

There is considerable potential for increasing returns to the fishery through the value chain and incorporating market and cost considerations. To date, there has been a focus on harvest optimisation (maximising catches of prawns) with very limited attention to costs and markets. While imported *vannamei* prawns continue to dominate the lower priced prawn market, there is an increasing demand for locally produced seafood, and, in some areas, for community-based fisheries. Smaller producers in the agriculture, aquaculture, and to a lesser extent, wild fisheries are realising gains from increasing prices in niche markets, using innovative marketing strategies. SeaNet, DAFF and Oceanwatch assistance to tunnel netters in Moreton Bay to improve demand/price and demonstrate environmental credentials are a good example of such initiatives.

[9] A 2006 review of fees found that setting fees based on cost recovery would be considered a levy which, as interpreted by Queensland, the States are unable to impose. A resource rent model was eventually adopted as a basis for setting fees in Queensland

Most industry stakeholders, while having different views on how to address the issues, realise the economic status quo in the fishery is untenable. This recognition will help to drive change. Prawns are one product from Moreton Bay with catches of sand crab, bugs and squid also from the trawl fishery; mullet, bream, flathead, garfish and Black Trevally taken from the net fishery; mud crab and sandcrab from the pot fishery; and also oyster production. This provides potential to link prawns with other species to present an additional marketing opportunity.

The bioeconomic modelling work undertaken by the project has indicated that substantial benefits might be gained from improved spatial and temporal management and other changes to input controls, even with the current fleet. Such changes should be supported by industry and could be introduced in the relatively short term. Restructuring, changes to licenses and some of the more integrated approaches highlighted in the project and advocated by industry will take some time to design and subsequently implement.

As with many small fisheries Moreton Bay is made up of operators working largely in isolation from different landing locations, with limited educational[10] backgrounds, high levels of individualism, and minimal cooperation. Most fishers seek to simply maximise individual catches. This individualistic approach extends to self (individual) marketing, where wharf sale prices are driven down by competition rather than up through cooperation. Getting consensus agreement on 'big ticket', complex and comprehensive solutions under these conditions, will be almost impossible in the short to medium term.

The Queensland Government has embarked on a programme of severe cost cutting, which has meant the loss of many positions in Fisheries Queensland within the Department of Agriculture Fisheries and Forestry (DAFF). This has seriously reduced the capacity, both in human and financial terms, of Government to assist the fishery as it attempts to capitalise on the research outputs and move to a better economic situation. In place of government support it will be necessary to look to other avenues of funding, such as the Federal 'Caring for Country' initiative, which, via a Queensland DASFF 'Qcodes' project, very successfully supported tunnel net fishers in Moreton Bay and Regional Councils. Regional Councils are seen as a good prospect for sound collaboration regarding industry development/ promotion, including the Moreton Bay Prawn Fishery.

Industry has a number of concerns with the current tiger prawn model including the estimates of mortality, catchability and effort, the outputs and implications for management changes. The degree to which industry wishes to pursue links to environmental drivers and reduce uncertainty before 'buying on' to recommendations may present a major barrier to achieving realistic short-term gains via more pragmatic approaches.

SWOT analysis and review of project and adoption strategies

[10] This comment refers to the ability to understand and engage in discussions concerning technical fisheries management issues, rather than proportions of fishers that completed high school and other more traditional means of measuring educational background.

Strengths	Opportunities
• Strong support from MBSIA with a clear incentive/desire to support change • Well resourced, qualified and experienced research team • HSE process and overall project driven by industry via a steering committee	• Value-chain development combining harvest optimisation with market/cost considerations • Increasing demand for locally produced and certified seafood • Geographic location of the fishery producing fresh seafood in a major population hub/market. • Recognition by some industry stakeholders that change is necessary to achieve economic viability • Links with broader Moreton Bay seafood industry production • Spatial/temporal management driven by industry and based on bioeconomic modelling
Weaknesses	**Threats**
• Project scope very ambitious • Difficulties in identifying and prioritising management objectives • Additional complexity arising from links with wider Qld E. Coast fishery • Limited history of consideration of economics in fisheries management decision-making. • Considerable uncertainties within the stock assessment model remain, including environmental drivers • Limited understanding of the relationships and networks within industry	• Difficulty in reaching consensus agreement between fishers on future management options and areas of cooperation • Lack of funding/ capacity/ commitment by DAFF Queensland due to budget cuts • Lack of confidence in the current tiger prawn model • Desire by industry for validation of the assumed temporal prawn-size structure in the model before acceptance • Ageing fishing community reluctant to change, with no financial capability for investment.

Conclusions

Taken at face value, the Moreton Bay Trawl fishery seems to have a number of features that would make the application of innovations to improve economic returns possible. Innovations suggested include co-management, cooperative approaches to marketing and, possibly, some form of corporate governance

structure. There is a relatively small number of fishers, an active industry association (MBSIA) and good linkages between stakeholders. However some major stumbling blocks exist:

Lack of industry cohesion: While some fishers are pro-change and are prepared to enter into discussion with researchers and government concerning new governance arrangements and other initiatives there remains little unity and a wide range of views on the dynamics and condition of the resource and what actions are necessary to restore economic viability. Getting the level of industry agreement (i.e. consensus) on the issues necessary for government to act will be difficult to secure. Similar comments apply to the development of prospective new governance arrangements. Research being undertaken by Vikki Schaffer on the identification of a core leadership group and an understanding of the current industry network structure will provide valuable input onto establishing and developing social capital necessary to drive change. This will be particularly important as industry moves to develop an effective management strategy and associated market.

Lack of acceptance of the stock assessment: The current stock assessment strongly suggests that the brown tiger prawn biomass in Moreton Bay has recovered well from years of chronic (and probably recruitment) overfishing in the 1980s and 1990s. Now that effort in the Bay has fallen to record lows, stock assessment scientists consider it likely that reduced effort is the driver behind the significant increase in biomass and the current high catches and catch rates. Industry contends that these changes could be the result of one or more environmental changes and/or changes in fishing practice, but current research has found no evidence of this. The conflict over the stock assessment and related advice i.e. defining what the problem is, makes moving forward with tangible solutions to the problem very difficult. In the opinion of researchers, there is a need for industry to take responsibility for the impact of their fishing effort levels on this stock, and especially brown tiger prawns. A view by industry is that effort is low and never likely to increase. Catches are high – but cannot be sold at a good price. Most of the product is fresh and there is no longer a supply chain that can deal with large pulses of fresh product, even though the quantities are still low by historical standards.

Availability of funding and other support: In a more buoyant economy, some contribution to a strategy to improve the status of the fishery by government would be a strong consideration but it is clear that DAFF is in survival mode with many essential (to effective fisheries management) services under threat as a result of budget cuts. With a gross value of around $5 million it is unlikely that FRDC or other institutions will be persuaded to fund extensive additional research to resolve some of the ambiguity in the assessment and to undertake further economic analysis.

Weak market position: The on-going high levels of competing products are severely impacting on price, particularly of the now abundant greasyback and other species. The competing supplies are made up of cheap imported prawns and Australian–caught product which used to be exported but is now sold nationally due to the high Australian dollar. There is a clear need to improve the

value of the product in key markets, as is being successfully achieved by the Tunnel Net fishery.

Research overload: Fishers have been and are currently being subjected to a wide range of research projects and development initiatives, three of which are CRC driven. Given the nature of fishery participants and their independent, and at times fragmented, modes of operation, this has led to some confusion. The sheer volume of material developed is almost impossible for fishers to digest or to make meaningful comment on and with very limited resources, to implement the outcomes. As one industry commentator expressed 'It is a source of bewilderment to fishers that researchers in the main tend to gain more from the projects than any real outcomes or funding for development of the commercial fishing industry'.

Links to the wider east coast prawn trawl fishery were also considered, together with the possibility of a major legacy project to improve the management of that fishery. Should such a project go forward, there would be spin-offs for Moreton Bay, since the opportunity could be taken to address the TI/MI licensed vessels which are able to operate both in Moreton Bay and the wider east coast fishery. This would involve a major project to consider future management options, including means to address problems associated with the mobility of the fleet (low level of property rights and reduced fishery efficiency) and latent effort; and also, the spatial resolution of the information systems and associated harvest strategy evaluation processes (in the same style as Spencer Gulf).

The more traditional approaches of effort reduction aimed at simplistically achieving MEY and other options could be trialled alongside and a comparison made in a holistic sense, considering benefits to industry, individual fishers, regional communities and the environment. However, this option is not recommended for CRC funding, since while the analysis could be done effectively (subject to funding) there is little likelihood of the recommendations flowing from such a project being implemented by DAFF in the foreseeable future, due to resource constraints. To address this issue in the longer term, it would be helpful for government get a feel for the relative cost-to-benefit-ratios of changes to management; such an initiative would need to wait until the current management review process has been completed.

SeaNet officers have worked very effectively with industry to develop promotional/motivational media to promote the MB fishery and associated seafood products and assisted in the development of codes of best practice. While outside the scope of the project under review, it is clear that these officers, should SeaNet be refunded, have a role in the future development of the Moreton Bay Prawn Fishery.

Finally, there is an industry view that there is a need for a more integrated solution than simply reducing vessel numbers/effort, based on what is seen as relatively weak scientific justification. There is a justifiable push for developments that improve profitability and an opportunity to restructure to a fleet that matches the modern marketing environment. This includes looking again at an appropriate M2 boat replacement policy.

Recommendations

i) Undertaking a brief project to design an action plan for the Moreton Bay fisheries drawing together and highlighting the linkages between this project and other relevant projects (including 2010/777 - Identification of the core leadership group and network structure of East Coast Trawl to develop, implement and evaluate strategic opportunities and 2008/793 - Optimising quality and value in domestic prawn value chains).

ii) Gaining an improved, and more importantly common, understanding of the complexity of fisheries production, including the effects of environmental factors, which would enable industry to have effective input into decisions concerning production and associated marketing to achieve maximum value for the product. This may be best addressed by a mediated discussion between researchers, managers and industry 'champions', including David Sterling.

iii) Boosting the spatial resolution of the information system thereby gaining confidence in the stock assessment. Given the resource restraints, this will only occur with a strong working relationship between industry and fisheries managers and a workable collaboration on this issue

iv) Using improved temporal/spatial knowledge of the fishery, well thought out appropriate harvesting and marketing strategies should be determined to maximize production and value, and keep a check on sustainability and acceptable environmental/social impacts.

v) Provide support for a proposed collaborative (MBSIA, QUT and DAFF) follow-up project currently being presented for funding under the framework of the Industry Doctoral Training Centre; this work should include the establishment of the size of prawns in the catches, particularly in the part of the season where there is the most interest in "beneficial" closures to avoid growth overfishing.

vi) Revisit the industry M2 boat replacement strategy on the basis that economic analysis within this project has shown that the benefits of the proposed M2 replacement policy are high and that the most likely outcome is an effort reduction (not an increase).

vii) Seek funding elsewhere, or use agreement on resource status and an action plan as a leverage for additional FH funding, to support initiatives that have been suggested through the project outcomes and subsequent discussion

viii) Capitalise on the early findings of project 2010/777 to communicate more effectively options for development and in particular, identify and use networks and leadership groups to drive change.

In the area of value-chain improvement, one initiative that may offer considerable promise is the trialling of a community-supported fishery CSF, as has been successfully implemented in a number of US fisheries on both the East and West Coasts under Sea Grant and other support. Modelled after community-supported agriculture, a CSF is a shore-side community of people collaborating with local fishermen to buy fish directly for a predetermined length of time. CSF shareholders give the fishermen financial support by purchasing a weekly 'basket' of fresh seasonal seafood products. In other direct marketing

arrangements, fishermen may sell catches to the public directly off their boats, at farmers' markets or through pre-arranged deals with restaurants. A number of these initiatives have included prawn fisheries (e.g. Louisiana, where the initiative, Delcambre Direct (*http://delcambredirectseafood.com/Home.htm),* has been running for three years and increased the price received for prawns from around a dollar a pound to $3-3.35 per pound).

The Australian Council of Prawn Fishers is working on the organization of a national marketing and promotion campaign building on raising the awareness of Australian prawns, which are better regarded than imports. This recognition can and does drive buying behaviour (and associated price increases). This marketing initiative would support any individual/ regional/ state based marketing and promotion and maximise their benefits, and vice versa.

Finally, the project provides some excellent advice on the options and benefits of the application of a corporate management model to the fishery. Such a model would improve the integration of harvest optimisation strategies with market/cost considerations, and provide a greater say for industry in the management of their fishery. However, given the level of cooperation and administrative change necessary to achieve such a goal, such an initiative may be unrealistic at this stage

5. Project: 2011/750 – Bioeconomic model for SA prawn trawl fisheries

Project status:

The project was developed in response to reductions in prawn prices and reduced profitability for SA Western king prawn fisheries in the Spencer Gulf (SGPF) and Gulf St Vincent (GSVPF). The primary focus of management for these fisheries has been biological sustainability and, given their demonstrably sustainable management histories and ongoing cost/price pressures, there is an acknowledged need to examine approaches for maximising profitability.

As with many other SA fisheries, the SG and GSV prawn fisheries have management plans and economic objectives and indicators. However, Economic needs are not explicitly considered in the harvest strategy or output control rules, which for the Spencer Gulf are currently set to *'restrict the catch and effort for the harvest period to sustainable levels'*. That said, fishing is managed implicitly to improve gross revenue, e.g. by i) taking into account price fluctuations associated with the Christmas period ii) acknowledging that of selection of size at harvest is the key determinant of price and iii) using minimum catch per vessel (proxy for revenue) as a harvest control rule.

The status of the stocks and the fishery in the two gulfs is very different and the management framework of the GSVPF is currently being reviewed with respect to taking decisions on how best to manage the biological and economic recovery of that fishery going forward.

The project will use and adapt an existing Eastern king prawn bioeconomic model to develop optimal fishing /harvest strategies and, upon completion extend the model and its outputs to other Australian prawn trawl fisheries. This model will be useful in testing future management options, including recommendations from the review discussed above. The application of this model to the review outcomes should provide 'real-life' applications of

bioeconomic models to fishers, thus demonstrating the benefits of models.

A related CRC project (2009/715, Optimising business structures and fisheries management systems for key fisheries) has been instrumental in working with SGPF operators and introducing the concepts that will be necessary to get full benefit from the bioeconomic modelling.

Proposed pathways to adoption (completed project)

The primary pathway proposed is to ensure that end user beneficiaries, i.e. industry members and fishery managers, can understand and utilise the outputs of the model to modify the harvest strategy. The key message will be to optimize the economics of fishing rather than simply to pursue highest sustainable catch strategies. A primary means of promoting project results and their subsequent adoption will be face-to-face communication with industry and managers, together with the ability to demonstrate the model's capacity to effectively reflect fishery behaviour and with a high degree of accuracy reflect the financial drivers for operators' businesses.

Discussion

The project is strongly supported by both SGPF and GSVPF industry associations. The Spencer Gulf fishery's Management Committee (which includes PIRSA and SARDI) considers the project has the potential to:

- provide a guide to improve the fishery's economic performance (i.e. ask questions about pre and post Christmas catches and related prices and including improving the understanding of size structure and growth relating to prices and time of harvest); and
- potentially modify survey requirements in the future (reduce cost and burden).

The project will build on the eastern king prawn bioeconomic model developed for Queensland East Coast fishery. The South Australian government management agency, PIRSA are also very supportive of the project. There are considerable benefits from using this approach and capitalising on the expertise available at SARDI, DAFF (QLD) and, potentially, CSIRO (Cathy Dichmont et al). Having a single species model with well-understood dynamics and a relatively stable biomass/harvest of western king prawns (SGPF) in also a key strength. The model will allow for testing of alternate management strategies, including fleet reduction, and, through demonstration and industry engagement will increase understanding and industry support for management change. Both fisheries have a history of explicit management plans that include goals, objectives, indicators and control rules; this will make the shift towards explicit consideration of economics in the harvest strategy and control rules easier. As with other SA fisheries, prawn fisheries operate under a full cost recovery system, which will potentially provide opportunities to reprioritise or support additional funding for any additional modelling or support for a change in harvest strategy. An established fishery-independent survey program used for stock assessment and harvest/fishing strategy purposes is in place and provides robust data for the model.

While there is a useful economic dataset of costs and revenues collected under

contract by Econsearch, this coverage is somewhat incomplete. The major gaps lie in coverage of different vessel types (especially in GSV) and prawn prices by grade. Missing data can be supplied by Industry with little or no extra cost or activity. This sort of information will be necessary to make robust interpretations of the economic performance of the fisheries. While bioeconomic models offer much promise in measuring and improving economic performance, in practice dealing with some issues in an input controlled fishery (e.g. advances in technology and changes in technical and allocative efficiency) is notoriously difficult. In the case of the NPF, dealing with these problems through the establishment of some form of autonomous control mechanism, using tradable effort or catch units, is currently being explored. Using an East Coast model lays the project open to charges of applying an inappropriate approach ….. 'but I don't operate like that, therefore the model is wrong'. Accordingly it will be important for the model to account for diversification in fleets.

The SGPF has a strong track record of cooperation and innovation on the co-management sphere and the fishery has long been held up nationally and internationally as a 'model' fishery in terms of overall performance. There is a substantial opportunity to build on this history and capitalise on the awareness[11] that the status quo in terms of vessel numbers and a harvest strategy built more on catch maximisation than economic efficiency is no longer viable. This awareness is matched by a willingness by SG fishers to consider (and hopefully adopt) change, as illustrated by the outcomes of Project 2009/715. There remains a niche market for high quality larger prawns and a very strong (and dynamic) relationship between prawn size and price. The planned availability of an integrated bioeconomic model, incorporating relevant cost and price data, will enable more informed decisions to be taken concerning the timing and location of harvest.

While the availability of data to inform bioeconomic models is usually a stumbling block in many fisheries, SA fishers have a long track record of supplying economic data. Similarly, the fisheries have demonstrated strong leadership in terms of at-sea surveys and adaptive real-time decision-making. The bioeconomic model may point the way, and inform progress to, MEY and in the interim, this short-term, adaptive capability will continue to be a significant opportunity for realising the legacy of proposed economic analysis.

Finally a review of the GSVPF fishery is now underway and Government has indicated that it is willing to take strong decisions to address the recommendations arising from the review. The Review will provide a base from which to use the project's outputs in support of improved fishery performance for sustainability as well as efficiency. The GSVPF has previously used a novel and early derivation of a bio-economic model; unfortunately over time the commitment to it has waned by both Government and Industry[12].

While catches in the SGPF have been relatively stable, those in the GSVPF have been low for some years. A closure aimed at accelerating rebuilding, combined

[11] Project 2011/750 – Bioeconomic model for SA prawn trawl fisheries

[12] Economic Analysis of Management Options for the Gulf St Vincent Prawn Fishery, South Australian Fisheries Management Series No. 18, Julian Morrison, April 1996

with a conservative harvest strategy did result in rebuilding stocks. Despite this there was a subsequent decline in performance of the fishery, leading to current re-building efforts to address low stock levels. In these circumstances, and given the level of conflict often present in the fisheries, it will be difficult to reach agreement on measures that will be necessary to rebuild and restore the fishery to optimal economic performance. Transition costs of fleet reduction will be substantial, especially in the GSVPF. An objective model will be highly useful in management forums to inform negotiations and decision-making. From an industry perspective, the current main constraint on the project is the available expertise within the country to ensure the model can reach its full potential. The failure of SARDI to attract a candidate to develop the model in house is an indication of the competitive nature for modelling skills in the market. However, the alternative plan to build capacity within the SARDI organisation, including expert guidance is a strategy to overcome this concern.

SWOT analysis and review of project and adoption strategies

Strengths	**Opportunities**
• Strong support from industry associations and the government management agency • Builds on E. King prawn model, capitalising on expertise at SARDI, DAFF (QLD) and, potentially CSIRO • Will allow for testing of alternate management strategies, including fleet reduction • History of explicit management plans including goals, objectives, indicators and control rules • Cost recovery in place providing independent (of Government) funding • An established fishery-independent survey programme used for stock assessment and harvest/fishing strategy purposes.	• Existing history of cooperation and innovation within the SG fishery, including recent initiatives to achieve economic optimisation • Continued market differentiation towards higher prices for larger prawns • Availability of a quantitative stock assessment model • Enhancement of existing system of industry surveys, both economic and at-sea • Review of GSVPF underway
Weaknesses	**Threats**
• Lack of economic data sets covering a variety of boat-specific requirements (See p 41) • Usual suite of problems associated with input controlled fisheries and MEY	• Parlous economic (and, arguably, biological) state of the GSV prawn fishery combined with a history of conflict and inability to reach census decisions. • Gaining adequate support for

• Limited ability for models to account for diversification in fleets.	explicit incorporation of economic control rules in harvest strategies • Transition costs of, and support for, fleet reduction • Inability to demonstrate the model's capacity to effectively reflect fishery behaviour and with a high degree of accuracy reflect the financial drivers for operator's businesses. • Timing – immediate need for the model due to need for management change for the GSV fishery. • Ongoing development, maintenance and operation of the model

Conclusions

While the project seeks to develop a bioeconomic model and identify, develop and implement improved harvest strategies, it is very clear that the path to uptake and the associated strategies will be very different between the two Gulfs.

For both fisheries, achieving industry understanding, support and buy-on will be pivotal, and considerable effort has been planned in this regard. The project is a somewhat light in terms of exactly how the optimal fishing strategies will be 'sold' to fishers and it would be helpful to be more explicit on how this will happen. To date for GSV it has been limited to invites to attend briefings / workshop for EOs. While committed to the project, there can be a tendency for researchers to assume that adoption will occur because the benefits have been demonstrated; in the final analysis, they are not responsible for adoption. The project must demonstrate a clear benefit for industry, at both individual and fishery levels. Once this is achieved the chance that industry will become innovators, adopters and drivers will be increased substantially. These are the roles for industry in the project – evaluating benefits and promoting the system to the fishers. Getting buy-on from managers, once industry is engaged and supportive of the process, will be relatively easy.

Giving some early indication of what economic control rules might look like and work in practice would help industry obtain a better vision for the project and thereby provide support for its outcomes. Also, the ability of the project to provide an economic focus and demonstrate economic losses (and ways to address them) is evident. To achieve acceptance of the project outcomes, it will be necessary to demonstrate the model's capacity to effectively reflect fishery behaviour and with a high degree of accuracy reflect the financial drivers for operators' businesses. There will be a phase-in period in the use of the model.

It would be useful if the outputs from the bioeconomic model were presented in ways that fishermen can understand, e.g. catch rates, TACC and profit. This will encourage fishers to be involved in discussions, see the benefit in the models, understand what the models can be used for, and then get on board to use

models more widely.

Practical examples of how economics and management of the fish can walk hand in hand, for example in the SA Pippi fishery where the economic model showed that profits would be decreased with a higher TACC, led to fishers asking for the TACC to be lower than it could have been set under biological considerations alone. For SA Prawns, this could be information on the best times of the year to take prawns and particular sizes, or how many boats/how much effort is necessary to optimise economic returns.

Spencer Gulf

The SGPF appears to be well placed to be the key beneficiary of the project. Since 1993/94 catches have been relatively stable and stakeholders have demonstrated responsibility and capacity to take on new ideas. The key initiative arising from project 2009/715, to establish the SGPF Economic Optimisation Working Group and consideration of two future options for management of the fishery under tradable units (quota or effort), is illustrative of the progressive nature of this fishery.

The culture of the fishery is to adapt and try new information. However there will be a period of time where the output from the models will be tested against actual outputs from the Gulf. Industry has stated that once the model has been tested and proven to provide a high degree of certainty, the fishery will consider the data developed by the model as one of the tools available to them in the process of making decisions.

A sub-Committee of the Fisheries Council including industry, PIRSA and SARDI. has been delegated to oversee the development of the new management plan and the included harvest strategy. For the SG, a research sub-committee is developing fishery a management framework. The framework will incorporate performance indicators that define stock status and guide fishing strategies throughout the year, based on measures of biomass using survey data in the short-term and model outputs in the long-term. Ideas developed by the sub-Committee will then be taken to industry for wider discussion, prior to more detailed development of the harvest strategy.

Gulf Saint Vincent

As discussed above it is hard to draw particular conclusions and recommendations at this time as to how the project legacy will eventuate in the GSVPF, or inform the outcomes of the current review of management. The Review will, however, define the principles for the harvest strategy, including how outputs from the model will be integrated.

It is somewhat encouraging that the fishery agreed to a form of transferrable nights in 2011/12, a first step towards addressing some of the very clear economic inefficiencies apparent in the fishery. The project outputs have the potential to drive change while providing a framework for improved management process. This will identify pathways to generate optimum economic returns from catches under a rebuilding strategy and inform performance indicators to guide decision-making.

_____

The project also aims to extend the work and facilitate the application of the model to other prawn fisheries when complete. This will have the advantage of increasing the usage of the project, as well as offering the opportunity for development of the model by other users, as has occurred in the case of rock lobster. For this to occur effectively and to make the work more accessible, it would be useful to provide funding to convert the current model code from MatLab to AD Model Builder (or some other user-friendly interface).

Recommendations:

i) Clearly outline how; industry will be engaged in the project; support for optimal fishing strategies will be achieved; and the results of the research will be extended to industry.

ii) Demonstrate how harvest strategies developed under the project will address the current economic losses being incurred by the fisheries at both fishery and operator level.

iii) Increase the role of industry associations in evaluating benefits and promoting an economic approach to management to the fishers.

iv) Ensure adequate industry input into model inputs to ensure model outputs reflect fishery behaviour and with a high degree of accuracy the financial drivers for operator's businesses.

v) Provide an early indication of what economic control rules might look like and work in practice to help industry obtain a better vision for the project and thereby provide support for its outcomes.

vi) Present the outputs from the bioeconomic model in ways that fishermen can understand, e.g. catch rates, TACC and profit.

6. Project: 2010/714 – Future Harvest Master Class

Project status:

The Project is now effectively complete, with the final report held back while awaiting result of request for extension. The project developed and delivered a one-day Master Class training programme consisting of four modules:

- **Key economic concepts** including: cost benefit, types of cost, role of markets and the role of government.
- **Bioeconomic modelling** including: dealing with common property/tragedy of the commons; key concepts of static bioeconomic models including MSY and MEY, and stock effects.
- **Optimising future catch** demonstrated using: bioeconomic model teaching software which incorporates fleet dynamics, input vs. output controls, demand, stock dynamic considerations and catch optimisation.
- **Competing uses and allocation between sectors** including optimal allocation, valuing non-market uses and the role of impact analysis.

The Master Class was rolled out between September and December 2010 in capitals and other cities in all coastal states (not Northern Territory), with a total of nine courses being delivered to 121 participants. Attendees comprised: fisheries managers (52%); industry (18%); researchers (23%); and NGOs (5%).

Response to the training was generally positive, with 84% of the participants considering that the Master Class had substantively improved their understanding of the role of fisheries economics in future harvest decisions.

In early 2011, the PI and project team worked with the CRC Communication and Extension team to develop a project variation (extension) at a cost of around $48,000, comprised of two major components:

1. Revision/refinement of the existing Master Class materials/resources to support further 'on demand' face-to-face delivery,
2. Development of the revised/refined Master Class as an online short course.

The revision/refinement of existing Master Class resources included new modules on i) fisheries policy and the role of economics and ii) cost-benefit analysis, and further development of the teaching software, including a manual.

The online short course would include the development of podcasts and audio files, supplementary reading material, web-based discussions and online assessment. After completing the online course a certificate of participation would be provided.

Assessment of this project by the CRC was held, pending the FH Legacy Review.

Proposed pathways to adoption (completed project)

By developing the capacity of fisheries managers, biologists and industry the project seeks to increase understanding and appreciation of the value of:

- incorporating economic targets into fisheries objectives;
- identifying (lost) opportunities associated with inefficient management strategies; and
- comparing different management measures/scenarios and trade-offs to determine how best to address lost opportunities

The project was also designed to make participants aware that current management arrangements are rarely optimal and to motivate efforts to improve them.

The increased capacity and understanding will provide a platform to support the uptake of outcomes of CRC projects, including decision support tools, fishing to market opportunities and the utilisation of capital in prawn and other fisheries.

The Master Class would be available on demand and on an ongoing basis.

Discussion

It is clear from feedback from Master Class participants and discussions with managers, researchers and industry that the course has been generally successful. The outcomes of the successful bioeconomics projects either completed or underway will provide a plethora of material suitable for incorporation into teaching materials. This, in turn will provide a very useful platform for extending the project outcomes to other fisheries, or increasing understanding by those in whose fisheries the projects were based. A strong network of fisheries economists has been built under FRDC project 2008/306

(Building economic capability to improve the management of marine resources in Australia) which is capable of delivering courses. Many of these fisheries economists are working on FH bioeconomics projects. The one-day Master Class will be available on an on-demand, cost recovery basis.

The teaching materials, while generally meeting the needs of participants, are in need of further development both in terms of material and means of delivery. Key feedback suggests that:

- 'tailoring' courses to jurisdictions and the economics of specific and relevant fisheries would make the courses considerably more attractive;
- in some select cases, having participants from more than one jurisdiction, particularly with common species/fisheries (e.g. rock lobster, abalone) would be very beneficial for knowledge transfer;
- attending a one-day course and expecting a high rate of retention beyond a general awareness of concepts is unrealistic. Similarly, to expect an audience of fishers and higher degree qualified fisheries managers/researchers to find a single level of course delivery sufficiently informative and challenging while not being overly complex is somewhat optimistic.

The online, self-paced course would address any tendency towards retention deficit caused by the intensity of face-to-face one day session.

There is an increasing demand for capacity building in fisheries economics. This is becoming evident as fisheries management becomes more sophisticated and harvest strategies and control rules in management plans become widely used. In addition, the increasing competition for resource access also heightens the demand for understanding economic valuation and principles of allocation.

There is a FRDC-funded project to develop a national approach to harvest strategies, which will incorporate the use of economic target reference points. This will boost the need for a wider appreciation of the value and use of economic analysis. Currently, many within industry and government are either unfamiliar with the underpinning economic theory (if any) behind these new forms of management, or have an incomplete awareness of the range of solutions available. The first round of Master Classes generated considerable interest and, in the absence of similar educational offerings, the ongoing need is clear.

The issue of ongoing funding and continuation of capacity building once the CRC is complete is an issue. Most fisheries departments and industry leaders have the resources and a high degree of 'willingness to pay' for staff development, particularly in the absence of other training options. The marginal cost of updating the proposed online short course and Master class material should not be significant, particularly if the former becomes part of a unit in an accredited course.

The fact that FRDC Capacity Building Programme has indicated that it would like to be engaged, mostly to be in the loop, and would be willing to be on a steering committee is thought useful. Further, FRDC have indicated that it is unlikely it will have capacity to promote and organise courses into the future.

SWOT analysis and review of current adoption strategies

Strengths	**Opportunities**
• Capacity to deliver • First round Master Class course developed and established, including software training resource • Effective courses – evidenced by positive feedback from course participants and indication of future demand • Availability of Future Harvest project outcomes	• Increased use of bioeconomics and economic decision support tools creating need/demand for master classes to address knowledge gaps • Momentum generated from first round of courses • Absence of other similar educational offerings • Use of flexible delivery methods utilising online delivery • Fisheries management/research institutions willing to support staff to undertake economics training and likely to maintain continuity • FRDC Human Development Programme • Overseas interest, indicating the possibility of leveraging off this material to increase international collaboration.
Weaknesses	**Threats**
• Courses not tailored for individual fisheries/jurisdictions • Single-jurisdiction courses do not allow for adequate transfer of knowledge • Lack of retention of course content among participants • Catering for the different needs of fishers and managers/biologists in a single workshop	• Lack of interest from key stakeholders, and especially industry/post harvest • On-going source of funding post CRC • Time pressures on potential participants, including mangers and industry • Lack of individuals/entities to initiate and drive 'on demand' courses

Conclusions

A variation to project 2010/714 should address the following:

i) A two-pronged approach via:

- The retention, with refinement and update of material/resources, of the current Master Class course to be delivered on an 'as needs' basis, with particular consideration to those jurisdictions where FH outcomes are to be implemented. This course would continue to

focus on introductory material and would be suitable for advisory (MAC) committee members.

- An online short course aimed at fisheries professionals engaged directly in fisheries management or allied fields including fisheries research. The course would enable self paced learning, noting that if web-based seminars are to be used, start and end times of units will need to be coordinated. This course may be suitable for use as credit towards an accredited unit within a graduate diploma/certificate course. It is not clear if the effort required to accredit the course would be justified.

iii) Using input from state-based economists in both the online course and on demand, self-funding Master Classes and other face-to-face courses, will reduce costs, ensure relevance and increase participation.

iv) Refinement of the existing Master Class materials/resources to include: refinement of the bioeconomics teaching tool to enable easier 'tailoring' to case study fisheries of interest; expansion of the module to expand treatment of the role of economics in fisheries policy; review by economists that were part of the Master Class delivery team; and the addition of a new module on cost-benefit analysis.

v) The use of case histories and examples of particular application to jurisdictions, with an emphasis on FH projects, will also provide relevance and increase the awareness and adoption of FH outcomes.

vi) Short courses based on Master Class and online course material could be usefully coordinated with major meetings where the field of bioeconomics is applicable e.g. at Seafood Directions.

vii) A focus of the online course on fisheries managers/researchers/ senior industry stakeholders so as to help bridge the gap between bioeconomic research and uptake by decision makers and key advisers.

viii) A user group comprising course attendees and those undertaking the distance-learning module could be developed, which would form a network of practicing fisheries managers and other users of bioeconomic analysis

ix) A legacy strategy to be developed to provide for longevity for the materials and associated websites beyond the life of the current project. Options include hosting on the FRDC site, the University of Tasmania or the CRC.

Recommendation: Extend the current Master Class in Fisheries Economics Programme, based on the document previously developed and incorporating the above comments.

7. Project: 2011/750 – Optimising business structures and fisheries management systems for key fisheries

Project background and status:

The project arose from the identified (CRC/FRDC/industry) need to look at structural factors that impede the maximisation of profitability in many

Australian fisheries. The imperative for the work is being driven by declines in the economic performance of fisheries and the need to assist industry and managers to generate a vision, cultural change and integrated solutions towards improving this performance.

The project covers selected Seafood CRC participant fisheries, i.e. prawns, rock lobster and abalone. For each fishery the intention is to i) undertake an assessment of economic performance using an established World Bank sponsored methodology and ii) use workshops and a group of experts to identify issues and opportunities for improving the economic performance of CRC fisheries. This information will be used to identify the operational procedures, business structures and management/legislative systems that could be established to improve the economic performance. There are strong links between this project and the other CRC projects, which are developing economic decision support tools.

The project was modified to focus on fisheries sector-by-sector and initially work on the selected prawn fisheries (SA prawn fisheries in the Spencer Gulf and Queensland East Coast Trawl). Key constraints and areas for economic improvement were identified for all fisheries, as per the project objectives. The Spencer Gulf work was particularly successful and has exceeded the project objectives, having led to an established process to implement reform in a number of areas. These reforms will include amendments to the current harvest strategy and consideration of alternative management mechanisms based on tradable units. The task in Queensland was considerably more challenging and pathways to address the issues identified and leave a project legacy are not clear.

Proposed pathways to adoption (completed project)

This project is phase one (identifying options for improving economic performance) of two, with adoption pathways becoming more apparent in phase two: (facilitating change in fisheries where the greatest potential for change exists). As noted above, the Spencer Gulf Fishery has identified a pathway to adoption of project and identified a process and timelines for implementation which will be driven by industry and supported by South Australian fisheries managers and scientists.

Phase one of the project is focusing heavily on raising awareness and getting industry buy-on via a process of workshops, interviews, and the establishment of a Stakeholder Advisory Group (SAG) for each participating sector. The SAGs have a particular responsibility with respect to establishing a pathway to adoption and under the project document are assigned with the following responsibilities:

- assess changes to operational procedures, business structures and resource management systems that could result in major improvements in the economic performance of selected fisheries;
- discuss options for overcoming the inertia and resistance to change, and other factors, that are likely to impede the implementation of major innovations;
- identify the complex and inter-related changes to operational procedures, business structures and resource management systems that will be required achieve major improvements in the economic performance of

selected fisheries;

- describe a pathway to adoption for implementation of major innovative changes in each fishery; and
- provide input to assist the development of a proposal to facilitate the adoption of opportunities to improve economic performance in selected fisheries assist

Discussion

There is little doubt that there is a need for a scoping project of this type, as demonstrated by the strong stakeholder support shown in SA and in one location in Queensland. Fisheries managers were also very supportive and involved in both states. The use of practical examples, drawing on industry and other expertise, from fisheries that have achieved some success in pursuing economic efficiency, is far more effective then dry presentations by government economists, managers or scientists. The process, being both independent, and largely external, encourages a free-wheeling discussion of integrated alterative arrangements to address key constraints to economic efficiency. Such free discussion of strategic issues rarely occurs at MACs or like advisory bodies, which are often pre-occupied with short-term (but important) tactical issues.

While comprehensive and integrated in approach, the Anderson and Anderson indictors system developed for the World Bank to measure wealth generation on fisheries appears somewhat ahead of its time in relation to forming a basis for decision making by industry and managers as suggested in the project document. The main benefit of the approach is that it is a simple and efficient way to objectively identify issues that may be impeding the economic performance of a fishery and thus facilitate discussion of options for addressing these impediments. As such it will be an important step in the achievement of a tangible legacy, such as that which appears likely to be established in the Spencer Gulf Prawn Fishery. While mentioned in the project document, it is unclear as to how social issues are to be addressed. However, social implications are, arguably taken into account as industry assesses the benefits and costs of various options available.

The significant economic performance gap in CRC target fisheries (estimated at around $200 million) suggests that the project has the potential to provide a significant legacy by increasing efficiency. Recognition of this gap, exacerbated by price competition, a high exchange rate and rising costs, has led to a growing recognition across Australian fisheries of the need for change. This awareness provides fertile ground for implementing the outcomes of the project.

In recognition of the importance and potential value of investing in R & D to address economic efficiency, there is a growing body of decision support tools and resources to assist focus on economic, and to a lesser extent, social outcomes, including FH projects. So far, many initiatives have focused on addressing single elements, such as considering the effect of TAC setting on NPV for the fleet as a while via a bioeconomic model. There is significantly greater promise to be had from the use of integrated solutions that can combine *inter alia* setting catch levels, efficient use of capital, knowledge of the value chain and an efficient balance of risk, catch and cost in considering costs of management.

These approaches will enable both legislative change to take advantage, for instance of market preferences when whole-of-fishery responses are required, or at the enterprise level, when making investment decisions.

Governments have been slow in taking concrete steps on behalf of the broader community to identify and achieve economic and social objectives, or act proactively regarding management for economic efficiency. Where some willingness has been displayed, they will only act upon industry consensus, which can tend to lead to lowest common denominator outcomes. At the operator level there remains significant confusion between individual financial performance and overall fishery efficiency. For many fishers, decisions on issues such as optimum levels of effort are seen to be the business of industry, not research departments. There is some reluctance to accept the use of, for instance, fishery assessment models to drive bioeconomic modelling which in turn may be used to set TACs, levels of effort, size limits or closed seasons.

A number of fisheries in most need of change (e.g. Qld East Coast Prawn) are in dire economic circumstances and lack the industry government resources to change. In these circumstances, the project will leave a questionable legacy in terms of adoption.

SWOT analysis and review of project and adoption strategies

Strengths	**Opportunities**
• Clear need for the project • Strong stakeholder support and engagement. • Two objective processes for identifying weaknesses to be addressed: Anderson analysis and economic assessment • Focus on real-life examples drawing on management success stories • Independent, external process allowing free discussion of fundamental issues not often discussed at MACs or like advisory bodies	• Significant economic performance gap in target fisheries • Changing attitudes to economic efficiency and MEY approaches • Emerging body of decision support tools and resources • Use of integrated solutions
Weaknesses	**Threats**
• Low likelihood of World Bank (Anderson and Anderson) Indicators system being used as an objective tool for fisheries management decision-making • Unclear how social issues will be	• Reluctance of state governments to act proactively regarding management for economic efficiency • Confusion between individual financial performance and overall fishery efficiency.

addressed	• Inability to set clear objectives and establish trade-offs between economic, biological and social outcomes • Fisheries in dire economic circumstances unable to have effective input into process • Lack of capacity within industry to take responsibility for identifying improvements required

Conclusions

Where industry has the capacity (financial and otherwise) to take responsibility for identifying the improvements needed in their fishery, the project has the potential to make progress towards management and economic reform. Examples of this reform are to be found in the two SA Gulf prawn fisheries in South Australia. One of these fisheries, the Spencer Gulf Prawn Fishery, has taken the project outputs and moved part way to the proposed phase two of the project and has established a process for economic reform. The Gulf St. Vincent fishery was predictably more difficult. It has long been challenging to manage, and with the recent, largely unexplained, decline in stocks and revenue, getting consensus on reform will be difficult. The project did, however raise awareness of options (as per its objectives) and tradable nights were introduced in 2011/12 – with the resulting increase in economic efficiency. It should be noted that these are relatively simple fisheries, dealing with well-understood stocks and, in the case of Spencer Gulf, with a long history of cooperation, collaboration and innovation.

The East Coast of Queensland appears to be a case where the issues have been identified, the tools are ready (or are almost ready) to be applied, but there is a lack of industry leadership and government capacity to implement the level of reforms necessary to achieve the available benefits. Further investment to take the issues identified to the level envisaged by phase two of the project would not seem to be justified.

The abalone sector has already expended considerable R & D effort on improving spatial management (and marketing), with limited work on industry structure, particularly in respect of lease and owner divers. Some discussion and suggestions for improving industry structure, both by fishery and, comparatively across fisheries, would be very valuable, as would analysis aimed at showing how the quality, quantity and value of abalone catches could be improved by optimising the timing of harvest. Developing linkages between this project and project 2009/714.30 – *Economic management guidance for Australian abalone fisheries*, will be important as it will be for the corresponding projects on prawns and rock lobster.

Rock lobster would seem to present a major opportunity for further work; again examining issues around business structures and increased opportunities for cooperation.

Recommendations:

i) For rock lobster and abalone, further develop links with and support from the industry bodies (ACA and SRL Ltd), and their respective boards.

ii) Develop clear linkages between this project and the economic decision-making tool projects (prawn 2011/750; abalone - 2009/714.30, rock lobster 2009/714.10 and 2009/714.20.

iii) Consider an increase in funding for the project to ensure adequate resources to complete workshops in the remaining fisheries. The work on prawns has been a relatively resource-hungry process and ~50% of the project funding has now been expended.

8. Project: 2010/766 – Policy shift to risk-based fisheries management

Project status:

The project is using a risk-based approach to analyse the regulatory frameworks (essentially the current management plans) used in seven selected fisheries, each of which have varying levels of complexity. Biological, economic and social risks will be covered under the analysis. Project implementation has been slower than expected, due to a combination of the complexity of the work involved and staffing resources. A Milestone Variation Request is now pending for the project.

A pilot workshop examining the management plan for the West Coast Deep Sea Crustacean Fishery (WCDSCF) has been completed. The workshop involved a group of fishers and other stakeholders, using a standard risk/consequence analysis. The workshop identified key risks in the fishery and the degree to which the current measures were necessary and sufficient to manage risk resulting from commercial exploitation at an acceptable level.

The workshop proved somewhat ambitious, given the size of the audience and time necessary to work through the high number of identified risks/issues (157). A final list of eight risks were identified with greater than a 'negligible' residual risk, after application of current treatments (regulations). A number of regulations were found to be in need of change and a range of broader issues was raised including a comparison of permissive vs. prohibitory approaches. The project milestone report of May 2012 outlines a number of key learnings from the workshop.

Detailed analysis of the seven identified management plans has been completed. Analysis across management plans where there is significant spatial/species overlap has also occurred. Consideration has been given to increasing management flexibility by shifting more routine functions, regulations and provisions to schedules outside management plans to enable timely variation in response, for instance, to market or environmental change.

A new approach to the seven fisheries is now proposed. This is built on:

- consideration of 'control points' where effective control is necessary to maintain acceptable risk;

- completion by the project team of fisheries specific schedules based on Minimum Effective Regulation (MER) assessment guidelines (biological, economic, social) and dissemination to stakeholders for feedback; and
- a series of workshops with a small number of individual 'specialists' in each fishery who will conduct a risk assessment based on the schedules.

A significant change in the regulation of fisheries in WA is anticipated with the development and impending release for comment of the Draft Fisheries and Aquatic Resources Management Act (the Draft Act). Among other things, the Draft Act will provide, over time, for all existing fisheries management plans to be replaced with integrated Aquatic Resources Management Strategies, (ARMS). At the next level of management, Resource Use Plans (covering commercial, recreational, habitat and other uses) will provide the operational details of how various users (and uses) of the resource will occur. The Commercial Resource Use Plans will be analogous with the current management plans. Other changes to the Draft Act of relevance to the project include risk-based assessment, deregulation and devolution and delegation of decision-making.

Proposed pathways to adoption (completed project)

One of the key corporate objectives of WA Fisheries is to provide an enabling environment for the fisheries sector by minimising regulatory burden, or in the terms of this project, through minimum effective regulation (MER). Following discussions with executive managers in WA Fisheries, it is clear that provided the project is implemented effectively, including adaptation to likely outcomes arising from the Draft Act, its outcomes will be adopted.

By way of example, the Department now manages its activities via a comprehensive planning tool (FishPlan), which establishes a framework for allocation of resources to individual capture fishery assets, thus providing greater certainty to peak bodies and industry participants on the timelines for management reviews. The Department intends to utilise the outputs of the project to simplify management arrangements for those fisheries to be reviewed by the project, most likely under the provisions of the Draft Act. The extract below from FishPlan refers:

Resource	Fisheries	Method	Mgt Instrument/Estimated value	Mgt Focus	Base activities	2011 / 2012
Statewide Crustaceans	West Coast Deepsea Crustacean Interim Managed Fishery	Pot	IMF 7 permits $2 m	Watching brief **Mgt Plan amendments** **Subject to Seafood CRC MER Project**	L2 Research monitoring & assessment L1 Compliance risk assessment L1 Mgt (quota setting) EPBC compliance	**Mgt Plan amendments** **MER Risk Assessment**

Minimum effective regulation is included as a principle for the decision making under the new Draft Act.

Discussion

Fisheries regulation in WA has generally been developed via individual fishery management plans. The development of plans in isolation and at different times, in a rapidly evolving fisheries management climate, results in inconsistences and inefficiencies within and across plans through time.

The project aims to develop a robust and comprehensive framework for assessing risk and reducing unnecessary regulation, apply it to seven fisheries and extend its use to all WA fisheries. The resultant MER regime will reduce the cost burden of fisheries/resource management to the Department, the commercial industry and the community as a whole.

The commitment by the Department to use the results of the project are clear, and WA has a long track record of the application of risk based approaches to fisheries management, particularly to ecosystem effects of fishing via a risk register which is applied to all WA fisheries. Additional oversight and stronger linkages with the existing risk management process may be beneficial. Experience of the trial fishery highlighted the need for a different approach to provide a more manageable process for application to other fisheries. Such a process, involving additional in-house analysis prior to working with stakeholders, has been developed and will be tested in the New Year. The proposed consultative process, new workshop approach and knowledge and understanding of the social and behavioural context of the fishery will support the exploration of permissive regulatory approaches.

Unless clearly planned, the reviews of regulation within the trial fisheries stand the risk of becoming overly complex and difficult to interpret. Using the Steering Committee envisaged in the project, the proposed methodology could be reviewed prior to testing, and particularly by those responsible for fisheries policy within the Department. In the final analysis, it is Government who will have to agree to changes proposed under the project, with the support of stakeholders.

The proposed participatory approach seeks to deal with the latter issue. WA Fisheries has a primary focus on delivering sustainable fisheries and does not have an explicit process for directly 'trading off' ecological risk with economic and social risk, although its risk-based EBFM approach incorporates environmental, economic and social factors. Clarification of how the project intends to draw together the ESD elements outlined in the MER Assessment Guidelines would be helpful, and in particular how MER analysis will achieve 'a minimum level of regulation that maximises social benefits'. While minimising regulation is, of itself, a worthy endeavour the exercise is not without cost. Providing some indication of the likely net benefits from regulatory change would seem to be a useful tool for encouraging extension of the process.

As discussed in the opening paragraph, there is broad agreement that many of the current management plans would benefit from review and regulatory reform with a view to streamlining, standardisation (where possible) and removing unnecessary regulation. Given the focus on increasing prices and lowering costs in a limited production environment, the opportunities for generating substantial benefits are clear. The new Draft Act proposes a number of innovative changes, which, in turn, will have far-reaching implications for regulatory frameworks. The project will provide a useful process, which will

assist the review of regulation as fisheries make the transition from the existing management plans to the new ARMS and Resource Use Plans. The incorporation of an up-to date conceptual framework for integrated resource management based on the principles of Ecologically Sustainable Development (ESD) in the Draft Act is fully consistent with the approach taken by the project.

Since approval of the project, the emergence of the Draft Act has the potential to substantially change the intended direction of the project and its extension and adoption. Probably the most substantive issue is the clear resource management planning framework which, as it appears currently, will not allow for either substantial changes to existing management plans (these will transition to the new Resource Use Plans) or a separate 'State Management Plan', both of which were envisaged under the current project. As discussed earlier however, early unofficial indications are that the Resource Use plans will be analogous to current management plans and the process envisaged under the project will be readily adaptable to the Draft Act which is likely to enter into effect during 2013. It would seem essential that once an exposure draft of the Draft Act is available, a comprehensive analysis of how the proposed regulatory analysis will be used and adapted should be undertaken. Finally, to maximise project output uptake care will need to be taken to ensure that the final agreed process is manageable and easily communicated to prospective fisheries/resource users.

SWOT analysis and review of current project and adoption strategies

Note that this analysis goes further than the adoption strategies of the outputs of the project, owing to the current status of the project.

Strengths	**Opportunities**
• Commitment by WA Fisheries to implement outcomes • Proven experience available in the application of risk based/IFM approaches to fisheries management • Revised process for risk assessment and regulation simplification developed • Harnesses industry input and knowledge to inform/assess the risk of using permissive approaches	• Potential for all WA fisheries to make real efficiency/productivity gains through regulatory reform • Time of major regulatory change in WA and review of management arrangements (new Draft Act) • Integrated, ESD approach of project closely aligned with that of new Draft Act
Weaknesses	**Threats**
• Project scope very ambitious • Lack of oversight/input from steering committee • Unclear process for pulling review elements (biological, economic, social, legal) together	• New Act reduces the relevance of the project, including intention to produce a Draft State Management Plan and management schedule for each fishery • Move to fully tradable rights and

in a coherent package for regulatory reform • New workshop and consultative process untested • Cost/benefit of regulatory changes unknown	Annual Catch Entitlement (ACE) approach will change risk profile of fisheries and management control points • Process becomes unwieldy and overly complex, hindering/restricting use in other fisheries

Conclusions

While there is need for clarity around the process and form of output of the project, the broader context for the project established at the commencement of its implementation remains valid:

- There is an established need to simplify fisheries regulation and to develop an effective risk-based process to systematically examine management frameworks for fisheries resources.
- There is a commitment to incorporate the outcomes of the project into revised regulation, which will provide a long-term legacy to the fisheries/fisheries resources being used as pilots.
- Provided the project is successful, there is the opportunity and intention by WA Fisheries to extend the methodology to all WA fisheries/fisheries resources.
- If the project is deemed successful and its outputs are adopted widely n WA and the MER process is published and reported as good/best practice, there is potential broader adoption by other jurisdictions in Australia.

In answer to a request from the CRC, and due to the current changes both in project process and, as is most probable, the governing Act, this section goes beyond legacy considerations.

Recommendations

The proposed variation to project 2010/766 should address the following:

i) Sign-off by the steering committee on the final form of the risk-based process for reviewing and determining change to current fisheries regulation frameworks.

ii) Agreement on a revised and simplified risk assessment workshop process.

iii) Process for the continuation of adaptation of workshop processes; rather than running all seven in close sequence, suggest run a second pilot, analyse and modify, then run the remainder.

iv) Closer links with senor WA Fisheries staff dealing with fisheries policy reform.

v) Clarification of how the outputs of the project can be integrated into the new regulatory structure envisaged under the new act, including resource

use plans, the introduction of devolved decision making and use of Annual Catch Entitlement (ACE).

vi) Determination of benefit cost associated with regulatory reform to encourage uptake and participation.

B. Stock enhancement

1. Project: 2009/744 – Propagation and sea-based growout of sea cucumber stocks in the Northern Territory

Project status:

Tasmanian Seafoods Pty Ltd (TSF), as the most significant holder of wild fishery licences in Australia has been very successful in developing the viability of harvesting, processing, and marketing sea cucumber in Australia. The initial focus on improving yields from the wild fishery and post harvest processing systems has now shifted under this project to seeking innovative ways to increase the overall production capacity of TSF. It seeks to achieve this through the release of cultured juveniles into the wild population to augment the natural supply of juveniles and optimise harvest by overcoming recruitment limitation. The company has spent the past eight years developing a commercial hatchery and nursery facility in Darwin, which now has the capacity to produce 300,000 animals per annum. Year round spawning and two releases of juveniles has been achieved. Contribution of the releases to the local population was detected, with promising growth rates. Post release mortality has yet to be ascertained.

The Darwin Aquaculture Centre has improved the settlement and survival of juvenile sandfish through experimentation with different settlement substrates and larval diets. Preliminary work and a workshop on a bioeconomic model for sea cumber sea ranching operation has been completed.

Proposed pathways to adoption (completed project)

TSF will move to a commercialisation phase in 2015 based on the outcomes of the project and other related considerations. According to the project document, this will require a successful application to NT Fisheries for an aquaculture license and an approved Environmental Management Plan by the environmental regulatory department. The success of the application will be based on the pilot trials demonstrating technical viability and no detrimental environmental effects.

Discussion

The NT Government has long been supportive of the development of ranching of trepang in the Northern Territory both through the augmentation of the existing fishery, or the creation of a new extensive aquaculture industry where areas of seabed are leased for the purpose of growing hatchery produced sea cucumber. The project builds on significant past investment by TSF, which has shown promising results. Strong links with aboriginal communities on Groote Eylandt have been established, building on strong community interest in opportunities for employment and economic development. There has been encouraging progress with economic feeds and high survival rates for hatchery-produced juveniles. The risk of translocation of disease and parasites and of increased prevalence or virulence of pathogens linked to hatchery operations has been minimized through effective biosecurity controls.

The new NT Fisheries Enhancement Policy states that stock enhancement will be considered only where other fisheries management methods have been demonstrated to be ineffective at meeting fisheries management goals.

Currently, there are uncertainties concerning low recruitment vs. overfishing as a driver of stock condition of sandfish, which may reduce the ability of the project to obtain the necessary license to operate. After 12 months, there has been a tendency for animals to lose their markers, making it difficult to discriminate between wild and enhanced stock.

The demand for sea cucumber remains strong, particularly in Asian markets. A new policy on fisheries enhancement, including ranching, stock enhancement and restocking has been finalised. There is a lack of recovery in wild fisheries and strong variation in recruitment, which, without enhancement, will severely constrict the productivity of the resources. The project has made substantial efforts to engage aboriginal communities and will continue to do so as economies of scale increase. There are strong links between this project and initiatives by Government, including with the Warruwi community on Goulburn Island.

Tasmanian Seafoods are strongly of the opinion that governments are ineffective long-term participants in fisheries development. The TSF view is that the sort of cooperation potential shown in working with the Umbakumba community is likely to be a model of engagement that could be rolled out across the NT coastline, driven by the private sector.

The aims of the project appear increasingly to be technically feasible, although the commercialisation of the project continues to present challenges. These include the cost of production of juveniles and price competition from other aquaculture producers, and transportation methods. While TSF currently owns all licences to harvest sandfish and other sea cucumber species, there remains the possibility of the establishment of leased operations for the ranching of sea cucumber.

SWOT analysis and review of project and adoption strategies

Strengths	**Opportunities**
• Project builds on significant past investment • Strong Government support • Strong links/common interest with aboriginal communities • Encouraging progress with economic feeds and high % survival of juveniles in hatchery • Low risk of translocation of disease and parasites and of increased prevalence or virulence of pathogens liked to hatchery operations	• Strong market demand • Policy now in place, with a strong preference for ranching • Lack of recovery in wild fisheries • Engagement, leading to support, by aboriginal communities • Flow on benefits of research outcomes to Government projects, e.g. at Goulburn Island • Advances in manipulation of fishing patters combined with stock enhancement to minimise adverse Allee effects and yield greater productivity overall
Weaknesses	**Threats**
• Uncertainties concerning low	• Cost of production (of juveniles)

recruitment vs. overfishing as a driver of stock condition • Loss of markers after 12 months making enhancement	• Price competition from other cultured products • Legislative uncertainty regarding leases over grounds currently open to the wild (enhanced) fishery • OH and S issues constraining indigenous harvesting

Conclusions

The project has produced encouraging results and most significant issues appear to be linked to commercial feasibility and the need for increased clarity on the degree to which the NT Government will support stock enhancement if the decline in sandfish populations has been more a result of overfishing than reductions in recruitment. Ensuring that project outcomes and subsequent commercialisation aligns with the needs and aspirations of aboriginal communities is critical to obtaining government support.

The matter of commercialisation is primarily a matter for TSF and it is difficult to make recommendations in this regard.

Recommendations

i) Clarification of the issue of sandfish recruitment

ii) Clear statements by TSF concerning plans for community engagement and involvement as commercialisation occurs.

2. Project: 2009/710 Bioeconomic evaluation of commercial scale stock enhancement in abalone

Project status:

In 2004 and 2006 the Western Australian Abalone Industry Association (WAAIA) and the WA Government commenced large-scale trials to demonstrate the economic viability of stock enhancement of greenlip abalone. Based on the success of the field trials and the results of this project, the intention was to establish a stock enhancement company to commercialise the results. In support of this a CRC New Investment project ("2010/784 Commercialisation of abalone stock enhancement) was successfully proposed and approved for funding in 2010. However the wild stock industry proponents withdrew their support over disease concerns (see later).

This project output provides: additional information on long-term growth and survival; bioeconomic analysis of large scale stock enhancement; and evaluation of appropriate wild-stock management protocols and biosecurity protocols for stock enhancement.

Technically, the project was a success, reaffirming earlier research and indicating that the commercial enhancement of greenlip abalone in WA is feasible. Research concluded that equivalent survival and growth to natural populations can be achieved with hatchery bred and released abalone, subject to adequate consideration of local habitat capacity and controlled release

densities, and size at release. Overall the study suggests that, as long as release densities are controlled within natural limits, commercial scale stock enhancement can be attained with minimal ecological impacts.

Currently however, the main stumbling block to further development of abalone stock enhancement in Australia is the disease issue associated with the highly virulent herpes-like-virus (Abalone Viral Ganglioneuritis – AbHV-1).

In an effort to overcome concerns over AVG and other biosecurity risks, two risk assessments were completed[13] and incorporated into the development of a Restocking and Stock Enhancement Policy. The risk assessments concluded that biosecurity control measures can facilitate the stocking of hatchery-reared animals of equal or higher health status to that of aquatic animals already living in the considered "open systems". Acceptance of this finding by wild fishery stakeholders will be necessary if stock enhancement is to develop at a commercial scale.

Proposed pathways to adoption (completed project)

The project has a very clear pathway to adoption via the establishment of a stock enhancement company, which would be established with a business plan based on the analysis derived from the large-scale trials and the project results. To be acceptable to industry and government, any commercialisation would need to integrate stock enhancement into wild stock management and minimize, to an acceptable level, the ecological and genetic risks associated with enhancement

Discussion

At least initially, the project had strong Government and industry support, which backed by previous high quality research outcomes and a strong research team, delivered a promising outcome.

The risk assessments identified some high risks associated with abalone stock enhancement with current legal management arrangements, although it has been generally accepted that the risks also exist in the wild harvest sector, particularly where abalone are retained under stressful conditions. Industry considered that while the benefits of enhancement would be considerable, the possible cost in associated losses in the event of an AVG outbreak outweighed the benefits, making the risk unacceptable.

The carrying capacity of reefs at prospective enhancement sites suggests that it should be possible to increase the biomass and profitability without impacting the current fishery. This represents an opportunity for wealth generation for both harvest and aquaculture sectors. At the national scale, an enhancement scenario involving an annual release of 6.1 million, 4 cm juveniles (~age 2) resulted in a 60% increase in GVP ($25 to $40 million), a 120% increase in profitability ($12 to $26 million), and NPV ($190 to $420 million; 6% discount), and a 25% increase in spawning stock biomass.

[13] i) Assessment of the risks associated with the release of abalone sources from Abalone Hatcheries for enhancement or marine grow-out in the open ocean areas of WA. Fisheries Research Report No 227, 2012. WA Department of Fisheries and ii) Disease Risk Assessment for Abalone Stock Enhancement. Report of FRDC Project 2011/046

The establishment of a stock enhancement company, along the lines of the Challenger Scallop fishery in Golden Bay, New Zealand, offers considerable opportunity and preliminary work on this has been completed. A draft restocking and stock enhancement policy is currently with key stakeholders for their comment, due 15 February. The policy will assist with the establishment of a management framework to consider future restocking and stock enhancement proposals. The key objectives of this draft policy are to ensure proposals for restocking and stock enhancement are consistent with the objects of the Fish Resources Management Act 1994 and that the activities ensuing from these proposals have negligible adverse impacts on the aquatic environment, and are appropriately assessed and managed.

Despite the risk assessments, policy development and measures under consideration to reduce risk to acceptable levels, there remain strong biosecurity and genetic concerns among industry. While there are indications that the risk of a disease outbreak exists in wild populations, in holding facilities and aquaculture farms, the costs associated with a disease outbreak in the marine environment, while considered remote, are likely to be borne disproportionately by the wild harvest sector. This situation reflects the current status of the abalone wild harvest sector, which is considered a mature and well-developed fishery; whereas, whilst highly prospective, abalone aquaculture in Western Australia can be characterised as an industry in an earlier stage of development

SWOT analysis and review of project and adoption strategies

Strengths	**Opportunities**
• Government and industry support • Strong research team • Availability of growth and survival and other biological and economic data • Strong links with other abalone research	• Carrying capacity of reefs • Increasing the profitability and biomass without impacting current fishery • Wealth generation for both harvest and aquaculture sectors • Establishment of a stock enhancement company • Draft enhancement policy under development
Weaknesses	**Threats**
• High risks identified with current legal management arrangements • Perceived one-way threat to the wild fishery	• Biosecurity and genetic concerns • Difficulty in obtaining industry consensus

Conclusions

The risk assessments showed that while likelihoods of the AVG virus occurring in a hatchery range from “negligible to “low” should no additional management measures be applied, the consequences of detection (including biological,

economic and environmental) are generally "high" and in two cases the resultant risks were "unacceptable", under current legal management requirements. The primary concern is that the virus could become established in a hatchery facility and then be more likely to infect wild stock through the release of hatchery released juveniles into the oceanic waters. The likelihood of this outcome occurring has been assessed as very low if the suggested (within the risk assessment) hatchery management measures are adopted so as to mitigate the risk to an acceptable level . Protocols are in place to ensure that any emergence of AVG in a hatchery would be detected. The placement of grow-out structures and juvenile releases could also be planned in a manner to both minimise the likelihood of transmission to wild stocks and limit the spread of any infection.

Recommendations

See end of section on Stock Enhancement

3. Project: 2011/762Recovering a collapsed abalone stock through translocation

Project status:

The project is in the early stages of implementation. Following a catastrophic mortality of Roes abalone in a portion of Western Australia coast during the summer of 2010/11 and a subsequent fishery closure, industry requested that the possibility of assisted recovery through translocation/stock enhancement be investigated. The project seeks to establish founder populations of Roe's abalone in areas of mass mortality, evaluate the genetic structure of existing and founder populations, compare natural and assisted recovery rates, and evaluate the genetic contribution of existing and founder populations to stock recovery.

Proposed pathways to adoption (completed project)

The project seeks to demonstrate the effectiveness of multiple founder populations in the recovery of the Kalbarri abalone fishery, which, if successful, will demonstrate the value of founder populations as a fisheries management tool. It is suggested that the outcomes of the project will be of value to state and national abalone industry bodies, nationwide abalone scientists and biologists as well as regional abalone managers.

If successful, the results of the research will be promulgated through a variety of industry meetings, conferences and workshops thereby increasing the targeted use of stock enhancement as a means of recovering abalone stocks.

Discussion

WA fisheries have a strong track record in abalone stock enhancement/recovery using translocation, stocking and restocking methodologies. The work has been requested by industry and for its part, has agreed to support a closure, which will be essential to recovery efforts. The controversy in WA surrounding greenlip and the risk of AVG was sufficient to halt a technically feasible commercial initiative. Translocation, based on local wild stocks is considerably less controversial than hatchery-based stock enhancement

Climate change predictions suggest that there are likely to be recurrent warm water events, which could undermine efforts to reseed stocks in affected areas.

While feasibility of the method may be proven there remains considerable resistance to the use of re-seeding by other states, which will limit the uptake of results.

The primary weakness of this project is the extreme logistical issues associated with the study area. The affected reefs are the most remote abalone reefs in Australia, being 700km North of Perth, and the weather conditions needed to carry out the translocation are extremely rare. Consequently the opportunities are few. To date there have been five attempted translocations, but in each case conditions have not been optimal.

SWOT analysis and review of project and adoption strategies

Strengths	**Opportunities**
• Proven expertise and track record in abalone stock enhancement/recovery • Industry driven and supported research. • Translocation less controversial than hatchery-based stock enhancement	• Carrying capacity of reefs • Increased understanding of the value of founder stocks to the recovery of depleted populations • Changing environment requiring mitigation strategies in an increasing number of fisheries
Weaknesses	**Threats**
• Logistical issues (remote ness of study site, coupled with adverse weather conditions).	• Recurrent warm water events • Lack of uptake of results by other states

Conclusions

The project faces a range of challenges and even if successful, the threat that recurrent warm water events will simply result in the same levels of mortality that occurred in 2010/11. Despite this, the work offers the opportunity to gain a further understanding of abalone stock enhancement using the translocation of existing stocks. While has been attempted in other states, with limited success, including NSW and Tasmania, there remains considerable interest in this activity, both from industry and fishery managers.

Recommendations

See end of section on Stock Enhancement

4. Project: 2005/029 Factors limiting resilience and recovery of fished abalone populations

Project status:

This Tasmanian project to determine the feasibility of using translocated black lip abalone to enhance the recovery of severely depleted stocks was completed in 2010. The project results were somewhat equivocal in that while the translocation was relatively successful at relatively low cost and achieved a clear increase in the density of abalone, a number of factors resulted in the conclusion

that there was limited likelihood of the method being widely used in the future. The key problems were identified as:

- movement of translocated abalone away from the release site reducing the likelihood of establishing effective spawning populations;
- little evidence of increased recruitment associated with translocation;
- the relatively small spatial scale of benefit of enhancement resulting in the conclusion that rebuilding depleted stocks beyond discrete reefs, using the methods explored under the project, would not be viable as an industry funded commercial venture; and
- the difficulties associated with securing a supply of wild abalone for translocation surplus to requirements of the fishery.

Since the time to determine if a viable spawning population was established using translocation is at least seven years, final conclusions about the project are only just being drawn using further surveys of the experimental sites.

The current view of researchers is that the success of translocation of mature adults as a tool for stock rebuilding will be dependent of the rate of dispersion of translocated adults. Larval recruitment derived from translocated populations will be subject to normal spatial and temporal patterns of reproductions and recruitment as experienced by wild populations, and assisted recovery will be measured over decades, rather that years. Localised depletion of abalone populations through setting of high TACs and low legal minimum lengths remains on of the largest threats of the going productive and economic viability of abalone fisheries. Translocation should not be considered as a tool for remediation following poor management decisions.

Proposed pathways to adoption (completed project)

The project hoped to show that translocation was a viable option for recovering severely depleted populations, where there is little or no prospect of recovery under natural conditions. As discussed above, the results of the project were somewhat disappointing and it is unlikely that translocation will be adopted as a means of recovering stocks in depleted areas within Tasmania in the foreseeable future.

Discussion

The project had strong industry and government support based on an identified absence of recovery in a particularly productive area of the east coast abalone fishery (Block 30). This area produced more than 100 tonnes per annum in the years 1977-1995 after which there was a steep decline to around 15 tonnes in 1992. Catches remained below 20 tonnes until the area was closed in 2007. The site was carefully selected in close consultation with industry, who provided substantial assistance with translocation and other support for the project.

The project faced substantial difficulties following a successful translocation. These included a storm event which severely impacted some of the sites, tag loss making identification .of translocated abalone difficult for the purposes of determining survival rates and level of emigration. As with many of these types

of projects, identifying project outcomes within the life-cycle of the project was difficult.

The opportunities for rebuilding stocks in Block 30 and other areas of the Tasmanian fishery and other fisheries, including NSE and Victoria, remain. Due to low densities of abalone in many of these sites the likelihood of recovery arsing from natural processes is low, and in some limited, spatially discrete, highly productive areas, there remains an opportunity for stock enhancement of blacklip abalone via translocation.

In Tasmania, a number of other factors including the loss of kelp and ingress of the black sea urchin, Centrostephanus, has reduced the productivity of a number of reefs on the East Coast and shifted the focus of abalone research interest in restoring depleted areas. The economic viability of commercial translocation is very unclear and there is no definitive cost/benefit analysis of translocation available on which to base investment or management decisions. If translocated from areas of slow growth (i.e. mature abalone below the minimum size) costs will be minimal, but if commercial sized abalone are used, the economics of the operation become questionable

SWOT analysis and review of project and adoption strategies

Strengths	**Opportunities**
• Strong initial industry and government support • Choice of formerly productive site made in close association with divers	• Low or no prospect of recovery using natural recruitment • Availability of suitable habitat
Weaknesses	**Threats**
• Storm event impacting translocation sites • Tag loss making determining of survival and emigration difficult • Time to determine success of project beyond life of project	• Centrostephanus and loss of kelp reducing productivity and shifting focus of research • Availability/cost of adult abalone for translocation • Lack of cost benefit evidence on which to base investment decisions

Conclusions

Stock enhancement of depleted abalone stocks has proved to be a challenging task. The recent international Abalone Symposium (2012) held in Hobart underlined the inherent difficulties and generally concluded that the best management option was not to allow stocks to be depleted to levels where natural recruitment, even with no fishing mortality, would be unable to recover the fishery in a reasonable period of time. A similar conclusion was drawn by a group of abalone specialists advising Victorian fisheries on rebuilding options for the Victorian abalone fishery, which among other advice, recommended:

i) A mix of rebuilding options. The most cost effective and widespread stock rebuilding outcomes will come from the contribution of appropriate fisheries management actions that includes flexible and enforceable size limits and closures that ensure a spawning biomass adequate to meet fishery management objectives is developed and maintained.

ii) In areas where there is no natural recovery or where natural recovery is unlikely to occur within acceptable timeframes, spatially-focused stock enhancement strategies (i.e. seeding and translocation) warrant consideration.

iii) Where increasing stock biomass on a small scale (i.e. reef code or smaller) is required and local abalone stock are available, translocation should be considered.

Recommendations

See end of section on Stock Enhancement

5. Project: 2011/744 Commercialising translocation of southern rock lobster

Project status:

The project builds on previous FRDC/Seafood CRC work which established the commercial feasibility of translocation and identified a range of other benefits to the broader coastal ecosystem. The concept is simple and involves shifting small lobsters from an area of very high density, where they do not contribute to the harvest because their growth is stunted by competition for food, to places where they were depleted and high growth rates can be achieved.

The project aimed to move total of 100,000 lobsters per year from three stock assessment areas off Western Tasmania to areas to the north along the same coastline. Unfortunately, the initial translocation only composed of 60,000 lobsters within the intended time frame, with the balance of 40,00 yet to be shifted (as at end February). Letting the contract for translocation has proved to be difficult with only two fishers tendering for the contract, one of which was believed to be a hedged proposal which was withdrawn and the other, more likely committed tenderer, withdrew due to delays and took up an alternative opportunity (additional leased quota).

The TACC on 2012/13 was maintained at a higher level (50 tonnes) than would have been the case if translocation had not been supported by the TRLFA and industry and gone ahead.

Proposed pathways to adoption (completed project)

The intention of the project is to allow managers of the fishery and the industry to assess whether translocation is a useful tool and to make decisions on the wider fishery in the context of translocation. If the previous successes are continued and the productivity of the fishery is increased on a commercial basis (taking account of costs and benefits in terms of catch levels) there is a high likelihood that translocation will become an integrated element in the management of the fishery. The degree to which this occurs will hinge on continued, and preferably increased, support from industry and to a lesser

extent, from Government. In this respect effective communication between researchers, industry and other stakeholders will be essential.

Clear communication of the progress with the project and eventual outcomes of the project will be essential. This is to be achieved through the work of the steering committee established under the project, the usual series of port tours around the state each year, two annual industry meetings, and five management advisory committee meetings.

Another requirement before full adoption is the establishment of effective governance and operational arrangements and a better understanding of how best to encourage adequate participation.

If the project is successful as a commercial pilot, the pathway to adoption is clear, particularly if fishers will be faced with making a choice either to fund and be engaged in regular translocation or not realise the potential productivity increase and higher TAC.

Discussion

The current project has a strong background in that the previous desktop feasibility study and a larger scale translocation experiment provides strong evidence that a commercial scale translocation activity is both feasible, and for the overall fishery and ecosystem, desirable. Other than an active minority, the industry and the Tasmanian rock lobster fishermen's Association (TRLF a) are highly supportive of the project: this support is demonstrated through the contribution of over $200,000 to the project through the payment of levies. The rock lobster research team have long enjoyed a good working relationship with industry and, through an advanced capability in both biology and economics, has been instrumental in achieving the progress made so far. Consultation through both industry and government processes is excellent and through its use progress and delays are regularly discussed and dealt with. A steering committee has been created to overview the design of the scheme that offers sufficient incentive to undertake translocation ensuring transparency and ongoing industry support. The project features a strong research tem incorporating economic and biological expertise.

Implementation of the project relies heavily on industry cooperation. Such cooperation at times can be relatively fickle and even during the development of the project, it became apparent there were many misunderstandings and misgivings about the project, some of which were later translated into misinformation in an attempt to undermine the project. As a group, rock lobster fishers are quick to see the benefits of translocation to the fishery as a whole, but are frequently unable to translate that benefit into the enterprise level. Caleb Gardner, as principal investigator, has been pivotal in garnering support for this project and also maintaining its momentum. He is a man in great demand and the project is highly reliant upon his innovative and entrepreneurial character.

Previous work has clearly demonstrated that translocation can significantly increase the productivity of the Tasmanian rock lobster fishery. In addition to fishery benefits, there are wider flow on benefits through fishes that are attracted to fish in stock enhanced areas dragging pressure from currently exploited areas thus providing relief, including on the East Coast. If this project

were to be attempted during a more prosperous time for the fishery, it would be difficult to secure support. However there is a clear need now to rebuild the stock following a long period of below-average recruitment. This factor is helping to shore up support both from industry and government.

As with the previous pilot project, they remain elements within the fishery who will continually attempt to undermine the project. Particular concerns include the impact of removing rock lobsters from areas on catch rate and a concerned that areas of translocation will attract fishes and overly deplete stocks in those areas. Both are perceptions rather than realities. As discussed above, it has been difficult to get significant interest in undertaking translocation. An increased incentive (50% more) been offered to attract more tenders for the second part of the first translocation.

SWOT analysis and review of project and adoption strategies

Strengths	**Opportunities**
• Builds on previous successful research outcomes • Strong industry support and engagement, including provision of funds • Excellent consultation processes • Steering committee to promote good governance • Strong research tem incorporating economic and biological expertise	• Increased productivity and productivity with positive stock and ecosystem effects • Flow-on benefits for other sectors of the fishery, and in particular the east coast • Need to rebuild stock after prolonged period of below average recruitment
Weaknesses	**Threats**
• Relies on industry cooperation • Benefits at the fisher level less apparent • Reliance on the principal investigator to drive the project	• Disaffected elements within the TRLFA seeking to undermine initiative • Lack of industry participants willing to undertake contract translocation • Lack of understanding and related withdrawal of support

Conclusions

The potential of the project is clear and while substantial uncertainties exist they relate more to governance issues and operational procedures rather than technical feasibility. The TACC on 2012/13 was maintained at a higher level (50 tonnes) than would have been the case if translocation had not been supported by the TRLFA and industry and implemented. The cost to industry per quota unit was $10, which provided them with an increase in quota of 5 kg per unit,

with a leased value of $20/kg ($100) . Thus the industry funding of translocation provided a ten-fold return on investment

Keeping the industry fully engaged, informed and supportive will be pivotal to the success of the project and eventual adoption of translocation as a regular part of maximising the productivity of the Tasmanian rock lobster stock.

The project is only just at the halfway mark. As the intention of the project is to allow managers of the fishery and the industry to assess whether translocation is a useful tool and to make decisions on the wider fishery in the context of translocation, the scope for comments about ways to improve adoption of the outcomes are limited as the detailed outcomes are yet to be determined. The potential of the project is clear and while substantial uncertainties exist they relate more to perceptions, governance issues and operational procedures rather than technical feasibility.

Keeping the industry fully engaged, informed and supportive will be pivotal to the success of the project and eventual adoption of translocation as a regular part of maximising the productivity of the Tasmanian rock lobster stock. The potential for a relatively small minority of industry to undermine support for the project through misinformation and social pressure (on radio, industry meetings etc.) is very real.

Recommendations

i) Listen closely to concerns at an early stage and proactively provide contrary evidence.

ii) Focus on "how" to explain / provide contrary evidence to concerns at an individual fisher level and similarly for "selling the benefits"; determine and provide information that is meaningful to an average fisher and how can this best be presented.

iii) Increase the remuneration provided to make translocation operations a desirable activity (relative to say, lease fishing); this will mean industry may have to pay more, increasing the need to make the cost/benefit argument clear.

iv) Provide business mentoring for industry members who will need to manage the operations themselves once the CRC withdraws.

Overall conclusions – Stock Enhancement projects

In the past, stock enhancement has not had a good record of success, due mainly to several ambitious but poorly conceived projects failing. However, stock enhancement is now increasingly being put forward as an alternative management tool in certain circumstances, such as in the event of severe stock depletion due to overfishing or environmental change. It is considered particularly appropriate in areas where natural recovery and recruitment are unlikely to rebuild stocks within acceptable time frames, if at all. Another novel use of enhancement is where natural systems inhibit yield from a fishery, such as areas of limited food, or where there is competition for space. By shifting animals into more productive habitats, an increase in yield can occur. Implementing successful enhancement programmes will require well-designed business structures and realistic financial targets, based on thorough feasibility studies

that consider both biological and economic issues.

The science of stock enhancement is usually more complex and less developed than fisheries science because of the need to know much more about the ecology and productivity of localised stocks, as well the genetic, aquaculture and biosecurity aspects. Consequently, it is generally long-term strategic work and to be effective, requires commitment to sufficient trials and studies to get to grips with complex, poorly understood systems.

In the case of the Tasmanian abalone example, the research was essentially a one-off pilot study using a release of 6,000 abalone, the equivocal results of which were somewhat confounded by the loss of kelp beds (and possible reduced productivity), severe storms and a short time period over which to observe any increase in recruitment. The WA greenlip work was based on four separate releases of 30,000 abalone into a 'best functioning' habitat with post-release surveys detecting a sustained density increase. This led on to a potentially successful project that was halted for political/administrative reasons rather than technical feasibility. Similarly with the rock lobster translocation trial and the second, commercial pilot stage which is already considered (from the results of modelling) to be contributing to productivity within the fishery.

As suggested in the opening paragraph of this section, the potential of fisheries/stock enhancement is increasingly being discussed, but its development is somewhat constrained by the wild fishery paradigm based on controlling harvest and thereby maintaining adequate breeding biomass to achieve relatively constant productivity. This is not necessarily true, with a recent published review of well known fisheries (n = 230)[14] finding that around 40% of fisheries are shifting their productivity constantly, presumably in response to something unrelated to abundance or fishing.

Additionally, governments have been wary of fisheries enhancement, mostly, it appears, due to opposition from the wild fishery sector which generally views this activity as a clear threat rather than an opportunity. Subsequent AVG outbreaks have served only to enforce their views concerning the former. For fisheries enhancement to succeed, it appears there is a need for:

- acceptance that a long-term, strategic view is necessary to achieve cost-effective approaches;
- acknowledgment by government that fisheries enhancement is an important fisheries management tool (an assisted recruitment process), to be supported by effective policy and education;
- clear policy statements confirming the point above;

[14] Katyana A. Vert-pre et al. *Frequency and intensity of productivity regime shifts in marine fish stocks.* PNAS 2013, 110 (5), 1779-1784

- strategies to show how an enhanced or restocked fishery would be managed, what changes in governance would be required and how interactions with the wild harvest fishery would be managed;
- clarification of access rights, particularly in relation to quota fisheries;
- hatchery production systems designed for and geared to enhancement rather than aquaculture; and
- use of 'success stories' to increase support.

Some of these issues have been addressed by the fisheries enhancement policy development under FH activities, which has been implemented or is underway in NT and WA.