

Future Harvest Theme Leadership

Caleb Gardner

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Australian Government
**Fisheries Research and
Development Corporation**



An Australian Government Initiative



Non-Technical Summary

2009/712 Future Harvest Theme Leadership

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PROJECT OBJECTIVES:

To assist the program manager to deliver an effective research theme and its associated outcomes.

OUTCOMES ACHIEVED

A suite of projects were developed in the Future Harvest Theme following workshops and meetings with individual industry partners. These projects fell into two main areas of enhancement and bioeconomic projects. In both cases, the objective was to increase the value of production, either by increasing tonnage in the case of enhancement, or by changes to management following bioeconomic modelling so that improvements in price, cost or production led to higher economic yield.

The majority of projects produced outputs and benefits to commercial fisheries with very significant gains in some cases. Projects with most substantial benefit to industry were those on enhancement of production in southern rock lobster and sea cucumber, plus changes to harvest strategies in response to bioeconomic research on SA prawns, western rock lobster and southern rock lobster. Other projects provided benefits of a more modest scale, such as projects on stress in abalone and rock lobster supply chains, and the ability of density reduction to improve yield and meat quality in abalone.

Projects universally faced barriers to full adoption with several projects identifying clear and substantial opportunities that failed to be adopted by industry partners. In many cases it was possible to identify common problems across different projects in extending research. Activities for overcoming these barriers were developed through a suite of legacy projects that dealt mainly with education and training.

LIST OF OUTPUTS PRODUCED

Bioeconomics projects

These FH projects made a substantial contribution to moving beyond using economics as a factor in the 'weight of evidence' approach to setting catch and other fisheries management controls and towards using economics in 'hard wired' decision rules.

Outputs for individual projects included a suite of communications and also data collection methods and bioeconomic models for different fisheries. These management tools will continue to be used for guiding management beyond the life of the CRC. More sophisticated models and harvest strategies were developed for WRL and SRL. These were constructed in modular form and continue to evolve in response to management needs.

Enhancement Projects

Guidelines and processes for enhancement (or translocation) have been developed for

abalone, sea cucumbers, and rock lobster with commercialisation underway with the latter two industries. Abalone and sea cucumber enhancement projects used free software ("EnhanceFish") developed by a CRC visiting fellow, Prof Kai Lorenzen. This was generalised and converted into a MatLab package through CRC projects which means this software can be used more widely, for example with fast growing tropical invertebrates.

Cross-cutting outputs include a review and guidelines for economic data collection methods; videos on fisheries economics; training workshop for fisheries managers; a review of enhancement and opportunities / issues for Australia, and teaching materials for fisheries economics courses.

Acknowledgements

This project was achieved with support from Dr Emily Ogier and input from industry leaders from each of the CRC wild fishery participants. Legacy project development was led by Ian Cartwright and his recommendations and observations are repeated within this report.

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1. Introduction and Background

1.1. Background

The CRC requires the Future Harvest Theme to deliver the following outcomes:

1. fisheries management delivering maximum benefit from the resource while maintaining stocks above sustainability indicators
2. novel management strategies in place which increase economic yield from our fisheries; and
3. the technical efficiency of our fishing fleet will be improved to respond to rising costs.

The outcomes are to be developed through the following strategies:

1. field / pilot trials of novel or alternative management systems;
2. bioeconomic modelling of specific harvest strategies allowing stakeholders to select optimal fisheries management and harvest systems;
3. manage change and promote implementation of results in fisheries management and business structures;
4. improve technical aspects and efficiency of fishing operations; and
5. foster better management and a progressive and collaborative culture by educating and training CRC participants & theme management.

1.2. Need

The Future Harvest Theme is the last of the CRC's initial research themes to be developed. The management of the theme requires significant input from an expert in fisheries management - expertise that does not currently reside within the CRC staff.

1.3. Objectives

To assist the program manager to deliver an effective research theme and its associated outcomes.

2. Methods

The theme leadership role incorporated the following activities and operated on the basis of implementation of an on-going workplan which was reported on and updated every six months.

- Complete business plan for the theme through consultation with partners
- Lead or assist in project development
- Assist program manager as needed

- Facilitate relationship with CRC participants
- Represent program manager as needed
- Assist in Theme technical reviews, reviewing applications, milestone reports and final reports
- Complete economic impact tool evaluation of CRC investments within the theme
- Plan and lead theme workshops
- Assist in development and coordination of training and capacity building
- Provide a link to non-CRC agencies and research
- Complete tasks for each milestone period according to a workplan developed with the program manager

3. Results and Discussion

3.1. Theme Management

3.1.1. Business Planning

The objectives and main areas of activity in the theme were developed through workshops, both as part of the development of the wider CRC and also specifically on the Future Harvest Theme. The strategic plan was substantially developed subsequent to input from a Future Harvest workshop held in Melbourne July 2008 with representation from KAL Analysis, University of Tasmania, Central Zone Victoria Abalone Industry, Fisheries Research & Development Corporation, Tasmanian Seafoods Pty Ltd, Victorian Rock Lobster, South Australian Research and Development Institute, Western Abalone Divers Association, Department of Primary Industries and Water Tasmania, Western Australian Fishing Industry Council, Abalone Industry Association of SA Inc., Abalone Council of Australia, WA Fisheries Department, and the Tasmanian Rock Lobster Fishermen's Association.

A theme business plan and associated operational plan for the theme was developed in 2008 and approved by all contributing participants. These had the following agreed outcomes, approaches to measurement, and strategies. Detailed plans were developed for each strategy and specific project proposals for each of the participating members.

Future Harvest Theme Outcome

1. Fisheries management in Australia will change into a process of targeting maximum benefit from the resource (while maintaining stocks above sustainability indicators)
2. Novel management strategies will be developed that increase economic yield from our fisheries
3. The technical efficiency of our fishing fleet will be improved to respond to rising costs

Outcome Measurement

Performance against Outcome 1 (management that targets optimal benefit) will be quantified by metrics typically applied in single organisation structures: improvement in earnings and change in asset value. Change will be measured relative to fisheries in 2007.

1. Improvement in earnings is measured through change in economic yield from the entire fishery (change in lease price (scarcity rent) x number of units of catch). This measure is comparable to EBIT in a single company structure.
2. Market capitalisation of participating fisheries (number of shares in the fishery x market price) provides an additional measure of change in economic yield, although needs to be scaled by external factors (most importantly changes in risk-free rate of return).

Measurement of performance against Outcome 2 (novel management strategies) must quantify the improvement in economic benefit from new management. This will be partially captured in measurements listed above, but also through modelled change in maximum economic yield (MEY). Economic yield is the gross value of product (GVP) minus the costs of harvesting the fish. The point of maximum economic yield changes with different management rules.

Performance against Outcome 3 will be measured by change in efficiency extrapolated across the fleet and scaled by extent of uptake (eg. a cheaper bait reduces cost by a known proportion which can be scaled across the fleet).

Five Strategies to Achieve the Outcome

1. Field trials of novel or alternative management systems and the collection of data for bioeconomic modelling.
2. Moving beyond discussion of concepts to bioeconomic modelling of specific harvest strategies. This strategy aims to allow industries to select the best management system.
3. Changing to more profitable fishing will require management of the process of change. Novel management systems may require novel business structures. Change in fisheries management and business structures needs to be explored and managed.
4. Improvements in technical aspects of fishing operations to reduce costs and thus increase economic yield.

5. Education and training in fisheries management opportunities to foster better management and a progressive culture.

3.1.2. Project Development

Detail of outcomes of projects that progressed to research stage are detailed below. Several other projects were developed in response to prioritisation by industry partners although ultimately did not progress. These included:

- Increasing yield of Australian abalone fisheries through management of spatial and temporal differences in productivity and profitability (ACA)
- Optimising fishing strategies based on market knowledge (WAFIC)
- Optimising the harvest in Australian Sea Cucumber fisheries (TS)
- RFID technology for providing real time management solutions for the WRLF (WAFIC)
- Deep scale trap fisheries of the NW (WAFIC)
- Crystal crab harvest optimisation (WAFIC)

3.1.3. Economic Impact

Future Harvest impact tool was updated in late 2012.

Impact for CRC output 1.02 (increased production by enhancement) was estimated for projects on enhancement of Roes and greenlip abalone, seacucumber, and rock lobster translocation. Estimated impact from that project suite was \$48 million (NPV, 15 year projection, 5% discount rate).

Impact for CRC output 1.04 (adjusting management to target MEY) was estimated for projects on MEY in southern rock lobster, western rock lobster, and SA prawns. Estimated impact from that project suite was \$76.6 million (NPV, 15 year projection, 5% discount rate).

3.1.4. Communications and Reporting

Contribution to Program 1 was also through other activities such as a seminar on projects at Seafood Directions, assessment of project proposals, project commercialisation agreements, and reviews of milestone and final reports.

3.1.5. Legacy Planning

Detailed information on legacy planning is provided as an appendix.

Legacy planning occurred in collaboration with Ian Cartwright and involved several steps. These were meetings with all PIs and industry partners, formulation of a list of possible legacy activities (see appendix), refining this list with input from AFMF, CRC, FRDC, and industry partners, then finally production of project applications and liaising with research providers to work on the projects.

Extension of much of the research required support from government so responses from AFMF members on Future Harvest legacy review recommendations were sought. The context given to the AFMF members was that the Seafood CRC's Future Harvest theme had conducted a range of research activities with a focus on the development of economically profitable harvesting strategies based on bioeconomic modelling and on a range of fisheries enhancement activities. The Seafood CRC commissioned a review of its Future Harvest theme with a view to identifying one or more legacy activities that could enhance the delivery of outcome from the theme research. The key recommendations were circulated to senior fisheries managers in each state with an invitation to comment. The table below summarises the comments from these fisheries managers (Table 1). Supported projects were further developed into proposals with funding allocations (Table 2).

It is noted the variability in results are reflective of a combination of different local drivers in each jurisdiction and the availability of funds for agencies to support anything other than routine fisheries management services. Most agencies are stretched to breaking point with several having faced major restructures recently and all (except WA until recently) facing budget freezes, cutting functions and/or staff reductions. Decisions on management settings will, however, continue to need to be made. Without a clear understanding of the economic outcomes of various options, it is difficult to see how the Community as a whole can be assured that fisheries are being managed effectively to ensure both sustainability (which is now a diminishing concern for most Australian fisheries) and optimal economic outcomes.

The level of support refers to the recommendation only. Comments provided by states and territories differed widely and support or otherwise for them should not be inferred.

Table 1. Feedback from jurisdictional fisheries management agencies on Future Harvest legacy investment proposals.

Recommendation	AFM A	NSW	Tas	SA	WA	NT	QLD	Comments
Economic report cards and monitoring framework								• Some fisheries agencies could benefit from specialist economic capacity. • Needs stronger recommendation and make clear this is linked to biological data. • Should be collected by industry associations • Identify details of two year reporting process before sign up possible • Some agencies see key roles as sustainability and efficient management to promote good economic outcomes – rather than intensive economic interventions. • More activity in the field of economics a national progression as fisheries move beyond sustainability • Useful for cost benefit analysis to inform changes in fisheries management • Critical for a number of roles, e.g. decisions associated with marine parks
Specific extension plans		-						• Needs clear industry association buy in • Identify resources for implementation • Who will pay for Fishery Managers Input • Should not be driven by Government • Standard process for SA
Industry exchange programs								• Can work provided genuine industry commitment. • Visits have presented new options but industry reluctant to implement in some Australian jurisdictions (e.g. CRA 8) • Industry needs adequate sophistication to benefit.

Recommendation	AFMA	NSW	Tas	SA	WA	NT	QLD	Comments
								• As valuable to see examples of less effective fisheries management and consider overseas examples where resources permit.
Handbook for fishers/managers								• Mobile App. or YouTube media may be better • Involvement of AFMA fisheries management sub-committee recommended
Heads of Agencies Round Table		-						• Needs driver and context, may be higher priority in future. • Heads of agencies generally agree – problem lies with politics and resources. • Would help discuss and clarify the role of government in economic objectives • Also need deputy/technical fisheries management input present at round table to be effective
Journal Paper								• Only for the record. • One on bioeconomics and a second on enhancement may be helpful. • Good for debate among the informed, but of limited use for broader consultation or to gain acceptance. • Will help with political and broader acceptance – form of ‘accreditation’. • If graduate student ensure adequate supervision/co investigator with long-term experience of fisheries economics
Policy and business case reviews	-	-						
Re-establish annual fisheries management workshop								• Some states won’t have the resources. • Supported for operational fisheries managers. • Annual frequency may stretch budgets.

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Recommendation	AFM A	NSW	Tas	SA	WA	NT	QLD	Comments
								• Involvement of AFMF fisheries management sub-committee recommended. • Value of networks and learnings can be substantial. • Consider ways to reduce cost – e.g. video conferencing.
Session at 2014 IFFET Conference		-						• Will help with political and broader acceptance – form of ‘accreditation’ .
Training for Fisheries Managers		-						• Needs in house capacity to train staff. One off training off-site delivers short term benefits only to individuals. • Need to identify clear gaps/topics ensure resources are focused on achieving a practical outcomes • Should include integrated training (biology/ management/ economics) as per previous AMC course • Lack of staffing/recruitment impeding demand for training and ability to provide out of work.

Key:  = Low support;  = Moderate Support;  = Strong support;

- = No comment provided

Table 2. Detail of proposed Future Harvest Theme legacy projects

Project No. (status)	Project	Total budget	CRC communal \$	UTas PD \$	Other \$	Outputs
2013/748 (awaiting final proposal)	Future Harvest Master Class (2nd phase)	\$42,000	\$42,000			- Revised/modified package of materials/guidelines for face-to-face delivery of Masterclass - Online version of Masterclass - Development of marketing strategy and budget model for delivery
2013/748.10 (contracted)	A template and protocol for a standard methodology for economic data collection in Australian fisheries	\$15,000	\$15,000			A standardised protocol and methodology for the collection and reporting of key economic data on major fisheries.
2013/748.20 (contracted)	Publication of research papers on the roadblocks to the adoption of economics and enhancement in fisheries policy	\$50,265	\$10,000	\$40,265		- A paper on the process of change management in Australia towards the increased use of economics in fisheries - A paper on the role of governments in achieving economic objectives in fisheries management. - A paper reviewing stock enhancement in Australia
2013/748.30 (contracted)	Introduction to the use of bioeconomics in fisheries management for key decision makers	\$32,000	\$28,000	\$4,000		Economics in Fisheries Workshop, primarily for fisheries managers
2013/748.40 (awaiting final proposal)	Improved understanding of economics in fisheries harvest strategies	\$60,000	\$50,000		\$10,000 (SARDI)	- High quality, informative educational video on economics in fisheries harvest strategies. - High quality, informative PowerPoint presentation on economics in fisheries harvest strategies. - High quality informative brochure on bioeconomic modelling and harvest strategies for SRL

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2013/748.50 (awaiting proposal)	Support to Future Harvest Extension	\$15,000	\$15,000			• Development and effective implementation of FH extension portfolio.
Total		\$214,265	\$160,000	\$44,625	\$10,000	

Projects Developed

The following projects were then developed (either written or with the help of other research providers in some cases).

1. Project title: a best practice protocol and methodology for economic data collection in Australian fisheries.

Background

There is recognition among fisheries management agencies that economic reporting from most jurisdictions 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.

Need

Developing basic frameworks for the collection and reporting of fisheries economic data is necessary to provide input into planned future versions of the national fisheries status report and at the state level, support the MEY-based approaches and associated target reference points that are increasingly being incorporated in fisheries management plans and harvest strategies.

Objectives

1. A best practice protocol and methodology for the collection and reporting of key economic data on major fisheries
2. Introduce and promote best practice to key fisheries managers

2. Project title: Introduction to the use of bioeconomics in fisheries management for key decision makers

Background

The economic performance gap (lost profit) in Australian fisheries has been estimated at 36-46% or \$350-450 million per annum. 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 CRC FH projects are making a substantial contribution nationally towards increasing both profitability and sustainability in Australian wild harvest fisheries 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.

Under the suite of FH projects, South Australia, WA and Tasmania are now using economic considerations in the management of fisheries and 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.

These strategies are also being used where changing circumstances within fisheries are driving change and a move away from business as usual approaches based on maximising short term catches. The fall in settlement and recruitment in the WA rock lobster fishery and subsequent severe reductions in TAC, combined with the introduction of quota created the circumstance where industry could fish more rationally to maximise value and avoid proportional falls in revenue. Examination of MEY approaches under the FH project highlighted the interactions between catch, catch rate, costs of fishing and price and industry is now considering harvest strategies that result in benefits from rebuilding stocks other than simply increasing catch based on biological yield estimates. Another iconic fishery, the Spencer Gulf Fishery has been hit by changing economic circumstances (rising costs, competition from imported prawns, exchange rates) and is now looking to the bioeconomic model under development as a FH project to inform a new harvest strategy and reform within the fishery.

In small scale/coastal fisheries there is a current debate concerning the need to give effect to balancing triple bottom line/ESD objectives found in most fisheries acts, and in particular social objectives. Operational fisheries management objectives may include regional employment, supply of local fresh seafood (in a resource sharing context) and other benefits beyond the catching sector. In these cases, calculation of potential economic yield by maximising the efficiency of the harvest sector can be calculated and more informed trade-off harvest strategies developed and decisions taken. While this 'economic awakening' is apparent throughout Australian fisheries, decision rules based on economics have been slow to be implemented. Adding to the problem of adoption, many fisheries departments are increasingly seeing their major role as ensuring long term sustainability of fisheries resources and the habitat, and that industry should take the running on fisheries management settings to achieve desirable economic outcomes.

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 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 through informed dialogue.

Need

Many fisheries managers in Australia have no formal fisheries management, let alone fisheries economics, background or training and tend to learn 'on the job'. There is currently a large gap between economists, researchers and fisheries managers. The latter group is under extreme pressure due to budgetary cuts and if the extensive results of the CRC FH harvest projects are to adopted, there is a need close that gap. The proposed workshop will demonstrate to senior fisheries managers that Government does have a key role in ensuring that the benefits from fisheries are realised, and that this includes economic benefits. They will learn about the application of a wide range of tools available to achieve this.

Other than the FH masterclass series of training courses there is almost a total absence of an opportunity for fisheries managers to be introduced to contemporary fisheries management approaches, including bioeconomic analysis. The recent AFMF workshop on small scale fisheries management held in Adelaide was an exception, and demonstrated the use and value of an interactive forum to increase the understanding and uptake of new concepts in fisheries management.

Objectives

1. Increased dialogue and establishment of networks of fisheries managers engaged in policy and fisheries management planning involving economic analysis and considerations
2. Fisheries management planning involving economic analysis and considerations
3. Fisheries managers are aware of the developments in fisheries economics and bioeconomic modelling, including success stories from the FH suite of projects.
4. Exposure of fisheries managers to international innovations in fisheries economics

The project is based on a three day workshop to be held in a central location which will incorporate the following elements:

- An introduction to fisheries economics based on UTAS training modules. This element will be enhanced by the prior provision of reading material to ensure participants arrive with at least an understanding of basic concepts and terminology.
- A series of presentations based on FH projects, emphasizing successes and challenges
- Case studies from Australia and overseas, including French coastal fisheries (potentially Olivier Thébaud, Ifremer), and approaches in the US (potentially Dan Holland).

3. Project Title: Roadblocks to the adoption of economics in fisheries policy

Background

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, there is a need here for two papers that provide a critical analysis of the performance of Australian fishery management in pursuing better economic outcomes. This is part of working on change and raising the bar for fishery management.

This project was proposed following a thorough review of FH projects. It was found that a paper on 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.

The second paper is about the role of governments in achieving economic objectives in fisheries management. There seems to be a growing approach for state fisheries to say they are concerned with sustainability and creating an enabling environment and industry should lead the way with strategies to achieve economic objectives. Industry have trouble with taking this role on (and in fact, cannot, other than at the individual enterprise level). Between them, this leads to an alarming lack of interest in many of the current and anticipated future outputs of the future harvest project. This paper challenges fisheries managers and focuses on their obligation to pursue economic benefits from marine resources.

Need

Producing peer-reviewed publication on these topics is part of the suite of approaches aimed at increasing uptake of FH projects. Scientific papers enable exchange of ideas internationally. They are part of the process of changing fishery management, which needs these types of outputs to defend decisions.

Objectives

1. Examination of the process of changing management in Australia resulting in the increased use of economics through production of two peer reviewed papers.

4. Project Title: Improved understanding of economics in fisheries harvest strategies

Background

Most of Australia's Commonwealth and State fisheries are managed with due consideration of optimising the economic returns to the community from utilisation of those fisheries resources. The Commonwealth Harvest Strategy Policy (DAFF 2007) is a key policy that guides the harvest of commercial species in Commonwealth fisheries. It provides for a strategic, science-based approach to setting fishing targets, limits and associated decision rules for fisheries management. The policy aims to ensure "....the sustainable and profitable utilisation of Australia's Commonwealth fisheries in perpetuity through the implementation of harvest strategies that maintain key commercial stocks at ecologically sustainable levels and within this context, maximise the economic returns to the Australian community." To achieve this, one of the main strategies of the Policy is that harvest strategies for key commercial stocks taken in Australia's Commonwealth fisheries will be designed to pursue maximum economic yield from the fishery.

The Policy recognises that "Economic considerations are important in determining appropriate targets for a harvest strategy. Economic efficiency in a fishery implies that the fish stock is protected and that the net returns (profits) of fishers are maximised. This occurs when the sustainable catch or effort level for the fishery as a whole maximises profits. This point is referred to as maximum economic yield (MEY). However, economic efficiency will only be ensured if a management regime is also in place that allows for fishing costs to be minimised and fishing revenue maximised at the given MEY catch level. That is, two conditions must be met simultaneously to achieve economic efficiency in a fishery:

- MEY catch level is set. This will account for the impact of current catches on future fish stocks, catches and fishing costs.
- A management regime is in place that allows fishers to apply the appropriate level of inputs in a fishery. This will help ensure that fishing costs are minimised and fishing revenue maximised for the given MEY catch level.

MEY depends on a combination of biological and economic factors. In particular, it depends on the relationships between harvest, stocks and recruitment and on the way in which fishing behaviour, revenue and costs relate to those factors". It is important to understand that the MEY concept relates to the "whole of fishery" at the fleet level, not to the profitability of individual businesses or boats. This is a major area of misunderstanding by industry in the use of economics in fisheries harvest strategies. This is illustrated by a tendency for industry to consider that incorporating economics in harvest strategies means intervention in their individual businesses ("we know best about profitability"). As a result, industry often states that managers should be more concerned with sustainability than economic efficiency.

This project is solely focused on addressing the misconception about the use of economics in fisheries harvest strategies.

Need

Successful adoption of fisheries harvest strategies is benefited by a good understanding of the underlying concepts. Generally, the concept of "sustainability" is well understood by all stakeholders and has been implemented in all state and Commonwealth harvest strategies around Australia. The concept of "Maximum Economic Yield" (MEY) in fisheries harvest strategies, on the other hand, is far less well understood and (as a result?) is much more poorly implemented. Despite improvements in the assessment and harvest strategy process over the last decade, there remains a great deal of industry frustration and misunderstanding about how this translates into management decisions. Having spoken to many industry members during this time, we know that much (but not all) of this frustration is a direct result of lack of knowledge about assessment techniques and assumptions, and how these interplay with the harvest strategy. Once they have acquired this knowledge, Industry members, with their extensive experience on the water, become extremely valuable members of RAGs and MACs and can help improve the assessment and management process and the understanding of other members.

A better understanding of the MEY concept, particularly by the commercial fishing industry is urgently required so there is better support for and implementation of MEY-based harvest strategies.

Objectives

1. Increase the level of understanding of industry and fisheries managers on the role and benefits of fisheries economics in fisheries management.
2. Production of a short (5-8 minute) video on economics in fisheries harvest strategies.
3. Production of a powerpoint presentation on the economics in fisheries in harvest strategies

3.2. Project Management

Summaries of each project are provided below and draw heavily from a review completed towards the end of the Future Harvest Theme Leadership project (Cartwright and Gardner. Defining the legacy from the CRC's research in Future Harvest).

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

This project was novated into the FH theme at the start of the CRC because it addressed the objective of increasing production by novel techniques – in this case 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 an outcome of increased industry production. 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.

The project was discussed at the international Abalone Symposium (2012) held in Hobart. A workshop was initiated to examine abalone enhancement given the presence of three projects on the issue in the theme (greenlip enhancement, blacklip translocation, Roe's translocation). These underlined the inherent difficulties, generally concluding that the best management option is clearly challenging, usually because of community / industry acceptance.

3.2.2. Project 2006/220. Spatial management of southern rock lobster fisheries to improve yield, value and sustainability

This project was novated into the CRC and was a forerunner for Project 2011/714.

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. Most work was directed to Tasmania where there was least resistance to increasing profitability by bioeconomic research.

Option 1. 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 resistance to change has meant that this initiative has not been progressed to date. The scale of the opportunity for enhanced production through the simple process of changing size limits was estimated to be in the order of 25% of the current economic yield.

Option 2. 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 was tested 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. This nonetheless led to a total increase in production from the project of 40 tonnes or \$1.8 million and gave the project a high ROI.

Option 3. Large gains appeared 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.

The changes in size limit that were examined continue to be debated by industry. These improvements in industry production were defeated by progressively decreasing majorities in industry votes in 2009, 2011 and 2013 (as the same issue can only be brought to vote after 2 years by the TRLFA constitution). In 2013 the vote was initially tied then lost by a few votes on a recount. A TRLFA committee continues to work on another attempt to gain industry support for a vote in 2015. Although this has been a laborious process the estimated gain in capitalisation of units at stake is over \$100 million.

3.2.3. Project 2008/900. Improving profitability in the western rock lobster fishery using a new rock lobster trap

This project was initiated early in the FH Theme and resulted from theme meetings with WAFIC and the WRLC. The need for a more efficient pot was identified by fishers at the time the fishery was under individual transferrable effort management (ITE).

The project evaluated three new pot designs were evaluated. 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 the benefit was mainly suited to niche conditions that occurred during management at the time. The project therefore failed to have extension with industry.

As the fishery has now 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 could be applied in the future. 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.

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

This project commenced early in the life of the FH theme. Theme activities related to managing project reporting and also in attempting to get extension of the results into commercialisation. The project had an active steering committee with participation by the Theme. Workshops involving experts in abalone enhancement from other states and NZ helped in progress with technical issues.

The project was a true enhancement exercise. Juveniles were released onto reef that was suitable for producing greenlip abalone but received little juvenile supply due to prevailing current movements. This led to successful increase in product at pilot scale and demonstrated the potential for commercial scale operations.

The project was a significant step forward in Australian abalone production because of technical advanced so that survival was high and cost of production low. As a result the economic feasibility was far better than any previous work had suggested.

Extension of the project was reliant on business structures for supply of juveniles and also access / ownership of the enhanced production. The plan was to use purpose-built hatcheries built on a cost-sharing basis (industry/CRC) to enhance the wild population, building on previous trials. 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.

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.

3.2.5. Project 2009/714.1 Decision-support tools for economic optimization of western rock lobster

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 Rock Lobster fishery. The model was used to examine various conditions of recruitment, discount rates, market price, and costs of capture (fixed and variable).

The project created 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. TACC setting and other rules associated with the shift to ITQs were informed by this project. This has resulted in substantial gains in economic yield in the fishery, which has translated to large gains in the value of quota units over the last two years.

The WRL fishery is iconic and the success of the bioeconomic approach to increase profitability in this fishery will be invaluable for change elsewhere in Australia. Large gains have been made but this is not well known elsewhere. All the better story because it's come at the same time as biological problems.

Communication and interacting with industry seems to remain a significant challenge because of poor working relationships between some stakeholders. The bioeconomics model is viewed by some of the industry as a way of pushing government policy, rather than (more correctly) a tool to test different views on what should be done. Most of this projects activities tried to deal with this problem.

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.

Future needs pursued later in the FH Theme

- i) Continue to bring industry along in the process by pursuing and being responsive to requests to trial various harvest strategy scenarios.
- 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) Establish the collection of an economic data set to monitor changes in cost structures, markets and prices to inform bioeconomic modelling.

3.2.6. Project 2009/714.2. Bioeconomic decision support tools for Southern Rock Lobster

Participation in this project was also as a CI although in many cases involvement was purely to explain the broader goals of FH and was thus attended in the FH TL role. An example was participation at SA port meetings, which were used to explain some of the other FH bioeconomic projects to promote discussion of applications to the SARLF.

The project used and extended the fishery population model used for rock lobster stock assessment in Tasmania and South Australia¹, 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, has resulted 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,

¹ The project proposal included Victoria, but this state was not included in the research.

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 some parts of industry have great 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. TAC decisions are already being made with this input. 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.

3.2.7. Project 2009/714.3. Economic management guidance for Australian abalone fisheries

The project was designed to 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, to 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. The substantial gains in profitability made with this approach in the other 2009/714 projects suggested that this project could also increase the profitability and quota unit values in abalone fisheries.

This project was proposed by the ACA at workshops involving other industries in 2009 but versions of the project proposal failed to gain acceptance until it was separated into three components: WRL, SRL and abalone. Support from the ACA was finalised late April 2010.

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 was less feasible for abalone than for other fisheries. This is partly due to the rise of aquaculture and also the lower cost of harvesting. Nonetheless, the absence of economic targets in the fisheries, as per WRL and SRL at the start of the CRC, suggested opportunity for gains nonetheless.

Collecting economic data proved 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 was 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. This is a greater problem than with the rock lobster fisheries, with 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 and indeed proposing this work during initial theme planning meetings in 2008 and 2009, seem unlikely to be able to get industry thinking about overall profitability and using harvest

strategies to increase the yields of quota owners due to other commitments/priorities, and its general misgivings about the ability of the project to deliver tangible outcomes. The role of this project also often became confused, for example with some viewing it as linked to increasing payments to divers (actually a cost). There was also confusion between assessment reporting components of the project (ie the econsearch data surveys) and application of this data to define more profitable harvest strategies.

Conclusions

The project completed data collection and basic reporting on economic performance of some fisheries although this struggled in some jurisdictions. The ACA ultimately withdrew support for the bioeconomic modelling components.

Of the three sectors, abalone was the toughest nut to crack with respect to introducing economics into decision-making. This pointed to challenges for legacy planning from the FH theme. The greatest single issue to be resolved was to show 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 proposed and supported by the ACA during planning in 2008-09, this body was slow in supporting the project once it was developed and the membership was not convinced of its benefits. Some members of 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.

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.

Future needs pursued later in the FH Theme

- i) Worked with the ACA Board to address concerns and demonstrate how long term benefits can result from consideration of the economic implications of management decisions. Several meetings were held with the ACA to discuss the project and define outputs/ outcomes so they could evaluate whether to continue or not. This involved additional focus on key management and marketing issues such as:
 - o 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;
 - o size limits and the longer term economic consequences of changes; and
 - o timing of harvest (following on from the Ben Stobart SA Geenlip study)².

² 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.

- ii) Strengthened linkages with the current fine spatial scale suite of projects³, where key decision on TACs and size limits are evolving as a result of comprehensive data logging and analysis. This was done by developing the capacity to use the GIS data for measurement and implications of travel cost on harvest patterns in abalone fisheries.
- iii) 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.
- iv) Database for economic data was completed and Tas data loaded (data confidentiality restricts this to storing survey (cost) data for Tas only, however price data is broadly applicable for analyses for all states being an export product).
- v) Complete and submit manuscript on abalone export price analysis. This was required to describe price patterns for analyses of alternate TACs/ size limits rather than being an output with direct application (although could serve to test progress with marketing projects). This provided some of the basic price relationships, such as supply-demand effects, which were more important with abalone than other species in the CRC (because of the market dominance) and price trends (because price is trending down which can be considered in projections).
- vi) One of the more important changes to business structures in the fishery is the use of wet wells for live product. The benefit of this approach varies with travel distance and the premium paid for live product. This aspect of the fishery was explored as a test case of cost-benefit analysis utilising the survey data.
- vii) The most significant outputs from the project was to come from model based evaluation of alternate TAC and size limits on abalone fishery profitability. This relied on collaboration with CSIRO and access to the model, which was regularly renegotiated due to reasons such as when the project was placed on hold or when the CSIRO resources were unavailable.
- viii) Efforts were made to complete survey data collection, in particular the problems of getting surveys completed in Victoria. This remained an outstanding problem.

The legacy of the project, considered in isolation and without further intervention, is likely to be very limited. However, the fishery would benefit from the same cross-cutting legacy activities as the other large industry participants that involve increasing understanding application of bioeconomic methods. It is similar to the Moreton Bay trawl project in that there has not been the same history of tangible gains from adoption of bioeconomic tools as occurred in SRL or WRL. This means that the legacy projects that describe managing for profits are needed at a grass-roots level to try to promote moving in this direction in the future.

³ 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 Mundy in Tasmania, Duncan Worthington in NSW and Harry Peeters in Victoria (Western Zone).

3.2.8. Project 2009/715. Optimising business structures and fisheries management systems for key fisheries

This project was initiated by industry partners at the theme planning workshops in 2008/09. Representatives from ACA, prawns, and SRL independently proposed research in this area so a single collaborative project was developed.

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.

The project used meetings and workshops to explore better business structures. These meetings were directed at weaknesses in each fishery, first identified used a scoring approach to find where current performance was sub-optimal and thus had scope for improvement. This was the Anderson and Anderson indicators system developed for the World Bank to measure wealth generation in fisheries.

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.

Where industry has the capacity (financial and otherwise) to take responsibility for identifying the improvements needed in their fishery, the project had 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.

The most successful outcome from this project was with 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. There appeared to be some scope for improving industry structure, and also managing the quality, quantity and value of abalone catches by optimising the timing of harvest.

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

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

This enhancement project was developed within the FH theme. Theme involvement through the life of the project has been in managing progress reporting. Visiting fellow support was obtained for Kai Lorenzen, developer of enhancement modelling software EnhanceFish. Work on modelling of sandfish enhancement occurred in 2014 and remains underway.

The initial focus on improving yields from the wild fishery and post-harvest processing systems in sea cucumbers 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 cucumber 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. The project has involved collaboration with the Darwin aquaculture centre, which 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 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.

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. For this reason the theme has invested in additional support of economic analyses of operations to identify bottlenecks.

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.

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

This project was developed by the FH Theme through a process of several meetings to define their needs and frame these as tractable research questions. Several versions of the project concepts were developed by the theme and rejected until a version was accepted by Tasmanian Seafoods that met their objectives.

The FH Theme was also involved in resolving the issue of permitting of the project and the sale of meats from experimental fishing at high harvest rates / low size limits. The project was ongoing mid 2014.

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.

The value in this project is that 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.

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

Project Development

This project was developed through several meetings with the Australian Council of Prawn Fishers (ACPF) including through CRC workshops and a research and development planning workshop associated with the ACPF board meeting in April 2010. A list of priorities for investment in prawn fisheries in FH were developed in a meeting with industry participants at CRC workshops in 2009 and 2010. Linda Cupitt from the Moreton Bay Seafood Industry Association had proposed a project on harvest strategies in that fishery and we were successful in getting this prioritised by the ACPF.

Development of this project required aligning the objectives with priorities for the CRC (ie it had to fit within the FHT strategy), the ACPF (i.e. it had to serve as a template for management of small mixed prawn fisheries), and the MBSIA.

The following issues were addressed in the project proposal:

1. Several parts originally proposed were core business or part of project development and were unlikely to get support from CRC. For example collation of data on biology; capturing industry knowledge on alternative harvest strategies/ or knowledge on the way fisheries are managed elsewhere ; identifying gaps in knowledge.
2. Data collection was emphasised originally including biological data, historical catch and effort, proposed financial and economic, proposed industry based (undefined) data collection. Much of this was expensive to collect and wasn't critical for the development of harvest strategies. An exception was the collection of economic data, which was not available in any form so this was pursued.
3. The industry had already identified several ideas for better management, both through their knowledge of the MBTF and also from visits to other fisheries such as Spencer Gulf. These ideas were incorporated and used to shape the proposal better.
4. The priority of the group was identified and emphasised in the project development, which was to regulate effort across multiple species to maximise profit. This was to be done by developing catch rate thresholds for opening and closing spatial blocks. We also identified secondary priorities including using spatial "paddock"

management to allow pulse fishing to market demand and reduce fuel usage, using market price triggers to open blocks in a stepwise manner; and providing capacity to fish to market with a system that allows 12 months access, but with effort penalties for harvesting at periods that reduce economic yield of by-product species.

5. It was clear that extension was reliant on working with QDPI to develop a management plan that would enable the strategies to be implemented. This extension was developed in the plan.
6. Extension was also required to other prawn fisheries as part of the outcomes to the ACPF.

After development of this project it was circulated to CRC researchers through an expression of interest process.

Expression of Interest for Research Provider

Harvest strategy optimization and co-management for the Moreton Bay Trawl Fishery

The Moreton Bay Seafood Industry Association (MBSIA) is a member based organisation representing commercial fishing operations of Moreton Bay, South East Queensland. The MBSIA has a strong track record in delivering industry projects with funding partners such as FRDC, and is well recognized for the regional Environmental Management System for professional fishers developed by the Association and its members.

MBSIA is calling for suitably qualified research providers to be the Principal Investigator for an industry initiated and led project, *Harvest strategy optimization and co-management for the Moreton Bay Trawl Fishery* (MBTF).

In summary, a research provider is required to complete the following tasks:

- Undertake desktop studies: existing relevant harvest strategies and; distribution and abundance of prawn species in Moreton Bay
- Develop model of collecting finer scale economic data of current fishing operations
- Undertake bio economic analysis and modeling of existing and alternative management
- Develop specific harvest strategies that allow stakeholders to select optimal fisheries management and harvest systems
- Develop strategy for intra-season industry data collection program
- Reporting on process and outcomes

An application from a collaborative team involving QDPI and CSIRO was successful (August 2010) and contract awarded.

Project Management

Involvement in the project through the research phase included survey methods, milestone review, CRC master classes in fisheries economics for the MBSIA members, and changes to the time line.

Other possible research projects for the fishery were proposed and discussed with the ACPF although none progressed to the project proposal stage.

The draft final report was reviewed with input also obtained by the ACPF because of their support. This was straight forward except in relation to governance options for the fishery, especially in relation to the definition of co-management and whether this was feasible in the fishery. There was also a need to relate governance in this fishery with research on other fisheries including Exmouth Gulf prawns, Northern Prawn Fishery and Spencer Gulf Prawn Fishery.

Project legacy

Additional work was done on creating a legacy on this project, both through work on the FRDC legacy project with Ian Cartwright and also a separate workshop organised in November 2013. Discussion on extension have continued through 2014.

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 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.

Conclusions from the workshop in November 2013 were:

The project has delivered a potentially valuable analysis but this was unlikely to result in higher economic yield in the fishery in the current environment. This was because the project was not well understood by fishers and they were not motivated to adopt the project outputs as a harvest strategy. There were numerous parts of the CRC analysis that were not understood by fishers, which is reasonable given that it's a new and complex model.

Significant opportunities were found for improving economic yield in the fishery, especially in management of tiger prawn harvests but this was also where there was resistance to harvest strategies because fishers believed more biological research was needed (growth, movement, mortality from different sectors).

The creation of a legacy from the project, with implementation of harvest strategies to increase profitability, appeared improbable. The main barrier identified by workshop attendees was communication although it also appeared that training of managers and industry in harvest strategies and fishery economics would help. Specific actions proposed included:

- 1) more frequent and facilitated workshops on management in the fishery, perhaps as chaired meetings twice or even four times per year to discuss fishery status before a decision making meeting once per year. This is part of normal fishery management and outside the CRC project.
- 2) inclusion of the fishery as a case studies in generic material proposed from the future harvest theme for communicating how to increase economic yield from fisheries. For example, video, brochures and the fisheries economic master classes.

3.2.12. Project 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. As with other ACA projects, the research was developed after prioritisation by industry at workshops in 2008/09, in this case in response to mortalities observed during a period of higher temperature.

The project involves testing physiology of abalone during late summer with field-work vulnerable to availability of staff and access to suitable abalone during this period.

Following initiation of the project, the project progressed steadily aside from delays related to availability of abalone so that theme involvement has been only standard project management.

3.2.13. Project 2010/714. The Future Harvest Master Class

This project was developed to help explain the application of economics to fisheries management (as opposed to individual firms). These courses were intended to help in extension of projects. They were very successful although this varied between industry groups with very high interest / attendance with some sectors but little (even nil) in others. The theme leadership role involved initiating and planning the courses.



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.

The teaching materials developed by the project are in need of further development both in terms of material and means of delivery. In particular, courses would ideally be tailored to jurisdictions and specific fisheries.

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

3.2.14. Project 2010/740. AS-CRC PDRF Project - Fisheries Economist

This project provided for a post-doctoral research fellow (PDRF) to be 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 was 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 provided additional support and contributed widely to theme activities.

3.2.15. Project 2010/766. Policy shift to risk-based fisheries management

The project was developed following a series of visits to WA for meetings with WAFIC and WA Fisheries to discuss details of the project, especially extension and the willingness of government to incorporate the proposed approach into management processes. Project progress was tracked through attendance at some of the specific fishery workshops.

The project used a risk-based approach to analyse the regulatory frameworks (essentially the current management plans). The initial plan was to roll this out across all WA fisheries but this scope was later reduced to a series of test fisheries, each of which had varying levels of complexity. Biological, economic and social risks were covered in the analysis which used standard risk assessment processes of expert opinion and scoring of consequence and likelihood.

Project implementation was slower than expected, due to a combination of the complexity of the work involved and staffing resources. The project, when completed, could 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. There is potential for extension to Australian fisheries outside WA.

Barriers to progress

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 had the potential to change substantially the intended direction of the project and its extension and adoption.

Conclusions

There was 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 developed a comprehensive framework for assessing risk and reducing unnecessary regulation, and applied it to a number of candidate fisheries although this process was slow and it is particularly challenging to draw the major conclusions and identify outcomes for delivery in the absence of the two principal investigators who are no longer working with WAFIC.

The adoption of the project by the Department may be eased by their long track record of the application of risk-based approaches to fisheries management. Progress with project implementation were problematical.

The FH worked on managing the project to provide a legacy for Australian fisheries. This was dependant on its ability to create change in WA and then to have effort placed into communicating this to other jurisdictions.

3.2.16. Project 2011/733. CRC Abalone Research Forum

This project was led by the FH Theme and supported workshops on areas of interest for abalone research in the CRC. It was held in conjunction with the international abalone conference so that international experts could attend the workshops at no cost to the CRC.

The CRC Abalone Forum was run in Hobart in May 2012. This was a communication, engagement and training exercise with most CRC abalone projects represented. We were especially interested in areas that could contribute to the CRC legacy:

A reseeding workshop was held to review and reinvigorate the concept of abalone enhancement. Enhancement operations were showcased from Japan, the USA and NZ.

The CRC has substantial investment in marketing. The forum assisted with this through the presentation of information on global production and markets. The intent was to develop a better-informed Australian research and industry community fully aware of the latest global trends.

A workshop was held to progress the development “Snailbase” which involved participants from several countries.

The conference and thus the forum attracted a large number of registrants (261) from 19 countries. The forum dealt with areas of special relevance to CRC projects and was effective in generating outputs from the CRC with many papers currently under review for publication in a refereed journal. The forum also included sponsorship for industry registrations which contributed to the larger than usual participation of industry in this type of event (130 registrations).

3.2.17. Project 2011/744. Commercialising translocation of southern rock lobster

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 and slow growth, 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.

3.2.18. Project 2011/750. Bio-economic model for SA prawn trawl fisheries

During the life of the FH theme there was a desire to expand projects on improving profitability in production of wild harvest prawns. This was to complement the success in post-harvest projects on prawns in the CRC. Research was ultimately initiated on SA prawn fisheries which provided a good case study as their harvest strategy was more developed than for the Moreton Bay fishery yet still had capacity for further gains. The fishery was also less complex than Moreton bay with fewer species and less effect on businesses on the ability to retain and sell scale fish and bugs.

The project was developed in response to the common problem in prawn fisheries of reductions in prawn prices and reduced profitability. The fisheries examined were the SA Western king prawn fisheries in the Spencer Gulf (SGPF) and Gulf St Vincent (GSVPF).

The project used and adapted an existing Eastern king prawn bioeconomic model to develop optimal fishing /harvest strategies. Upon completing the model its outputs were 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 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 developed a bioeconomic model and identified and developed 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 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.

The project relies on industry to be innovators, adopters and drivers. Getting buy-on from managers, once industry is engaged and supportive of the process, will be relatively easy.

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 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.

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

This project extended abalone enhancement research conducted in 2009/710 and was shift from ongoing increase in production with enhancement to tactical recovery of stocks that had been seriously depleted. In this case the application was for a catastrophic mortality of Roe's abalone in a portion of Western Australia coast during the summer of 2010/11 but the approach was conceptually relevant to recovering overfished stocks and areas impacted by AVG. Involvement of the theme in this project was through standard processes of managing progress reporting, application of the economic impact tool, etc with no unique issues that required special intervention.

The project aimed 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.

The primary weaknesses of this project are the extreme logistical issues associated with the study area. 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.

Industry have agreed to support the closure to fishing to aid recovery efforts. The controversy in WA surrounding greenlip and the risk of AVG, which was sufficient to halt application of 2009/710, was not present in this project. This was because translocation was 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 provided an 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.

4. Benefits and Adoption

The projects conducted through the Future Harvest Theme had varying success and some did not result in any ongoing benefit. In other cases, however, there were benefits that were adopted and have delivered gains to the industry partners. Individual project benefits are described in detail above but a summary of those where benefits were achieved were:

Abalone fishery projects involved researchers from WA Fisheries, SARDI, University of Newcastle, UTAS, CSIRO, NSW Fisheries and DPI Vic. Projects were:

1. Factors limiting resilience and recovery of fished abalone populations – this project examined the feasibility of translocating abalone back into areas that had been impacted by overfishing so that they could recover. This showed that attempting to recover depleted area by translocation of adult abalone was not economically feasible – potentially saving wasted funds had these operations proceeded.
2. Economic management guidance for Australian abalone fisheries – this project completed surveys of the economics of abalone production in Tasmania and NSW for the first time so that the impact of these fisheries can be better described and analysed. The method for monitoring economic performance can be repeated in future years as part of the routine assessment process. An important benefit of this is the ability to examine the effect of changes in the stock or management decision on economic performance, in the same way that biological outcomes are reviewed.
3. Could harvests from abalone stocks be increased through better management of the size limit / quota interaction? Examined whether abalone stocks were density limited in some areas and whether harvests could be increased. This provided a test of the potential for meat quality and abalone production to increase as density was reduced. No improvements could be detected, which provides information for setting TAC and size limits in Tasmania.
4. Maximising value by reducing stress-related mortality in wild harvested abalone – examined how to avoid mortality events that occur sometimes when abalone are stressed at harvest. This identified several ways to reduce stress and improve survival of product.
5. CRC Abalone Research Forum – supported international workshops on issues important to CRC abalone projects including Asian market research, and genetics.
6. Bioeconomic evaluation of commercial scale stock enhancement in abalone- involved the release of hatchery reared juvenile abalone onto reef with far better results than previous attempts. Commercially viable but halted due to concerns with disease in abalone.
7. Recovering a collapsed abalone stock through translocation. Investigated recovering populations of abalone from large die-offs in an extreme heat event. Methods are now available but it's unclear if future adoption will occur.

Southern Rock Lobster projects involved researchers from SARDI, DPI Vic, CSIRO and UTAS.

1. Spatial management of Southern Rock Lobster fisheries to improve yield, value and sustainability – alternative size limits, regional quota systems and translocation were examined. Greatest change has been in translocation – now adopted commercially. Regional size limit changes have enormous potential but have not been implemented to date although this may yet happen. Discussions are ongoing and continue to rely on the results from this project.
2. Bioeconomic decision support tools for Southern Rock Lobster - used to develop harvest strategies in SA and Tas plus adjust management off eastern Tasmania to respond to low lobster biomass / urchin barrens.
3. Commercialising translocation of Southern Rock Lobster – shifting lobsters to areas of higher growth is now a commercial operation that increases production by ~ \$3million p.a. with much scope for expansion.

Western Rock Lobster projects involved researchers from WA Fisheries, CSIRO, WAFIC, and WRLC.

1. Improving profitability in the Western Rock Lobster fishery using a new rock lobster trap – explored alternative trap designs that are more efficient for two day sets so that trips and thus fuel use can be reduced. This has not been adopted yet but has some future potential. This is because there is now less need to control gear with the shift to output management.
2. Decision-support tools for economic optimization of western rock lobster – estimated levels of quota and other regulations that produced maximum economic yield. These were implemented and have contributed to decisions that led to a remarkable increase in profitability of this large fishery at a time when recruitment fell. Profits have increased in this fishery through both higher price and lower cost. Higher price occurred without any input from this project. However, costs have also fallen as a direct result of TAC setting decisions.

Prawn projects involved researchers from SARDI, QDI, UQ, and CSIRO.

1. Harvest strategy evaluations and co-management for the Moreton Bay Trawl Fishery – involved surveying fishers for cost data to test alternate harvest strategies with opportunities identified for brown tiger prawns. This project has not been adopted as yet but did develop options to increase profitability which may be adopted in the future.
2. Bio-economic model for SA prawn trawl fisheries – similar to project above with bioeconomic used to identify opportunities for the Gulf St Vincent and Spencers Gulf prawn fisheries. The project increased capacity to tweak the harvesting, which is expected to improve profitability.

Sea Cucumber projects involved researchers from NT Fisheries, Tasmanian Seafoods and UTAS.

1. Propagation and sea-based growout of sea cucumber stocks in the Northern Territory – has successfully produced 100,000s juvenile sea cucumbers for enhancement into bays of the NT that once supported large fisheries for this species. Results are being adopted with work proceeding on pilot scale grow-out.

5. Further Development

Projects in the Future Harvest theme had outstanding overall return on investment (ROI) relative to other areas of activity in the CRC (Appendix 3: Economic Impact Tool). However there was also much variation in ROI with many projects failing to lead to adoption despite the identification of opportunities for higher profit. There is clearly much scope for further development and this requires not only project development but also efforts towards training and educating industry and management on the use of economics and enhancement in fisheries.

Despite the many years of activity in these topics through the CRC, it's apparent that poor understanding of aspects of fisheries economics remains a barrier in development of Australian fisheries. To illustrate, there remains a widespread perception that using economic yield as a target for fisheries management could lead to overfishing and that "sustainability" targets for biological indicators are needed to prevent overfishing. This perception illustrates that even many professionals in Australian fisheries have not understood the process of

maximising economic yield with fisheries management decisions (because sustainable harvests are a prerequisite for ongoing economic yield from a fishery).

Legacy projects were developed through the Future Harvest Theme to address this problem of limited understanding / application of fisheries economics concepts. These cover activities of:

1. Overview papers
2. Fisheries economics master classes
3. Fisheries economics for managers workshop
4. Short video on fisheries economics
5. Template for economic data collection.

Further development requires consideration of the barriers to uptake of bioeconomic and enhancement opportunities. Resistance to enhancement has many aspects, including legitimate concern about the feasibility of many blue-sky proposals. Nonetheless, research in the Future Harvest Theme has clearly addressed two misconceptions around enhancement, which is that it doesn't work or is the last resort of bad management. Projects on Southern Rock Lobster and greenlip abalone have shown that enhancement can be used to achieve production gains that could not be achieved with conventional management.

5.1. Barriers to increased use of bioeconomics

5.1.1. Who's responsible for seizing opportunities – government or fishers?

Bioeconomic projects were often able to identify opportunities for large increases in profit by changing management that weren't implemented because of resistance to change by industry. This raises the issue of the role of government in making decisions that affect profitability. If there's an opportunity to increase economic yield from a fishery, does the government have a responsibility to implement this change?

A perception that has persisted throughout the duration of the Future Harvest Theme has been that the government is responsible for decisions around sustainability of the stock but economic decisions should be deferred to industry. This ignores the obligation of government to manage the stock with regard to economic yield, as illustrated by the following examples of objectives of legislation:

- o “resources of the State is to be allocated between users of the resources in a manner that achieves optimum utilisation” (South Australia)
- o “to provide social and economic benefits for the wider community of New South Wales” (NSW)
- o “maximising the net economic returns ..” (Commonwealth)
- o “to achieve the optimum economic, social and other benefits from the use of fish resources ..” (Western Australia)

Resistance to change by either government or industry led to lost increases in economic yield and return on investment in bioeconomic research was reduced. This occurred even in the Southern Rock Lobster fishery, which has exceptionally well developed bioeconomic models and progressive management. For example, CRC projects identified changes to the harvest strategy in South Australia that equate to a foregone yield of around \$150 million NPV. Likewise, simple changes were identified for size limits in Tasmania that could have increased economic yield by ~\$100 million NPV (Figure 1).

The need for greater government involvement in these situations where economic yield to the community is being foregone is to be discussed in the workshop and video legacy projects.

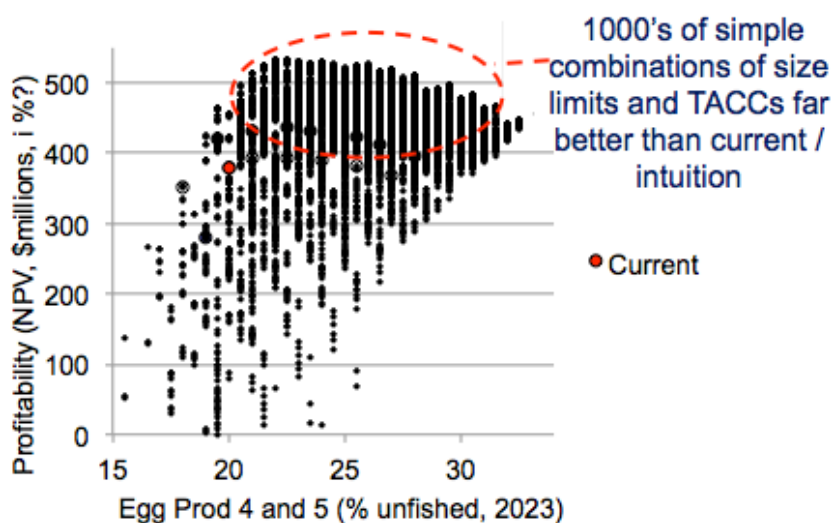


Figure 1. An example of an output from bioeconomic modelling that would increase economic yield but was not adopted because of government deferral of economic decisions to industry and resistance to change by industry. The effect of alternate size limits in Tasmanian Southern Rock Lobster on egg production and economic yield are shown. Thousands of alternate size limit combinations (between areas and genders) were identified that increased both egg production and profitability compared with the current management. Implementation of any one of these better size limits has been resisted by industry for a range of reasons, including concern about the last time size limits were adjusted in 1967.

5.1.2. Moving beyond the Gordon-Schaefer curve

The Gordon-Schaefer curve is a simple, static bioeconomic model that describes how economic yield is increased when catch is reduced below maximum sustainable yield. It's widely used and was helpful for discussion of increasing economic yield but too simple to deal with the complex issues facing real fisheries. Stakeholders often struggled with difficult concepts and decisions when moving from simple economic concepts like the Gordon Schaefer curve to applying bioeconomic research in their own fishery. Examples of complex issues that industry and government faced through the course of Future Harvest projects are:

1. How to target maximum economic yield when recruitment fluctuates? In particular what how does this affect the use of bioeconomic models for decisions like setting the economic yield maximising TAC or size limit?
2. Many stocks had biomass well below that which is needed for producing maximum economic yield, which meant that stock rebuilding was required. But if rebuilding was required, how fast should this be? (formally this is a question of what discount rate should be applied). Rebuilding to increase economic yield involves setting interim biomass or catch rate targets and these required complicated decisions to be made on (i) the level of the interim target, (ii) what year in the future the interim target is to be reached, and (iii) the probability of meeting the target.
3. Changes to the fishery often lead to restructure of capital (for example change in the number of vessels and processing facilities). Are there better ways to manage this restructure? For example, slowly reducing the number of vessels may help maintain resale values.

These issues could be addressed by economic approaches but they were complex and in some cases they stalled or derailed attempts to increase economic yield with bioeconomics. Legacy projects have attempted to deal with this problem and provided the following guidance:

- The objective of the management needs to be very clear. Often “stock rebuilding” is given as an objective but this is inadequate because it doesn’t define why the rebuild is required and to what level. Stock rebuilding is ideally viewed as a strategy to meet an objective of “maximum economic yield”.
- The rate of rebuilding should ideally be equal to the discount rate of commercial fishers, with business lending rate a reasonable proxy.

5.1.3. Perceptions of high cost of economic data collection programs

Economic data was fundamental to many of the projects conducted in the Future Harvest Theme and was generally not available through existing data collection programs. Management agencies often commented that it was not possible to maintain economic data collection programs because of the high cost and limited resources. This was despite (i) all of the jurisdictions having a legislative obligation to consider economic outcomes (see Who’s responsible for seizing opportunities – government or fishers?, Section 5.1.1), and (ii) the cost of economic data reporting being far less than that of biological programs. The low cost of economic data collection programs was apparent from South Australia where economic data collection is especially extensive yet only a few per cent of the cost of biological programs.

This issue of incorrect perception around the cost of economic data collection programs was addressed by a legacy project on low-cost approaches to collecting economic data. The aim of this project was to stimulate ongoing assessment of the economic performance of fisheries into the future.

5.1.4. Uncertainty around estimates of cost and price

Bioeconomic projects sometimes encountered resistance to adoption because future prices and costs were unknown and can vary through time. The issue of future uncertainty also occurs with biological data where future recruitment is unknown. In both cases, the presence of future uncertainty doesn't mean that management can avoid making decisions. The appropriate response is to use best information and examine outcomes under a range of scenarios (i.e. ranges of prices, costs and recruitment). This is explained in some of the legacy projects.

5.1.5. Who are the beneficiaries of higher economic yield?

Bioeconomic projects sometimes struggled to gain support or adoption because there was confusion around the group of stakeholders who could benefit from bioeconomic research. The following stakeholders exist and it's often the case that one group stands to benefit at the expense of others by management decision:

- Jurisdiction consumers
- Australian consumers
- Overseas consumers
- Recreational fishers
- Regional community
- Australian community
- Jurisdiction quota owners
- Australian quota owners
- Overseas quota owners
- Fishing labour (skippers and crew)
- Processing and supply chain labour

Changes in management to benefit one stakeholder group often come at the expense of another group. This problem affects many aspects of fisheries management decision-making and was clearly a problem with adoption of bioeconomics. Industry groups often assumed that bioeconomic approaches would be used to benefit a particular group at the expense of others, for example fishers versus quota owners.

Resolving this problem requires decisions from Government on which of the groups above they want to prioritise for fisheries benefits. Bioeconomics can then be used as a tool to explore how to increase those benefits. Examples of where the absence of clear guidance from legislation led to inconsistent or strange outcomes from management were:

- Implementing a low TAC to reduce supply of sustainable seafood to *Australian consumers* and reduce employment of *Fishing labour (skippers and crew)* to increase resource rents paid to *Overseas quota owners*.
- Lowering the TAC to reduce benefit to *Regional community* to increase resource rents paid to *quota owners (Jurisdiction, Australian and Overseas)*. But then attempting to slightly increase the TAC to create a minor benefit to *Regional community*.

- Implementing a harvest strategy to target high resource rent payments to *quota owners (Jurisdiction, Australian and Overseas)* but using GVP as a performance indicator.
- Targeting and achieving high resource rent payments to *quota owners (Jurisdiction, Australian and Overseas)* but assessing the economic performance of the fishery based on *Fishing labour (skippers and crew)*, which is naturally low-profit.
- Objectives of providing benefit to *Regional and Australian community* from fisheries present in legalisation but contribution of recreational and commercial fishers to this benefit rarely measured (by Gross State Product) or used as a performance indicator.

A national debate around who owns Australia's fisheries and who should be the beneficiaries would be of value and would provide much needed direction to management decisions.

6. Conclusion

Leadership of the Future Harvest Theme from 2009 to 2014 involved working with industry participants and research providers around Australia in the development of project concepts for our largest wild catch fisheries. This role involved: (i) the prioritisation of industry needs at workshops; (ii) development a business plan for meeting these needs with investment from industry partners and participating research providers; (iii) assisting in development of project proposals, such as in cases where the industry had identified a need with a researcher recruited through an open call; (iv) managing project progress including reviewing milestone and final reporting; (v) evaluating usage of research generated through the CRC using economic impact reporting; and (vi) legacy planning and response.

The suite of projects supported through Future Harvest have had mixed success, although provided an overall high ROI from research that leaves a legacy in Australian fisheries production.

The scope for increasing benefits from Australian fisheries is substantial, which was apparent from the ease with which projects were able to identify opportunities for increasing economic yield. This occurred even in some of Australia's best studied, and data rich fisheries so smaller fisheries are presumably even less likely to be managed optimally.

The Future Harvest Theme was able to overcome some barriers to adoption but many issues remain and are detailed in the section above in Section 5: Further Development. These often involve confusion around the use of bioeconomic approaches so more communication and training is indicated. Other challenges include fundamental issues around fisheries management and are needed to improve Australian fisheries management more broadly than just the adoption of economic approaches. This includes greater clarity around which stakeholder group or section of the community that fisheries management is intended to benefit.

7. Appendices

7.1. Appendix 1: Intellectual Property

Nil. All IP resides in projects supported through the Future Harvest Theme.

7.2. Appendix 2: Staff

IMAS, Caleb Gardner

IMAS, Emily Ogier

7.3. Appendix 3: Economic Impact Tool

7.3.1. Program 1, Future Harvest Outputs 1.2 & 1.4

This text provides a summary of results from the CRC impact tool, which was one of the tasks completed for all projects in the FHT. It provides a summary of overall theme progress.

This task was required for all projects as part of CRC reporting requirements to DIISRT.

Activities

The focus under the Future Harvest research theme is in two areas of innovation:

- 1) The enhancement of wild stock to increase yields from existing fisheries covering:
 - a. The development and economic evaluation of translocation protocols for moving low value, deep water, Southern Rocklobsters (SRL) into higher yielding, higher value, shallow water fisheries.
 - b. 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.
 - c. The development of protocols for enhancement of WA green lip abalone fisheries through stocking of aquacultured juveniles and analysis of its economic viability.
 - d. The development and economic feasibility analysis of hatchery production and ranching of high value sea cucumbers in NT.
- 2) The development and application of bioeconomic models to be utilised as decision support tools in the development of fisheries management to improve the economic efficiency of some of Australia's iconic invertebrate fisheries including SA/QLD prawns, Tasmanian and SA SRL, rocklobsters in WA and temperate abalone. This work is supplemented by additional projects to:

- a. Apply newly developed wealth based fisheries performance indicators to identify potential improvements to business and management structures for these same fisheries.
- b. Develop, and verify on some trial fisheries in WA, risk based fisheries management leading to a simplified but broad based (accounting for biological, social and economic factors) regulatory system.
- c. Use shell based measures to improve the economic efficiency of harvest of abalone.
- d. Quantify and identify means to reduce the impact of harvest/post-harvest stress in wild caught abalone to improve product quality.

Outputs 1.2

1.01 Enhanced yields from wild-harvest innovations

Translocation of SRL is viable and profitable and is being commercialised with over 100,000 lobster translocated p.a. in Tasmania. Stock enhancement of green lip abalone in WA over several seasons has led to economically viable increased fishery yields. A commercialisation model for enhancement is developed but implementation is stalled over biosecurity concerns. Breeding populations of Roe's abalone have been re-established in the decimated fishery. Protocols for hatchery production of juvenile sea cucumber have been developed and are being upscaled with pilot scale ranching of >300,000 sea cucumbers indicating that enhanced yields are likely.

Milestones

FY	Key Milestones (144 Characters per year)
1	Pilot scale SRL translocation of rock lobsters from deepwater fisheries to shallow water sites in Tasmania
2	Pilot scale abalone enhancements of greenlip abalone initiated in WA
3	Pilot scale WA abalone enhancements impacting yield. Feasibility of SRL translocation established in Tasmania
4	Hatchery production of 20,000 juvenile sea cucumbers (SC)
5	Abalone seeding protocols optimised, commercialisation plan developed. Roe abalone stock translocated. Pilot ranching of SC and their genetic structure understood
6	First harvest of ranched SC. Genetic plan for captive SC developed. 1 st breeding of Roe's abalone
7	Business feasibility of SC ranching established. Feasibility of Roe's abalone translocation established. Development of fishery enhancement policy in WA and NT

Note: Add legacy projects in later years when projects approved e.g. Acceptance of stock enhancement in the wider community as a useful and viable management tool for the appropriate fisheries.

Usages

1.01 Enhanced yields from wild-harvest innovations

Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced
- Translocation of 100,000 SRL p.a. in Tasmania from 2012/13 increasing by 20% p.a. up to 300,000 (cost of moving lobsters @ \$1.20 each). - Harvest of survivors of 300,000 ranched sea cucumbers p.a. from 2014 increasing by 20% p.a. (@ \$300 per 1,000 juveniles). - Harvest of 20 tonnes of greenlip abalone (based on stocking 500,000 juveniles in 2014) by 2018 increasing to 150 tonnes p.a. (based on release of 4m seed pa) by 2022 @ \$100 per 1,000 juveniles. - Harvest of 36 tonnes of Roe's abalone from area 8 fishery in WA based on translocations in 2012 & 2014 (no usage costs as recruitment will be from stock translocated during the project). (532 of 532 Characters)	80%

Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated
Based on 100% likelihood in SRL as commercial scale translocations are already happening. Also 100% likelihood of harvests in greenlip abalone as the stock is already enhanced from 2008 – 2012. Likelihood is 60% for sea cucumbers and 60% for Roe's abalone based on progress to date in these species and experience from similar efforts overseas with abalone. (300 of 609 Characters)	70%

Rationale for usage probability selections
SRL translocation @ 90% due to small risk that scaling up may not occur in future years. Risk of usage not occurring is high in greenlip abalone enhancement (probability of usage @10%) due to current impasse on implementing the commercialisation strategy, nominally associated with biosecurity risks. Likelihood of usage of sea cucumber ranching is high (@80%) with risks related to company decision to proceed with commercial scale ranching and issues arising with indigenous community partners. Usage related to recovery and re-opening of Roe's abalone fishery is @ 100% because the translocation of broodstock has occurred as part of the research project and the fishery will reopen if the stock has recovered. (603 of 609 Characters)

Timeline of key usage milestones

FY	Key Milestones (144 Characters per year)
6	Commercialisation of SRL translocation initiated in Tasmania
7	Commercial scale stocking of captive reared juvenile SC initiated and increasing annually. Commercial scale translocation of Roe's abalone broodstock completed for Area 8.
8	Scale up commercial translocation of SRL in Tasmania. Commercial scale enhancement of GL abalone initiated in WA
10	Scale up of commercial enhancement of GL abalone initiated in WA
12	Peak stocking of GL abalone across WA GL fisheries (4m juveniles) achieved. Peak SRL translocation (300,000 animals pa) achieved in Tasmania.
13	Target of stocking 6m juvenile SC p.a. for ranching achieved
14	Achievement of target of stocking of 6m SC juveniles for ranching p.a.

Impacts

1.01 Enhanced yields from wild-harvest innovations

Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring
SRL translocation increases harvest size by 329g per lobster (incl. foregone yield, survival & partial recovery) @ \$25 per kg. In Greenlip abalone (GL) increased income from new quota (harvest of stocked abalone after 4 yrs) @ \$30 per kg beach price (ex harvest cost), 330 g average harvest weight & 20% survival of stocked animals. If Roe population recovers due to translocation, fishery reopens in 2019. Previous catch (TAC) = 36tonnes, @ \$30 per kg (ex harvest cost). Increased income from ranched sea cucumbers of \$10 per kg (boiled & gutted; harvest cost included) x 100 additional tonnes by 2014, scaling up to 2000 tonnes by 2022.	56%

Rationale for probability calculation	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)
Note: The 'Probability of usage(s) required to enable impact occurring' must be calculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide) Probability of output generation (80%) x probability of usage of outputs (70%) = 56%	90%

Rationale for probability selection
Probability is very high (~100%) that monetary impact will occur for SRL translocation as it is already occurring. For the other enhancements, there are some risks that harvests related to the enhancement don't occur or added value is not recognised in full including for example that Tasmanian Seafood relationship with the indigenous corporation harvesting the sea cucumbers breaks down or the Roe Fishery may be affected by

further heatwave events or assumed beach prices deteriorate (e.g. due to exchange rate fluctuations). However, confidence in prices staying within historical means is high due to maturity and large size of export market and large.

Timeline of key impact milestones

FY	Key Milestones (144 Characters per year)
7	Commercial harvest of translocated SRL commenced in Tasmania
8	Pilot scale harvesting of ranched sea cucumber initiated.
12	Roe's abalone fishery re-opened at old quota. Harvest of additional quota from enhanced GL abalone commences in WA fishery
13	Peak harvest of translocated SRL in Tasmania achieved
14	Peak harvest of ranched SC achieved

Outputs 1.4

1.02 Removal or reduction of key production constraints to enhance profitability in selected wild-harvest production

Bioeconomic modelling projects are directed to increasing economic yield from wild fisheries. Bioeconomic models and other outputs are developed for wild harvest fisheries for:

- Southern Rock Lobster (SRL) (2009/714.1)
- Western Rock Lobster (WRL) (2009/714.2)
- Australian Abalone (AA) (2009/714.3)
- Moreton Bay Trawl (MBT) (2009/774)
- South Australian Prawn (SAP) (2011/750)

Outputs across each fishery are broadly the development of methods / systems for ongoing reporting of economic data as part of the regular fishery assessment process, the inclusion of economic information in target reference points for fisheries, and the change in management strategies to increase economic yield.

Two further projects increase recovery rates, price and productivity of abalone through changes in harvesting practice. One works on improving survival rates (2010/704) while the other uses shell traits to guide harvesting (2009/746).

(797 with limit of 1515 characters)

Milestones

FY	Key Milestones (144 Characters per year)
1	
2	- Stock targets and alternate management options developed for Tas SRL
3	- Economic status reporting completed for WRL - Deep water quota and MEY management introduced for Tas SRL
4	- Economic status reporting completed for MBT - Stock targets developed for WRL - Harvest strategy developed for MBT
5	- Economic status reporting completed for SRL, AA

	- MEY targeted in Individually Traded Quotas (ITQ) system for WRL - Seasonal harvest strategy implemented in MBT
6	- Stock targets and alternate management options developed for SRL, AA, SAP. - Recommendations on harvesting of abalone for reduced stress / higher production.
7	- MEY targeted in AA, SRL, SAP. - Alternate rules applied for AA, SRL, SAP.
8	- Corporate management structure changes in MBT, SAP.
9	-
10	- WRL, MBT harvests approximate MEY
11	-
12	- SRL, AA, SAP harvests approximate MEY - Alternate rules deliver peak benefits (i.e. gains plateau) in AA, SRL, WRL, MBT, SAP.

Usages

1.02 Removal or reduction of key production constraints to enhance profitability in selected wild-harvest production

Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced
i) use of models to increase sustainable economic yield. Costs (initially covered by R&D) are: • Fisher survey for costs, price data through processor survey, plus database costs = \$145K pa (\$10K to \$20K p.a. per jurisdiction per fishery: AA = \$50K; SRL = \$45K; MBT = \$15K; SAP = \$15K; WRL = \$20K). A legacy will be standardised data collection funded by state govt. • Model development + ongoing maintenance \$10K pa per fishery = \$80K (marginal cost only as assessment already funded). • Management communications / discussion papers \$5K p.a. per fishery = \$55K ii) monitoring shell and condition for abalone harvest. \$40K p.a. (443 of 532 Characters)	88%

Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated
Economic yield models (i) Ongoing economic data needs commitment from govt.: confirmed in SA and WA (100%), expected in Tas (95%) but less certain elsewhere. Overall 80%. (ii) Modelling committed in WRL, SRL, AA, and SAP. Extension of population modelling into bioeconomic modelling expected to be maintained. Overall 95%. (iii) Communications are part of ongoing commitments in all fisheries. Overall 100%. Change in ab. harvest (iv) Stress and shell studies on track. 85%. Score weighted by cost: 40% on economic data = $(80\% \times 40\%) = 0.32$; 20% on model and comms = $(95\% \times 20\%) + (100\% \times 20\%) = 0.39$;	50%

20% on stress and shell $= (85\% \times 20\%) = 0.17$.
 $0.32 + 0.39 + 0.17 = 88\%$

(519 of 609 Characters)

Rationale for usage probability selections

Usage is expected for all fisheries to some extent. For example, even the routine economic survey of fisheries will be used in the sense that it will inform management of the fishery status. However, full adoption of all strategies to increase economic yield is not expected in many fisheries. The probability selection of 50% is based on observed usage in SRL, WRL and MBT, which are the most advanced of the projects in this group. Each of these involved usage of most research outputs. The most significant usage of basing target reference points on bioeconomic was achieved in Tas SRL and WRL.

(496 of 609 Characters)

Timeline of key usage milestones

FY	Key Milestones (144 Characters per year)
1	
2	
3	Deep water quota and MEY management introduced for Tas SRL
4	
5	MEY target developed and applied in ITQ system for WRL. Seasonal harvest strategy implemented in MBT.
6	
7	MEY target developed and applied in AA, SRL, SAP. Abalone stress and shell monitoring to commence.
8	Alternate rules applied in AA, SRL, SAP Corporate management structure changes in MBT, SAP.

Impacts

1.02 Removal or reduction of key production constraints to enhance profitability in selected wild-harvest production

Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring
Projects define stock targets that give maximum economic yield (MEY); plus facilitate use of new rules and systems for managing the fisheries. Impact is estimated at 21% of current economic yield. This is from the FRDC analysis "Evaluating the Performance of Australian Fisheries" which scaled the performance gap at between 36% and 46%. We used the median of 42% and aim to halve this gap for RL and prawns (21% improvement). Ab. have lower cost so only 10% increase by bioeconomics + 5% for shell and stress in	50%

Tas only. (433 of 532 Characters)	
Rationale for probability calculation Note: The 'Probability of usage(s) required to enable impact occurring' must be calculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)
As per usage tab: Usage is expected for all fisheries to some extent. For example, even the routine economic survey of fisheries will be used in the sense that it will inform management of the fishery status. However, full adoption of all strategies to increase economic yield is not expected. The probability selection of 50% is based on observed usage in SRL, WRL and MBT, which are the most advanced of the projects in this group. Each of these involved usage of most research outputs. The most significant usage of basing target reference points on bioeconomic was achieved in Tas SRL and WRL. (495 of 609 Characters)	95%
Rationale for probability selection Uncertainty on monetary impacts is around assumptions about future prices and costs. This was formally examined in two fisheries (WRL and SRL) through sensitivity testing. Impacts tended to be stable, essentially because most effect came through change in stock (e.g. a 100% increase in stock abundance over three years is likely but a 100% change in labour costs or price is unlikely). Feasible ranges fell within 5% of expected value, thus 95% probability applied here. (397 of 609 Characters)	

Timeline of key impact milestones

FY	Key Milestones (144 Characters per year)
1	
2	
3	
4	MEY management impact commences for Tas SRL
5	
6	MEY management impact commences for WRL
7	Adoption of best practice for harvesting abalone by 50% of industry, increasing to 90% by 2017.
8	MEY management impact commences for AA , SRL (ex Tas), SAP, MBT Alternate rule impact commences for AA, SRL, SAP.
10	SRL Tas, WRL, MBT harvests hit approximate MEY. Stress and shell studies alter harvest practices in Tas abalone.
11	
12	Alternate rules deliver peak benefits (i.e. gains plateau) in AA, SRL, WRL, MBT, SAP.
13	SRL, AA, SAP harvests hit approximate MEY

7.4. Appendix 4: Defining the legacy from the CRC's research in Future Harvest

This appendix summarises conclusions from the Australian Seafood CRC Project 2012/739, Ian Cartwright and Caleb Gardner, 2013.

7.4.1. 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.

7.4.2. 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:

- 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;

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

- 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.

7.4.3. Cross-cutting legacy activities

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 be 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 managers 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.

7.4.4. 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 papers

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/ranchered 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*⁵.

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 Australia⁶

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.

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

⁵ Hundloe, T. 2002. 257pp. University of Queensland Press, St Lucia, Qld.

⁶ 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.

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.