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An Impact Assessment of FRDC Investment in 2011-030: Evaluating Candidate Monitoring Strategies, Assessment Procedures and Harvest Control Rules in the Spatially Complex Queensland Coral Reef Fin Fish Fishery

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Researcher Contact Details

Name:	Talia Hardaker
Address:	Suite 36, Benson House,
	Toowong QLD 4066
Phone:	07 3870 4047
Fax:	07 3371 3381
Email:	talia@agtrans.com.au

FRDC Contact Details

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

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

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Richard Little, Senior Research Scientist, CSIRO Oceans and Atmosphere

Abbreviations

ABS	Australian Bureau of Statistics
CPUE	Catch Per Unit Effort
CRFFF	Coral Reef Fin Fish Fishery
CRRDC	Council of Rural Research and Development Corporations
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CT	Coral Trout
DAF	Department of Agriculture and Fisheries (Queensland)
DAWR	Department of Agriculture and Water Resources (Commonwealth)
DEEDI[(a)]	Department of Employment, Economic Development and Innovation
FRDC	Fisheries Research and Development Corporation
GBR	Great Barrier Reef
HCR	Harvest Control Rule
ITQ	Individual Transferrable Quotas
LTMP	Long-Term Monitoring Program
MSE	Management Strategy Evaluation
OCS	Office of the Chief Scientist
PVC	Present Value of Costs
QLD	Queensland
RD&E	Research, Development and Extension
RTE	Red Throat Emperor
TAC	Total Allowable Catch

(a) The Queensland Department of Agriculture and Fisheries (DAF) was formerly the Queensland Department of Agriculture, Fisheries and Forestry, previously the Department of Employment, Economic Development and Innovation (DEEDI), and prior to that, the Department of Primary Industries and Fisheries.

Executive Summary

What the report is about

This report presents the results of an impact assessment of a Fisheries Research and Development Corporation (FRDC) investment *in evaluating candidate monitoring strategies, assessment procedures and harvest control rules (HCRs) in the spatially complex Queensland Coral Reef Fin Fish Fishery (CRFFF)*. The project was funded by FRDC over the period October 2011 to June 2016.

Methodology

The investment was analysed qualitatively within a logical framework that included activities and outputs, outcomes and impacts. Impacts were categorised into a triple bottom line framework. Principal impacts identified were then considered for valuation. Past and future cash flows were expressed in 2016/17 dollar terms and were discounted to the year 2016/17 using a discount rate of 5% to estimate the investment criteria.

Results/key findings

The major potential impacts identified were of a financial and environmental nature involving possible future increases in Coral Trout (CT) catch, improved sustainability of CT stocks and reduced costs for CRFFF fisheries management. The investment has improved simulation modelling technology for CT in the CRFFF. The improved model may be used in the future to provide input into the setting of better harvest control rules for the CRFFF.

Investment Criteria

Total funding from all sources for the project was $1.39 million (present value terms). FRDC investment in the project totalled $0.53 million. However, none of the impacts identified were valued, hence a full set of investment criteria were not estimated or reported as part of the impact assessment.

Conclusions

While the investment did not result in any significant impacts that could be valued, the investment was useful as it improved simulation modelling technology for CT in the CRFFF that may be used or further developed in the future as a resource to better evaluate HCRs for the CRFFF.

Keywords

Impact assessment, Coral Reef Fin Fish Fishery, Coral Trout, Management Strategy Evaluation, monitoring strategy, fishing data, simulation, modelling, ELFSim, Harvest Control Rule, Total Allowable Catch

Introduction

The Fisheries Research and Development Corporation (FRDC) required a series of impact assessments to be carried out annually on a number of investments in the FRDC research, development and extension (RD&E) portfolio. The assessments were required to meet the following FRDC evaluation reporting requirements:

- Reporting against the FRDC 2015-2020 RD&E Plan and the Evaluation Framework associated with FRDC's Statutory Funding Agreement with the Commonwealth Government.
- Annual Reporting to FRDC stakeholders.
- Reporting to the Council of Rural Research and Development Corporations (CRRDC).

The first series of impact assessments included 20 randomly selected FRDC investments worth a total of approximately $6.31 million (nominal FRDC investment). The investments were selected from an overall population of 136 FRDC investments worth an estimated $24.98 million (nominal FRDC investment) where a final deliverable had been submitted in the 2015/16 financial year.

The 20 investments were selected through a stratified, random sampling process such that investments chosen spanned all five FRDC Programs (Environment, Industry, Communities, People and Adoption), represented approximately 25% of the total FRDC RD&E investment in the overall population (in nominal terms) and included a selection of small, medium and large FRDC investments.

Project 2011-030: *Evaluating Candidate Monitoring Strategies, Assessment Procedures and Harvest Control Rules in the Spatially Complex Queensland Coral Reef Fin Fish Fishery* was selected as one of the 20 investments and was analysed in this report.

General Method

The impact assessments followed general evaluation guidelines that are now well entrenched within the Australian primary industry research sector including Research and Development Corporations, Cooperative Research Centres, State Departments of Agriculture, and some Universities. The approach includes both qualitative and quantitative descriptions that are in accord with the impact assessment guidelines of the CRRDC (CRRDC, 2014).

The evaluation process involved identifying and briefly describing project objectives, activities and outputs, outcomes, and impacts. The principal economic, environmental and social impacts were then summarised in a triple bottom line framework.

Some, but not all, of the impacts identified were then valued in monetary terms. Where impact valuation was exercised, the impact assessment uses Cost-Benefit Analysis as its principal tool. The decision not to value certain impacts was due either to a shortage of necessary evidence/data, a high degree of uncertainty surrounding the potential impact, or the likely low relative significance of the impact compared to those that were valued. The impacts valued are therefore deemed to represent the principal benefits delivered by the project. However, as not all impacts were valued, the investment criteria reported for individual investments potentially represent an underestimate of the performance of that investment.

Background and Rationale

Background

The Queensland Coral Reef Fin Fish Fishery (CRFFF) is a hand line fishery operating predominantly on the continental shelf off the Queensland (QLD) coast. There are three types of harvest quota in the CRFFF: coral trout (CT); red throat emperor (RTE); and other species. The CT quota covers seven species of coral trout, but the majority of landings consist of the Common Coral Trout (*Plectropomus leopardu*s). One quota unit represents one kilogram of fish (live weight equivalent).

The fishery area spans 14 degrees of latitude and is fished by approximately 150 out of the 367 vessels who are endorsed to take coral reef finfish target CT between the tip of Cape York and the southern boundary of the Great Barrier Reef (GBR). The fishery is spatially complex and there is significant variation in the distribution of CT. This spatial variability makes it challenging to use standard approaches to determining sustainable levels of harvest. The Total Allowable Catch (TAC) for CT was based on the historical commercial catch taken by the fishery, and has changed little since the Individual Transferrable Quotas (ITQ) system was implemented in 2004.

Fisheries management strategies are composed of three important stages:

1. The measurement or collection of data,
2. Analysis or assessment using the collected to data to understand the state of the stock and fishery, and
3. A subsequent decision to effect control on the fishery (often through the manipulation of TAC or effort).

Uncertainty or errors are possible in each of these stages. Management Strategy Evaluation (MSE) is used to determine the effect of these uncertainties on the management of a fishery, and to identify a strategy, i.e. a combination of measurement, analysis and decision, that minimises the effects of these errors and ultimately achieves the purpose or objective of management.

In an attempt to address the issue of sustainable harvest in the CRFFF, the Department of Agriculture and Fisheries (DAF) through the Long-Term Monitoring Program (LTMP) had invested significant resources in fishery-independent monitoring of CT at specific reefs throughout the fishery area, in addition to commercial logbook data. The information collected complements past information collected during the Effects of Line Fishing Program.

To recognise the spatial complexity of the CRFFF, a MSE also was developed to simulate the spatially explicit population dynamics of CT on over 4,000 reefs, the fishing activity on those reefs, and the potential effects of a range of management measures.

Rationale

Appropriate monitoring strategies and harvest control rules (HCRs) are needed to ensure sustainability and maximum economic benefit from the coral trout stocks in the QLD CRFFF. The reliance on historical data to determine the TAC has led to questions regarding the potential profitability and sustainability of the fishery.

The existing MSE represented an ideal platform to test, in a simulated environment, different monitoring strategies, including the LTMP, that could then be used on the real CT population. The MSE also provided the means to evaluate candidate HCRs which could subsequently be used in a sustainable harvest strategy for the CRFFF.

Project 2011-030 was funded to test, in an MSE framework, the effectiveness of:

1. Several potential monitoring and sampling regimes of the CT stock, including the existing LTMP surveys,
2. Different ways of analysing the data collected from a monitoring program, and
3. Candidate HCRs that translate the perceived state of the fishery into a TAC.

Project Details

Summary

Project Code: 2011-030

Title: *Evaluating Candidate Monitoring Strategies, Assessment Procedures and Harvest Control Rules in the Spatially Complex Queensland Coral Reef Fin Fish Fishery*

Research Organisation: CSIRO Marine and Atmospheric Research

Principal Investigator: Richard Little

Period of Funding: October 2011 to June 2016.

Objectives

The projects key objectives were:

1. To give scientists and managers in the Department of Employment, Economic Development and Innovation (DEEDI) their own ability to compare and contrast methods of data collection and analysis for the CRFFF, in order to aid the identification of appropriate harvest strategies.
2. To update the economic and fisheries data used to determine cost effective management strategies.
3. To identify appropriate spatial and temporal fishery independent and fishery dependent monitoring strategies, and assessment and harvest control rules that use them.

Logical Framework

Table 1 provides a brief description of the project in a logical framework.

Table 1: Logical Framework for Project 2011-030

Activities and Outputs	The project was divided into two components: **1. Collection and update of economic and commercial fishing data for parameters used in the simulation model through an economic survey.** • A survey approach was developed in collaboration with active participants in the CRFFF, licence and quota holders, DAF, and the GBR Marine Park Authority. • A workshop was held in October 2011 to present and discuss a fleet profile (developed by CSIRO and DAF) as well as the proposed approach to implementing the survey. Six industry members attended representing different areas and types of businesses. • The fleet profile was used in combination with the spatial distribution of the fleet along the QLD coast to structure stratified random sampling of CRFFF fishing operations. • A web survey tool was created to provide a central repository for interview-planning data, survey supporting documents, and the survey transcription form used to input data collected via paper questionnaires. • The questionnaire contained six main components on (i) the operators, (ii) vessel activity in the year under consideration, (iii) revenue, (iv) costs, (v) capital assets, and (vi) a set of questions regarding the history of the respondent's involvement in the CRFFF, as well as the perceived key drivers of profitability and possible responses to changes. • The survey also was used to collect data on relevant prices and quota trading.

	• The survey showed three broad classes of vessels operating in the CRFFF: (i) a large group of small 'generalist line fishers', a group of 'dedicated live CT fishers', and (3) a group of 'diversified fishers'. • The project also investigated the effect of fleet mobility on the distribution of effort and the ability of achieving fisheries management objectives at a regional level. The project found that, when vessels were released from fishing their own regional areas, effort tended to shift from the northern regions (Far North and Cairns) to more southerly regions (Mackay and Swains), which resulted in higher catches and profits. **2. Simulation and evaluation of monitoring, assessment, and decision procedures using the MSE software (ELFSim).** • The MSE used ELFSim. ELFSim simulates the spatially explicit population dynamics on each of over 3,000 individual reefs subject to fishing pressure. ELFSim is composed of three components: (1) a biological component (a population dynamics model), (2) an effort dynamics component (how fishers distribute their effort spatially), and (2) a management component (specifies future management options by sector). • ELFSim operates at a monthly time step with each step consisting of two parts: i) Initialisation – uses historical information from visual surveys, and the physical characteristics of the reefs, to determine the initial size of the population on each reef (CT or RTE) across all reefs. ii) Projection – after the model is initialised it projects the fishery into the future given assumed fishing behaviour of the vessel dynamics model, and the implemented management conditions. • MSE modelling for this project involved simulated monitoring and data collection for use in a stock assessment model developed by the QLD Department of Agriculture and Fisheries (DAF)[(a)]. • The initial simulated monitoring strategy included a structured line survey, simulating a vessel survey in September each year. • Three other monitoring strategies were compared against this survey option. These strategies were fisheries dependent and not based on a random sample of reefs, but on the commercial fishing vessel behaviour. The three strategies were: on board observer data collection, port sampling, and processor port sampling. Each of these three alternative strategies represented a different level of data aggregation. • The project found that the DAF stock assessment model was able to estimate relative biomass within about 10%. Within this range estimates were mainly overestimates. • There was little effect of the degree of aggregation, and between fishery independent and fishery dependent collected data. Thus, no appropriate spatial scale of monitoring was determined for the CRFFF. • Sampling rate was also examined through the simulation modelling. The project found that increasing the sampling rate, either through more observers or increased coverage of an observer, increased the accuracy of the stock assessment. • Harvest strategy evaluations based on an empirical Catch Per Unit Effort (CPUE) indicator and an associated HCR resulted in increased stock abundances. • The project team recommended that further economic surveys be undertaken in the future given the rapidly changing nature of the CRFFF. It was also recommended that a more detailed analysis be carried out for estimating the parameters of HCRs.
Outcomes	• Fisheries managers and stakeholder groups (like the QLD Seafood Industry Association) have been provided with improved information to determine ways of monitoring and analysing CT stock in the CRFFF. • This, in turn, contributed to the implementation of new HCRs for CT in the CRFFF in 2014 (Richard Little, pers. comm., 2017).

	• The 2014 CT decision rules guide the setting of CT quotas and allow the quota to be reviewed and declared every year to reflect current fishery conditions (DAF, 2015). This allows for ongoing protection of CT stocks in the CRFFF while providing for increases in fishery catch rates (CPUE). • The 2016/17 Status of Australian Fish Stocks Report assessed the CT CRFFF stock as "sustainable" (Richard Little, pers. comm., 2017). • The DAF stock assessment model was integrated into ELFSim. The MSE simulation may now be used directly by fisheries managers and the CRFFF management agency to allow DAF to continually evaluate and improve monitoring design, abundance indicators, assessment techniques, and decision rules that are used for calculating TAC limits in the CRFFF. • DAF/Fisheries managers have not yet used the MSE simulation. No use has occurred because key staff trained to use of the model have left the organisation and thus capacity and capability to use the model has been lost (Richard Little, pers. comm., 2017). • The loss of capability and capacity in model use is a major constraint along the pathway to any significant impacts for project 2011-030.
Potential Impacts	• Contribution to improved sustainability of the CRFFF; in particular, through a reduced risk of overfishing CT stock. • Contribution to possible increases in CPUE for CT in the CRFFF through improved stock monitoring, assessment and development of decision rules used to calculate TACs. • Contribution to reduced risk of TAC reductions for CT in the CRFFF. • Increased cost-effectiveness of the development and implementation of management strategies for the CRFFF. • Increased industry and State Government capacity to utilise advanced modelling and simulation tools.

(a) The Queensland Department of Agriculture and Fisheries (DAF) was formerly the Queensland Department of Agriculture, Fisheries and Forestry, previously the Department of Employment, Economic Development and Innovation (DEEDI), and prior to that, the Department of Primary Industries and Fisheries.

Project Investment

Nominal Investment

Table 2 shows the annual investment for the project funded by FRDC. 'Other' investors included DAF, CSIRO and other partners (including in-kind contributions).

Table 2: Annual Investment in the Project 2011-030 (nominal $)

Year ended 30 June	FRDC ($)	OTHER ($)	TOTAL ($)
2012	78,698	334,962	413,660
2013	118,563	338,928	457,491
2014	117,530	0	117,530
2015	39,349	0	39,349
2016	39,349	0	39,349
Totals	393,489	673,890	1,067,379

Program Management Costs

For the FRDC investment the cost of managing the FRDC funding was added to the FRDC contribution for the project via a management cost multiplier (1.115). This multiplier was estimated based on the share of 'employee benefits' and 'supplier' expenses' in total FRDC expenditure reported in the FRDC's Cash Flow Statement (FRDC, 2016). This multiplier then was applied to the nominal investment by FRDC shown in Table 2.

Real Investment and Extension Costs

For the purposes of the investment analysis, the investment costs of all parties were expressed in 2016/17 dollar terms using the Implicit Price Deflator for Gross Domestic Product (ABS, 2016). No additional costs of extension were included as the project included a consultation with key stakeholders such as DAF and Fisheries managers.

Impacts

The impacts from the improvements to the MSE simulation model delivered by the investment were considered marginal. Table 3 provides a summary of the principal types of impacts expanded from those listed in Table 1 and categorised into economic, environmental and social impacts.

Table 3: Triple Bottom Line Categories of Impacts from the Evaluation of Candidate Monitoring Strategies, Assessment Procedures and HCRs in the CRFFF

Economic	• Contribution to increases in future CT catch because of increased fishing effort permitted in the CRFFF. The potential increased fishery catch rate is the result of sustainably increased CT quotas that have been set based on new HCRs (used to set TAC limits in the CRFFF). These HCRs, in turn, will have been influenced by information generated by the improved reef simulation model that is used to determine ways of monitoring and analysing CT stock in the CRFFF. • Contribution to a reduced risk of TAC reductions for CT in the CRFFF. The increased precision of CT population estimates from the model may reduce the risk that something might happen that would lead to a sudden reduction in TAC (e.g. as a result of poor management and/or exogenous shocks to CT stocks) (Patrick Hone, pers. comm., 2017). • Potential for reduced costs for the development and implementation of management strategies for the CRFFF because of increased efficiency through the use of applied simulation modelling to evaluate suggested HCRs and monitoring strategies prior to real world application.
Environmental	• Contribution to improved sustainability of CT stocks in the QLD CRFFF because of project 2011-030's contribution to new HCRs implemented in 2014 that will reduce the risk of overfishing.
Social	• Potentially increased industry and State Government capacity to utilise advanced modelling and simulation tools for fisheries management through training and engagement with the Project team.

Public versus Private Impacts

Potentially, the project could lead to both private and public impacts through possible contributions to sustainable increases in CT quotas and reduced costs to fisheries management (including DAF). However, neither of these impacts have eventuated to date.

Distribution of Private Impacts

The beneficiaries of any private sector impacts would be the various businesses operating in the QLD CRFFF concerned with CT.

Impacts on other Australian industries

It is possible that, in the future, the improved MSE simulation model will be used to evaluate HCRs and monitoring strategies for other key species in the CRFFF (RTE and 'other') thereby contributing to the long-term sustainability and productivity of other fin fish industries that are part of the QLD CRFFF.

Impacts Overseas

No impacts to overseas parties are expected.

Match with National Priorities

The Australian Government's Science and Research Priorities and Rural RD&E Priorities are reproduced in Table 4. The project findings and related impacts will contribute primarily to Rural RD&E Priorities 3 and to Science and Research Priorities 1 and 2.

Table 4: Australian Government Research Priorities

Australian Government	
Rural RD&E Priorities (est. 2015)	**Science and Research Priorities (est. 2015)**
1. Advanced technology 2. Biosecurity 3. Soil, water and managing natural resources 4. Adoption of R&D	1. Food 2. Soil and Water 3. Transport 4. Cybersecurity 5. Energy and Resources 6. Manufacturing 7. Environmental Change 8. Health

Sources: (DAWR, 2015) and (OCS, 2015)

Valuation of Impacts

Impacts Valued

The investment did not produce any quantifiable impacts so no quantitative evaluation processes were applied to estimate benefits.

Impacts Not Valued

The impacts identified in Table 3 were not valued for the following reasons (Table 5).

Table 5: Reasons for Not Valuing Potential Impacts

Impact/Potential Impact	**Reason why Impact Not Valued**
Contribution to possible increases in future CT catch because of increased fishing effort permitted in the CRFFF. The potential increased fishery catch rate is the result of sustainably increased CT quotas that have been set based on new HCRs (used to set TAC limits in the CRFFF). These HCRs, in turn, will have been influenced by information generated by the improved reef simulation model that is used to determine ways of monitoring and analysing CT stock in the CRFFF.	A lack of evidence that any such improvement to the reef simulation has influenced the setting of HCRs since 2014 and a lack of evidence that a change in HCRs would result in increases to TAC limits for CT in the CRFFF.
Contribution to a reduced risk of TAC reductions for CT in the CRFFF. The increased precision of CT population estimates from the model may reduce the risk that something might happen that would lead to a sudden reduction in TAC (e.g. as a result of poor management and/or exogenous shocks to CT stocks).	A lack of baseline data on the existing/future risks of TAC reductions for CT in the CRFFF as well as the difficulty in linking and quantifying the incremental improvement in the precision of the model with any potential TAC change.
Potential for reduced costs for the development and implementation of management strategies for the CRFFF because of increased efficiency through the use of applied simulation modelling to evaluate suggested HCRs and monitoring strategies prior to real world application.	A lack of data on baseline development and implementation costs as well as no evidence that the improved model has been used since the project was completed nor that any change in costs has been realised.
Contribution to improved sustainability of CT stocks in the QLD CRFFF because of project 2011-030's contribution to new HCRs implemented in 2014 that will reduce the risk of overfishing.	A lack of evidence that improvement of the MSE simulation resulted in changes to the setting of TAC limits for CT in the CRFFF. The TAC for CT has not changed in the past three years and actual total catch of CT has been below the TAC since at least 2014.
Potentially increased industry and State Government capacity to utilise advanced modelling and simulation tools for fisheries management through training and engagement with the Project team.	Loss of trained DAF/Fisheries staff has reduced any such capacity to date. Discussions suggesting that further training and have taken place with the DAF monitoring unit but other priorities have taken precedence (Richard Little, pers. comm., 2017). At this time, there is no indication that DAF intends to revisit the issue.

Results

All past costs were discounted to 2016/17 using a discount rate of 5%. All analyses ran for the length of the project investment period plus 30 years from the last year of investment in Project 2011-030 (2015/16).

Investment Criteria

Tables 6 and 7 show the investment criteria estimated for different periods of costs for the total investment and the FRDC investment respectively. Note that, as no impacts were valued, the investment criteria reporting is restricted to the Present Value of Costs (PVC). In the interests of consistency with other project analyses and reporting, the PVC was reported for the length of the investment period plus for different periods up to 30 years from the last year of investment.

Table 6: Investment Criteria for Total Investment in Project 2011-030

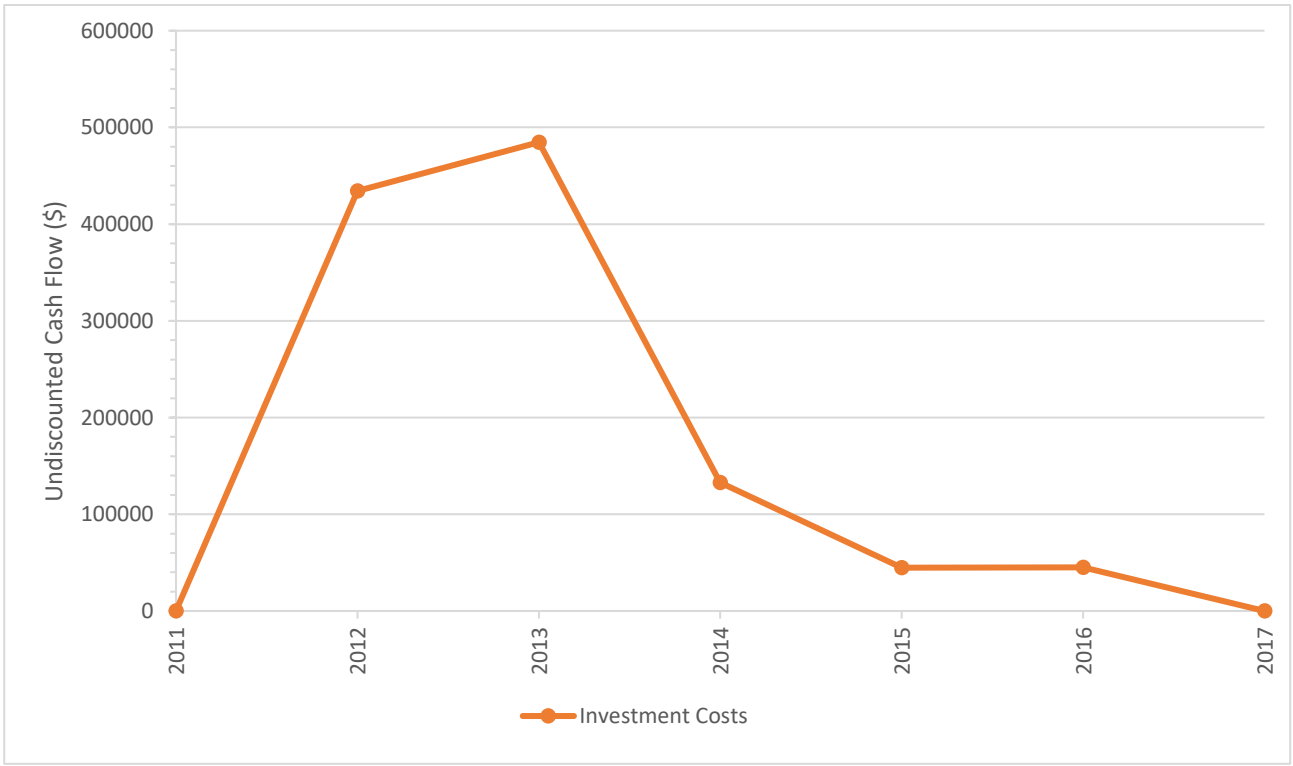
Investment Criteria	**Years after Last Year of Investment**						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present Value of Costs ($m)	1.39	1.39	1.39	1.39	1.39	1.39	1.39

Table 7: Investment Criteria for FRDC Investment in Project 2011-030

Investment Criteria	**Years after Last Year of Investment**						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present Value of Costs ($m)	0.53	0.53	0.53	0.53	0.53	0.53	0.53

The annual undiscounted investment cost cash flows for the total investment for the duration of Project 2011-030 are shown in Figure 1.

Figure 1: Annual Cash Flow of Undiscounted Total Costs



Conclusions

Funding for project 2011-030 from 2011/12 to 2015/16 totalled $1.39 million (present value terms). FRDC investment in the project was $0.53 million (present value terms). While the investment did not result in any significant impacts that could be valued, the investment was useful as it improved simulation modelling technology for CT in the CRFFF that may be used or further developed in the future as a resource to better evaluate HCRs for the CRFFF.

Glossary of Economic Terms

Cost-benefit analysis:	A conceptual framework for the economic evaluation of projects and programs in the public sector. It differs from a financial appraisal or evaluation in that it considers all gains (benefits) and losses (costs), regardless of to whom they accrue.
Benefit-cost ratio:	The ratio of the present value of investment benefits to the present value of investment costs.
Discounting:	The process of relating the costs and benefits of an investment to a base year using a stated discount rate.
Internal rate of return:	The discount rate at which an investment has a net present value of zero, i.e. where present value of benefits = present value of costs.
Investment criteria:	Measures of the economic worth of an investment such as Net Present Value, Benefit-Cost Ratio, and Internal Rate of Return.
Modified internal rate of return:	The internal rate of return of an investment that is modified so that the cash inflows from an investment are re-invested at the rate of the cost of capital (the re-investment rate).
Net present value:	The discounted value of the benefits of an investment less the discounted value of the costs, i.e. present value of benefits - present value of costs.
Present value of benefits:	The discounted value of benefits.
Present value of costs:	The discounted value of investment costs.

References

Australian Bureau of Statistics. (2016). *5204.0 - Australian System of National Accounts, 2015-16.* Canberra: Australian Bureau of Statistics. Retrieved from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5204.02015-16?OpenDocument

Council of Rural Research and Development Corporations. (2014). *Impact Assessment Guidelines.* Canberra: Council of Rural Research and Development Corporations. Retrieved from http://www.ruralrdc.com.au/wp-content/uploads/2016/04/CRRDC-Impact-Assessment-Guidelines-V.1-070514.pdf

Department of Agriculture and Fisheries. (2015). *Setting the coral trout quota - Fact Sheet.* Brisbane: Department of Agriculture and Fisheries.

Department of Agriculture and Water Resources. (2015). *Agricultural Competitiveness White Paper.* Canberra: Commonwealth of Australia. Retrieved from http://agwhitepaper.agriculture.gov.au/SiteCollectionDocuments/ag-competitiveness-white-paper.pdf

Fisheries Research and Development Corporation. (2016). *Annual Report 2015-16.* Canberra: Fisheries Research and Development Corporation. Retrieved from http://www.frdc.com.au/about_frdc/Documents/Annual_Report/FRDC_Annual_Report_2016.pdf

Office of the Chief Scientist. (2015). *Strategic Science and Research Priorities.* Canberra: Commonwealth of Australia. Retrieved from http://www.chiefscientist.gov.au/wp-content/uploads/STRATEGIC-SCIENCE-AND-RESEARCH-PRIORITIES_181214web.pdf