FINAL

An Impact Assessment of FRDC Investment in 2014-012: Tasmania's coastal reefs: deep reef habitats and significance for finfish production and biodiversity

Agtrans Research

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An Impact Assessment of FRDC Investment in 2014-012: Tasmania's coastal reefs: deep reef habitats and significance for finfish production and biodiversity.
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In submitting this report, the researcher has agreed to FRDC publishing this material in its edited form.

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Jeremy Lyle, Senior Research Scientist, Institute for Marine and Antarctic Studies

Abbreviations

ABS	Australian Bureau of Statistics
BRUV	Baited Remote Underwater Video
CRRDC	Council of Rural Research and Development Corporations
DAWR	Department of Agriculture and Water Resources (Commonwealth)
DPIPWE	Department of Primary Industries, Parks, Water and Environment (Tasmania)
FRDC	Fisheries Research and Development Corporation
OCS	Office of the Chief Scientist
PVC	Present Value of Investment Costs
RD&E	Research, Development and Extension
ROV	Remotely Operated Vehicle
SDM	Species Distribution Model
UTAS	University of Tasmania

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 *Tasmania's coastal reefs: deep habitats and significance for finfish production and biodiversity.* The project was funded by FRDC over the period May 2014 to June 2017.

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 2017/18 dollar terms and were discounted to the year 2017/18 using a discount rate of 5% to estimate the investment criteria.

Results/key findings

None of the impacts identified were valued. It is possible that the project may have made some contribution to potential future productivity increases for some Tasmanian fisheries through improved information on the distribution, abundance and population structure of key commercial fish species.

Investment Criteria

Funding for project 2014-012 totalled $0.63 million (present value terms). The FRDC investment costs were $0.30 million (present value terms). However, none of the impacts/potential impacts identified were valued in monetary terms. Thus, the full set of investment criteria were not estimated or reported as part of this impact assessment.

Conclusions

Though no impacts were valued, the project was successful and has contributed to a broader, regional and national understanding of associations between marine habitat characteristics and the distribution and abundance of some marine species. The project also used methods and produced data that may contribute to the development of predictive species distribution models to enhance future marine stock assessments.

Keywords

Impact assessment, cost-benefit analysis, Tasmania, coastal reefs, predictive species distribution model, SDM, fisheries, abundance, population structure

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, that included 20 randomly selected FRDC investments, was completed in August of 2017. The published reports for the first series of evaluations can be found at: http://frdc.com.au/Research/Benefits-of-research/2017-Portfolio-Assessment

The second series of impact assessments also included 20 randomly selected FRDC investments. The investments were worth a total of approximately $5.62 million (nominal FRDC investment) and were selected from an overall population of 96 FRDC investments worth an estimated $21.32 million (nominal FRDC investment) where a final deliverable had been submitted in the 2016/17 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 26% 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 2014-012: *Tasmania's coastal reefs: deep reef habitats and significance for finfish production and biodiversity* 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

Tasmania's Coastal Reef Habitats and Associated Commercial Fishing

The temperate, rocky reef habitat of south-east Tasmania consists of diverse algal, sponge and invertebrate assemblages that provide structure for mobile fauna such as fishes, lobsters and urchins (Integrated Marine Observing System, n.d.). The structure, composition and functioning of shallow reefs (< 20 metres) and their associated fish communities have been documented quite extensively in Tasmania.

The reefs represent important habitats for various exploited fish species in Tasmania, including: Banded Morwong, Bluethroat Wrasse, Purple Wrasse, Striped Trumpeter, and Bastard Trumpeter. Banded Morwong are the focus of a commercial gillnet fishery (a specialised component of the Tasmanian Scalefish Fishery) with almost all of the catch destined for the 'live fish' Asian restaurant markets of Sydney and Melbourne (DPIPWE, 2018). Similarly, Bluethroat Wrasse and Purple Wrasse are targeted commercially for the live fish markets.

A range of other commercially important species, including Longsnout Boarfish, Jackass Morwong, and Reef Ocean Perch, also spend much of their life within reef systems on the continental shelf. Also, many non-commercial species such as sea perches and leatherjackets that are critical to the functioning of the reef ecosystems.

In order to minimise the impacts of barotrauma[1], fishing has typically occurred in relatively shallow inshore reefs (< 25 metres), despite key commercial species occurring in depths up to 50 metres. It is thought that, though the proportion of the population of commercial fish species living in deeper reef areas is uncertain, these fish are likely to be afforded some degree of protection from the fishery.

Rationale

The ecological importance of deeper reef ecosystems had not been investigated previously, apart from baselines studies of offshore Marine Protected Areas. Linkages and associations between fish communities from shallow to deep reef areas remained a distinct knowledge gap. Further, Tasmania's coastal reefs are subject to increasing ecological pressures including the impacts of fishing, changes in the distribution and abundance of dominant macroalgal species, range extensions, and the broader consequences of climate change.

Project 2014-012 was funded to investigate the fish communities associated with coastal reef habitats and the significance of these habitats for fisheries production in Tasmania.

[1] Injuries resulting from rapid changes in pressure that cause bodily gases within a fish to expand (Northern Territory Government, n.d.)

Project Details

Summary

Project Code: 2014-012

Title: *Tasmania's coastal reefs: deep reef habitats and significance for finfish production and biodiversity*

Research Organisation: University of Tasmania

Principal Investigator: Jeremy Lyle

Period of Funding: May 2014 to June 2017

FRDC Program Allocation: Environment (100%)

Objectives

The project's objectives were to:

1. Characterise reef fish communities on the east and south-east coasts of Tasmania by depth and habitat structure.
2. Describe habitat associations for the key reef fish species and their links to life-history characteristics.
3. Assess the potential to use habitat characteristics to describe and predict fish community structure.
4. Assess the significance of reef habitats for fisheries production and fishery assessments.

Logical Framework

Project 2014-012 surveyed fish communities associated with two large patches of coastal reef that had been mapped previously. Patterns in community composition, interactions between species and relationships with reef characteristics were described with the ultimate goal of developing predictive distribution and abundance maps of key species. Table 1 provides a more detailed description of the project in a logical framework.

Table 1: Logical Framework for Project 2014-012

Activities and Outputs	• Butlers Reef (located on the central east coast of Tasmania) and The Friars (off the south coast of Tasmania) were chosen as survey sites for the project. Both reefs extend several kilometres offshore into relatively deep water. However, the sites differed in terms of structural complexity, exposure and prevailing oceanographic characteristics. • The two reef locations had been previously mapped using high-resolution multibeam acoustics. • The acoustic data were re-analysed to classify the seabed at $2m^2$ resolution for depth, habitat type (reef or sand), slope and terrain variation (rugosity and aspect). • Baited remote underwater video (BRUV) based sampling was used to survey the fish communities. Remotely operated vehicles (ROVs) and gillnet sampling methods also were applied at a subset of sites. • The multi-method approach was used to describe the fish communities more comprehensively, recognising that each method is subject to some sampling bias. • Sampling sites were allocated based on a balanced acceptance approach, stratified by depth. • Sampling was conducted between March and December 2015. • Quantitative analyses were based primarily on the BRUV data due to the greater number of replicate deployments and number and diversity of fish observed.

	• The BRUV data were used to examine several key features of the structure and composition of fish communities at the sites. These included:
	  o Patterns in the composition and structure of fish communities and their relationship with depth and other reef characteristics analysed separately for each study region;
	  o Comparison of community patterns between regions;
	  o Seasonal comparison of the fish community composition at Butlers Reef; and
	  o Comparison of community composition obtained using different sampling methods (BRUV and ROV).
	• Commonalities and differences in assemblages occurring between regions, seasons or gear types were initially explored using Venn diagrams.
	• To visualise patterns in assemblage structure, and to quantify the effect of environmental variables (reef characteristics) on the composition of assemblages, the Bayesian Ordination and Regression Analysis technique was used (akin to multivariate regression analysis).
	• A mean estimate for relative abundance was calculated based on BRUV data for each depth stratum and used to produce an overall mean estimate for each region.
	• A Generalised Linear Model with negative binomial distribution was fitted with data from the acoustic data to predict species abundance for key species across both survey regions. Depth, slope, region, northness and eastness were included as predictors.
	• A wide diversity of fish, elasmobranch and cephalopod species were identified as being associated with the deep coastal reef habitats.
	• Three families were especially prominent, Serranidea (sea perches; three species), Labridae (wrasses; seven species), and Monocanthidae (leatherjackets; ten species). Collectively, these species accounted for over 80 per cent of the total number of reef-associated fish recorded at both survey locations.
	• Species of commercial and recreational importance that were observed associated with the reef habitats included Banded Morwong, Jackass Morwong, Bluethroat Wrasse, Purple Wrasse, Striped Trumpeter, Bastard Trumpeter, Longsnout Boarfish, Reef Ocean Perch, Blue Warehou, and Southern Calamari.
	• Of these species, only Jackass Morwong and Bluethroat Wrasse were commonly observed.
	• The regional comparison did indicate differences between assemblages, with many species present in lower abundances at The Friars compared with Butlers Reef.
	• Species of commercial relevance to fisheries, including Bluethroat Wrasse, Reef Ocean Perch and Striped Trumpeter, were significantly more abundant at Butlers Reef.
	• Depth was a highly influential factor for the fish assemblages, with over half of the reef-associated species showing significant responses to depth.
	• In particular, the highest abundance of Purple Wrasse occurred at depths of less than 30 metres, Bluethroat Wrasse abundance peaked in the 20-50 metre depth range, Jackass Morwong increased in abundance at depths greater than 40 metres, and numbers of Striped Trumpeter and Reef Ocean Perch increased at depths of greater than 50 metres.
	• None of the other reef characteristics (slope, rugosity and aspect) were found to be particularly important.
	• Project findings were presented to key stakeholders including the Recreational Fisheries Advisory Committee and the Scalefish Fishery Advisory Committee.
	• Also, a compilation of BRUV video footage showing examples of reef habitat and various fish species was created and used to promote the project and the University of Tasmania's (UTAS) BRUV research in general at Agfest in May 2017.

Outcomes	• Data from the project have contributed to a broader, regional and national understanding of associations between habitat characteristics and the distribution and abundance of marine species.

	• The data also have provided a baseline for ongoing reporting and analysis of fish communities at regional and national scales. • The project also has provided Tasmanian fisheries with improved information on the distribution, abundance, and population structuring for a number of key species including Bluethroat Wrasse, Jackass Morwong, Banded Morwong, and Striped Trumpeter. • Further, the collation of spatially explicit biological and reef structure data has opened up the possibility of developing predictive species distribution models (SDMs) that may enhance stock assessments using spatial information such as the mapped extent of preferred habitat. • Distribution and biological information relevant to several of the commercial and recreational important species will be incorporated into future Scalefish Fishery Assessment reports. • Additional RD&E is being conducted within the National Environmental Science Program (under the Department of Environment and Energy) as part of the Marine Biodiversity Hub to further progress SDMs for commercial fish species (Jeremy Lyle, pers. comm., 2018). • A proposal/expression of interest has been submitted to FRDC to undertake a social and economic assessment of the Scalefish Fishery. The assessment aims to examine opportunities and constraints to development and profitability including access to markets, regulatory frameworks, and resource availability (Jeremy Lyle, pers. comm., 2018). • The information generated by project 2014-012 and the proposed economic assessment will provide context to fishers for assessing whether there is potential for expanding operations into deeper reef areas (Jeremy Lyle, pers. comm., 2018).
Impacts	• Potentially, maintained or increased future productivity for some Tasmanian fisheries from better management and planning as a result of improved information on the distribution, abundance and population structure of key commercial fish species. • Potentially, improved environmental sustainability of Tasmanian fisheries because of better future stock assessments resulting from future SDMs. • Increased scientific knowledge and research capacity.

Project Investment

Nominal Investment

Table 2 shows the annual investment (cash and in-kind) in project 2014-012 by FRDC and others. 'Other' investors included UTAS only.

Table 2: Annual Investment in the Project 2014-012 (nominal $)

Year ended 30 June	FRDC ($)	OTHER ($)	TOTAL ($)
2014	47,440	0	47,440
2015	34,501	126,783	161,284
2016	107,818	153,491	261,309
2017	38,145	0	38,145
Totals	227,904	280,274	508,178

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 (1.122). This multiplier was estimated based on the share of 'employee benefits' and 'supplier' expenses' in total FRDC expenditure (5-year average) reported in the FRDC's Cash Flow Statement (FRDC, Annual Reports, 2013-2017). This multiplier then was applied to the nominal investment by FRDC shown in Table 2.

For the UTAS investment (other), it was assumed that program management and administration costs were already included in the nominal amounts 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 2017/18 dollar terms using the Implicit Price Deflator for Gross Domestic Product (ABS, 2018). No additional costs of extension were included as project outputs were made publicly available and shared directly with relevant stakeholders.

Impacts

Table 3 provides a summary of the principal types of impacts from project 2014-012 investment. Impacts have been categorised into economic, environmental and social impacts.

Table 3: Triple Bottom Line Categories of Principal Impacts from Project 2014-012

Economic	• Potentially, maintained or increased future productivity for some Tasmanian fisheries from better management and planning as a result of improved information on the distribution, abundance and population structure of key commercial fish species.
Environmental	• Potentially, improved environmental sustainability of Tasmanian fisheries because of better future stock assessments resulting from future SDMs.
Social	• Increased scientific knowledge and research capacity.

Public versus Private Impacts

Both private and public impacts/potential impacts were identified in the analysis. Private impacts may be delivered through the project's contribution to the economic impact of potentially increased future productivity for some Tasmanian fisheries. Some public impacts may be delivered, including environmental impacts through improved sustainability of Tasmanian fisheries, and social impacts in the form of increased scientific knowledge and capacity.

Distribution of Private Impacts

Private impacts from the project are uncertain and likely to be minor. However, any private impacts would primarily be captured by individual commercial fishers operating in some Tasmania fisheries. Impacts would be distributed according to associated supply and demand elasticities along the fisheries supply chain.

Impacts on other Australian Industries

It was assumed that any minor private impacts from the investment in project 2014-012 will be confined to Tasmanian wild-catch fisheries and their associated supply chains. However, it is possible that the methods used may be applicable to other Australian fisheries with reef-based fishing operations.

Impacts Overseas

No significant 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 Priority 3, and to Science and Research Priority 1.

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 project did not produce any direct and/or significant impacts, so no quantitative evaluation processes were applied to estimate benefits.

Impacts Not Valued

The impacts identified in Table 4 were not valued for the following reasons (Table 5):

Table 5: Reasons for Not Valuing Impacts

Impact/Potential Impact	**Reason why Impact Not Valued**
Potentially, maintained or increased future productivity for some Tasmanian fisheries from better management and planning as a result of improved information on the distribution, abundance and population structure of key commercial fish species.	A lack of evidence that the project outputs have been used by Tasmanian fisheries to support management and planning decisions with regard to deeper-reef operations (Jeremy Lyle, pers. comm., 2018).
Potentially, improved environmental sustainability of Tasmanian fisheries because of better future stock assessments resulting from future SDMs.	Uncertainty regarding the project's potential contribution to future SDM improvements and subsequent changes to future stock assessments and a lack of evidence/data available to make reasonable assumptions.
Increased scientific knowledge and research capacity.	Significant uncertainty around the magnitude of any increases to capacity, and a lack of evidence/data available to make reasonable assumptions about incremental capacity change and values.

Results

All past costs were expressed in 2017/18 dollar terms. All costs were discounted to 2017/18 using a discount rate of 5%.

Investment Criteria

Tables 6 and 7 show the investment criteria estimated for different periods of benefits for the total investment and the FRDC investment respectively. Note that, as no impacts were valued, the investment criteria reporting was limited to the Present Value of Investment Costs (PVC).

In the interests of consistency with other FRDC project analyses and reporting, the PVC was reported for the length of the investment and for different time periods up to 30 years from the last year of investment (2016/17) as per the CRRDC Impact Assessment Guidelines (CRRDC, 2014). The FRDC proportion of real investment (undiscounted) was estimated to be 47.5%.

Table 6: Investment Criteria for Total Investment in Project 2014-012

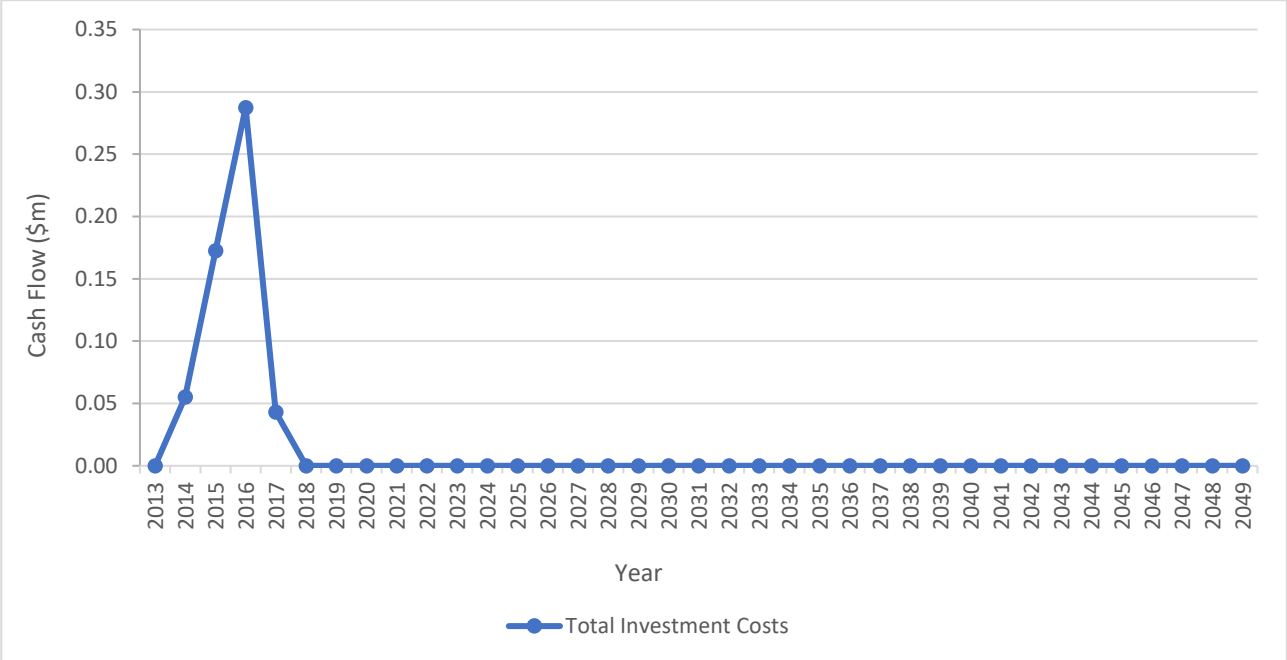
Investment Criteria	**Years after Last Year of Investment**						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present Value of Costs ($m)	0.63	0.63	0.63	0.63	0.63	0.63	0.63

Table 7: Investment Criteria for FRDC Investment in Project 2014-012

Investment Criteria	**Years after Last Year of Investment**						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present Value of Costs ($m)	0.30	0.30	0.30	0.30	0.30	0.30	0.30

The annual undiscounted cost cash flow for the total investment for the duration of the project 2014-012 investment plus 30 years from the last year of investment is shown in Figure 1.

Figure 1: Annual Cash Flow of Undiscounted Total Investment Costs



Conclusions

Funding for project 2014-012 totalled $0.63 million (present value terms). The FRDC investment costs were $0.30 million (present value terms). While a few impacts/potential impacts were identified, this project did not result in any significant and/or direct impacts that could be valued. However, the project was successful and has contributed to a broader, regional and national understanding of associations between marine habitat characteristics and the distribution and abundance of some marine species. The project also used methods and produced data that may contribute to the development of predictive species distribution models to enhance future marine stock assessments.

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 investment costs:	The discounted value of investment costs.

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