FINAL REPORT

An Impact Assessment of Investment in FRDC Project 2017-057:

Stock predictions and population indicators for Australia's east coast saucer scallop fishery

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An Impact Assessment of Investment in FRDC Project 2017-057: Stock predictions and population indicators for Australia's east coast saucer scallop fishery
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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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Abbreviations

CBA	Cost-Benefit Analysis
CRRDC	Council of Rural Research and Development Corporations
DAF	Queensland Department of Agriculture and Fisheries
DAWR	Department of Agriculture and Water Resources
FRDC	Fisheries Research and Development Corporation
MIRR	Modified Internal Rate of Return
OCS	Office of the Chief Scientist
R&D	Research and Development
RD&E	Research, Development and Extension
QLD	Queensland
UQ	University of Queensland
SAFS	Status of Australian Fish Stocks

Executive Summary

The Queensland saucer scallop (*Ylistrum balloti*) is found along the coastline of Western Australia and the east coast of Australia. While no commercial fishery for the scallop is present in the waters of New South Wales, there are commercial fisheries in central and southern Queensland (QLD) where the highest abundance of scallops are found.

The saucer scallop is one of several species targeted by the Queensland East Coast Trawl fishing industry. The scallop has been an important commercially harvested species in the past and has been one of QLD's most valuable commercially fished species in total monetary terms. For example, in 1993, annual landings peaked at just under 2,000 tonnes (meat weight), with an approximate annual gross value of $30 million.

In 2014, the QLD Department of Agriculture and Fisheries (DAF) conducted a quantitative stock assessment in response to concerns raised by the trawl industry about the decreasing catch rate of scallops. The assessment revealed that in 2015 spawning stock estimates of scallops were potentially only 5–6% of 1977 levels. This assessment resulted in the fishery being classed as overfished. As a result, management changes were introduced in January 2017 to prevent further declines in scallop stocks. The scallop then was classified as depleted in the most recent Status of Australian Fish Stocks in 2020.

Fisheries Research and Development Corporation (FRDC) Project 2017-057 set out to identify the associations between the abundance of scallops and the environmental variables chlorophyll-a concentration (Chl-a and sea surface temperature (SST). The project then built build age-based population models to predict spawning levels as indicators of scallop abundance for the fishery, and to inform future management of the fishery..

Important outputs of the project included:

- Description of impacts of fishing and environmental factors on saucer scallop populations
- Development of age-based population models to inform management of harvest and fishing effort
- Modelling suggested that increases in sea surface temperatures could adversely influence scallop survival and yields
- A series of eight recommendations resulted from the project

The key outcomes associated with the project were:

- Six of the eight recommendations have already been actioned
- The Queensland Government has been advised of recommended new management procedures that could be implemented in future

Unrelated to FRDC Project 2017-057, the QLD Government has since mandated that QLD trawl fishers will no longer be able to retain saucer scallops in central and southern coast areas. However, funding of Project 2017-057 has provided information that could potentially be used to assist future sustainability management of the QLD saucer scallop fishery.

Funding for the project over three years totalled $0.61 million (present value terms). The single impact was valued at $0.96 million (present value terms). This gave a net present value of $0.34 million, a benefit-cost ratio of 1.56 to 1, an internal rate of return of 7.7% and a modified internal rate of return of 6.7%. However, the set of investment criteria estimated are uncertain due to their dependence on assumptions that relate to uncertain future policies and their impacts related to the investment in Project 2017-057.

Introduction

The Fisheries Research and Development Corporation (FRDC) required an annual series of impact assessments to be carried out on a sample of completed investments from 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 funding partners and other stakeholders.
- Reporting to the Council of Rural Research and Development Corporations (CRRDC).
- Reporting RD&E impact and performance to FRDC levy payers and other fisheries and aquaculture stakeholders as well as the broader Australian community.

In April 2017, FRDC commissioned Agtrans Pty Ltd (Agtrans) to undertake the annual impact assessments for RD&E projects funded under the FRDC 2015-2020 RD&E Plan and completed in the years ended 30 June 2016 to 2020 (FRDC Project 2016-134). Between 2016/17 and 2020/21, four series of annual impact assessments were completed. Each of the four series of assessments included a set of 20 randomly selected FRDC RD&E investments as well as an aggregate analysis across all 20 investments evaluated in each year. Published reports for the annual FRDC evaluations can be found at: https://www.frdc.com.au/frdc-project-impact-assessments-benefits-research.

The fifth and final series of impact assessments under Project 2016-134 was for a set of FRDC RD&E investments completed in the year ended 30 June 2020, the final year of the FRDC 2015-2020 RD&E Plan. As in previous years, the fifth series of impact assessments included 20 randomly selected FRDC RD&E investments. The 20 investments had a total value of approximately $5.30 million (nominal FRDC investment) and were selected from an overall population of 81 FRDC investments worth an estimated $17.66 million (nominal FRDC investment) where a final deliverable had been submitted in the 2019/20 financial year.

The 20 RD&E 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 30.0% 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 (total nominal FRDC investment of $\leq$ $50.000, $50,001 to $250,000, and > $250,000 respectively).

Project 2017-057*: Stock predictions and population indicators for Australia's east coast scallop fishery* was randomly selected as one of the 20 RD&E investments completed in 2019/20 for evaluation in the fifth series of annual impact assessments (2019/20 sample). The current report presents the Project 2017-057 analysis and findings.

Method

The annual impact assessments of FRDC RD&E investments 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 assessment components that are in accord with the current guidelines for impact assessment published by the CRRDC (CRRDC, 2018).

The evaluation process utilised an input to impact continuum RD&E project inputs (costs), objectives, activities, and outputs were briefly described and documented. Actual and expected outcomes, and any actual and/or potential future impacts (positive and/or negative) associated with project outcomes then were identified and described. The principal economic, environmental, and social impacts were then summarised in a triple bottom line framework and validated through consultation with expert personnel and review of published literature.

Once impacts were identified and validated, an assessment then was made about whether to quantify/value any of the impacts in monetary terms as part of the project-level analysis. The decision to value an impact identified was based on:

- Data availability and information necessary to form credible valuation assumptions,
- The complexity of the relevant valuation methods applicable given project resources,
- The likely magnitude of the impact and/or the expected relative value of the impact compared to other impacts identified, and
- The strength of the linkages between the RD&E investment and the impact identified.

Where one or more of the identified impacts were selected for valuation, the impact assessment used cost-benefit analysis (CBA) as a principal tool. The impacts valued therefore were deemed to represent the principal benefits delivered by the project investment. However, as not all impacts were valued (based on the selection criteria), the investment criteria estimated for the project investment evaluated are likely to represent an underestimate of the true performance of the FRDC project.

The qualitative and quantitative analysis processes, data sources, assumptions, specific valuation frameworks (where applicable), and evaluation results were clearly documented and then integrated into a written report.

Project Background

Background

The saucer scallop (*Ylistrum balloti*) is found along the coastline of Western Australia and across the tropics to the southern cost of New South Wales. No commercial fishery for the scallop is present in the waters of New South Wales, but there are commercial fisheries in central and southern Queensland (QLD) where the highest abundance of scallops are found (FRDC, 2020). The scallop is found in sandy substrate ocean areas in up to 100 metres depth.

These scallops are one of several species targeted by the Queensland East Coast Trawl fishing industry. The saucer scallop in these areas has been an important commercially harvested species historically and, in earlier days, was QLD's most valuable commercially fished species. In 1993, annual landings peaked at just under 2,000 tonnes (meat weight), with an approximate annual gross value of $30 million.

In 2014, the QLD Department of Agriculture and Fisheries (DAF) conducted a quantitative stock assessment in response to concerns raised by the trawl industry about the decreasing catch rate of scallops. The assessment revealed that in 2015 spawning stock estimates of scallops were potentially only 5–6% of 1977 levels. This assessment resulted in the fishery being classed as overfished. As a result, management changes were introduced in January 2017 to prevent further declines in scallop stocks. The scallop has since been classified as depleted in the most recent Status of Australian Fish Stocks (SAFS) report (FRDC, 2020).

Catch areas for scallops had been surveyed between 1997–2006 and between 2017–2019 to investigate the recruitment and abundance of saucer scallops in central and southern QLD (DAF, 2021). Between two to four commercial trawl operators were chartered to survey the areas and contributed their vessels and fishery expertise, while accommodating scientists for up to 14 nights. Data on other species of commercial interest were also collected. Prior to 2006, the survey was conducted from offshore Yeppoon to Hervey Bay, as the majority of the catch occurred in these areas. In 2017, however, the survey moved as far south as Noosa to reflect the southern movement of the fishery's major harvest.

Rationale for Project 2017-057

FRDC Project 2017-057 was funded to address the associations between the abundance of scallops and environmental variables driven by predicted future climate change and its impact via sea surface temperature changes. A second part of the project employed population modelling to assist the QLD Government in refining policies and procedures for improved future management of scallops through the provision of specific recommendations.

Project Details

Summary

Project Code: 2017-057

Title: *Stock predictions and population indicators for Australia's east coast saucer scallop fishery*

Research Organisations: Queensland Government and the University of Queensland

Principal Investigator: Michael F. O'Neill, Maroochy Research Facility, Nambour

Period of Funding: July 2017 to June 2019

FRDC Program Allocation: Industry 100%

Objectives

1. Design stock model structures and estimate parameter values for the associations between saucer scallop abundance and environmental variables, including scenarios of scallop recruitment changing in parallel with changes in areas of the different habitat types..
2. To improve indicators and stock model predictions to estimate the current population size of saucer scallops for management procedures.

Logical Framework

Table 1 provides a description of the project in a logical framework developed for the evaluation.

Table 1: Logical Framework for FRDC Project 2017-057

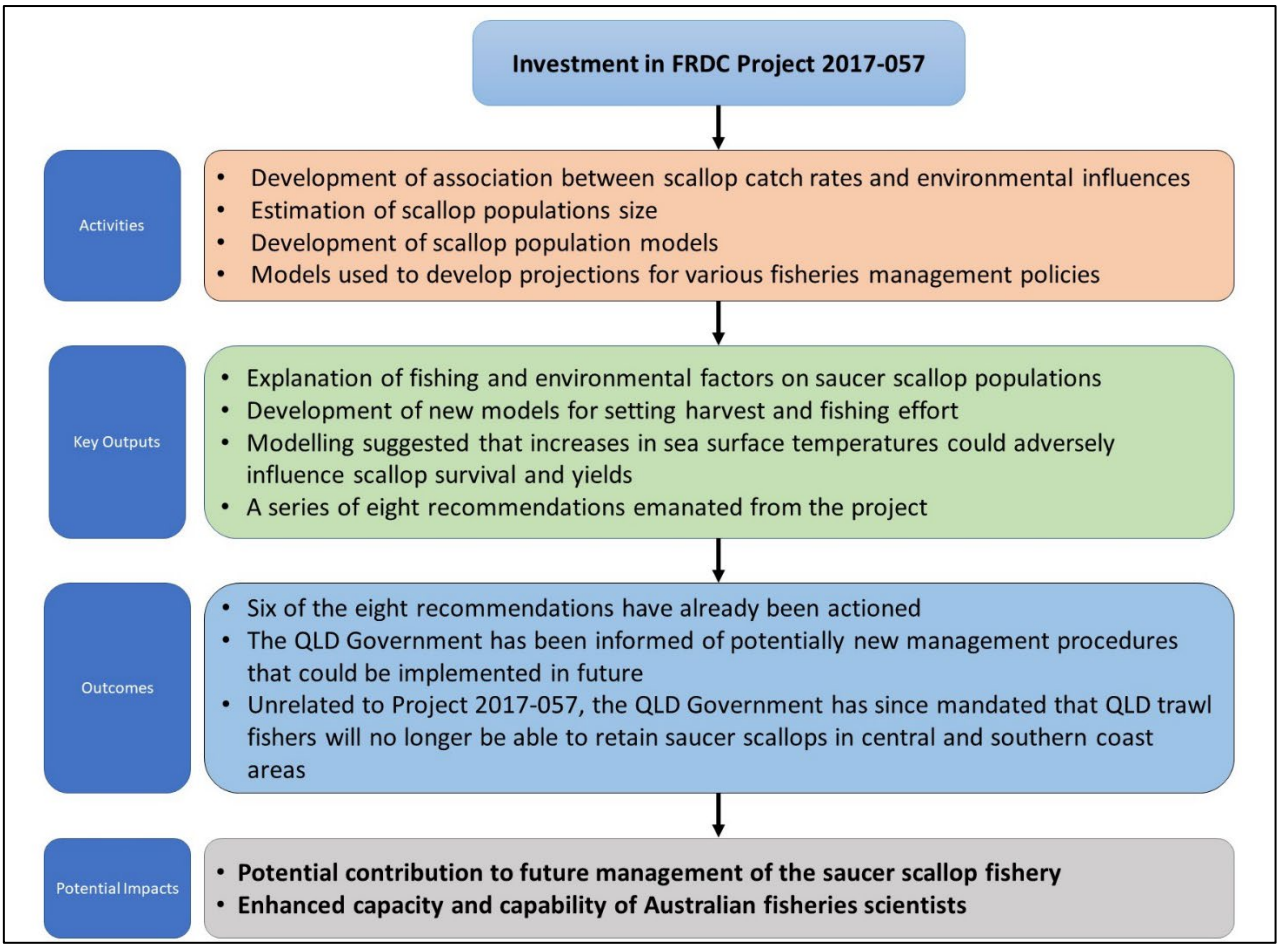
Activities	*Development of the association between scallop catch rates with environmental influences* • November to January catch rate data and environmental data (chlorophyll-a concentration and sea surface temperature) were analysed and correlations explored. *Estimation of scallop population size* • Scallop densities were assessed using spatial statistical methods for ten areas. • Scallop population sizes were estimated from maps of fishery areas combined with surveyed fishing densities. *Development of scallop population models* • A series of age-based population models were developed that took into account data relating to sea surface temperature and scallop data, including biology, area density, and harvest/catch rates. • The models were then used to predict spawning levels as indicators of scallop abundance across the fishery. • The models above were then used also to develop projections for the potential application of different fishery management policies.
Outputs	• Interpretations of the influence of fishing and environmental factors on the populations of saucer scallops. • Development of new models for setting harvest levels and fishing effort. • Projection that increased sea surface temperature could lead to reductions in scallop survival, abundance and fishery yields.

	Recommendations from the project included: 1. Revise fishery management to better control fishing effort, to help increase scallop biomass. 2. Update estimates of natural mortality and growth, using all historical tagging data and new data from related FRDC Project (2017-048). 3. Continue annual fishery independent abundance surveys of scallops to validate stock status and to optimise management procedures. The abundance of scallops aged 1+ years during winter was the critical index for measuring spawning biomass (the total weight of all egg-bearing stock that have reached sexual maturity and are capable of reproduction). 4. Surveys need to calculate their relative catching efficiency, with measures of effective trawl-swept areas, and the percentage of scallops caught per sweep. 5. Monitor, assess and report on sea surface temperature /ocean anomalies, and consider forecasts in management discussions. Also, use of the site-specific sea floor water temperature sensors may provide better data. 6. Review the time series data on trawl fishing power through compulsory logbook/ gear sheets. 7. Continue to evaluate and improve the time series of standardised catch rates. 8. Continue to adjust data and models, to improve estimates and forecasting and accuracy of reference points.
Outcomes	• Six of the eight recommendations have already been actioned; these are recommendations 1, 2, 3, 6, 7 and 8 (Michael O'Neill, pers. comm., 2022; Wortman, 2021). • However, due to the continuing decline in scallop stocks, QLD trawl fishers will no longer be able to retain saucer scallops when fishing in waters in central and southern parts of the coast. • If project FRDC 2017-057 had not been funded, it is likely that similar management changes by the QLD Government (non-retention of scallops by trawl fishers) would have been made anyway (Michael O'Neill, pers. comm., 2022). • Outputs of the project have informed the QLD Government regarding potentially new management procedures for the fishery that could be implemented in future. • The project has led to increased awareness by fishers of the potential for future elevated sea surface temperature to reduce scallop abundance, catch rates, and profits.
Impacts	Future potential impacts could include: • Potential contribution to future improved management of the fishery leading to future environmentally and economically sustainable yields from the QLD saucer scallop fishery (e.g. a contribution to the maintenance of the incomes of saucer scallop fishers after the fishery recovers in the years ahead to a spawning biomass to 30% of the unfished biomass). • Enhanced capacity and capability of Australian fisheries scientists.

Pathway to Impact

A diagram describing the simplified pathways to impact for the investment in Project 2017-057 is provided in Figure 1.

Figure 1: Pathway to Impact for Project 2017-057



Nominal Investment

Table 2 shows the annual investment made in Project 2017-057 by FRDC, DAF, and the University of Queensland (UQ) via the Centre for Applications in Natural Resource Mathematics.

Table 2: Annual Investment in Project 2017-057 (nominal $)

Year ended 30 June	FRDC ($)	DAF ($)	UQ ($)	TOTAL ($)
2018	120,000	138,000	45,000	303,000
2019	0	107,000	22,500	129,500
2020	29,000	0	0	29,000
Totals	149,000	245,000	67,500	461,500

Source: FRDC Project Agreement

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 (x1.179). 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, 2017-2021). This multiplier then was applied to the nominal investment by FRDC shown in Table 2. A multiplier of 1.00 was applied to the nominal investment by DAF and UQ.

Real Investment and Extension Costs

For purposes of the investment analysis, the investment costs of all parties were expressed in 2020/21 dollar terms using the Implicit Price Deflator for Gross Domestic Product (ABS, 2021). No additional costs of extension were included as the outcomes and impacts were largely driven by project activities including communication carried out within and after the project.

Impacts

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 Principal Impacts from Project 2017-057

Economic Environmental	• Potential contribution to future improved management of the QLD saucer scallop fishery leading to an increase in future sustainable yields and environmental sustainability.
Social	• Enhanced capacity and capability of Australian fisheries scientists.

Public versus Private Impacts

The impacts identified in this evaluation are directly related to the future effective management of the QLD saucer scallop fishery. Potentially, both future private and public impacts will be delivered by the investment in the project. The public impacts include an increase in the capacity and capability of Australian fisheries scientists and improved environmental sustainability for the saucer scallop fishery, including their ecosystem services. The private impacts include a contribution to the maintenance of the incomes of saucer scallop fishers after the fishery recovers in the years ahead to a spawning biomass to 30% of the unfished biomass.

Distribution of Private Impacts

Any future benefits accruing to fishers will be captured initially by QLD saucer scallop fishers, as well as the supply chains with which they interact. Such private benefits likely will be shared by members of the various fisheries supply chains according to associated supply and demand elasticities. Also, regional communities servicing saucer scallop fishers could be potentially impacted.

Impacts on Other Australian Industries

It is expected that there would be negligible impacts on other Australian primary industries.

Impacts Overseas

There are unlikely to be any significant impacts overseas.

Match with National Priorities

Australian Agriculture, Science, and Research Priorities

The Australian Government's National Science and Research Priorities and Agricultural Innovation Priorities are reproduced in Table 4. Project 2017-057 has contributed to National Science and Research Priorities 1 and 2. Further, the RD&E investment is likely to contribute indirectly to Agricultural Innovation Priorities 1 and 2 because of the contribution to future improved management of the QLD saucer scallop fishery leading to an increase in future sustainable yields and environmental sustainability.

Table 4: Australian R&D Priorities

Australian Government	
National Science and Research Priorities[1]	**National Agricultural Innovation Priorities**[2]
1. Food – optimising food and fibre production and processing; agricultural productivity and supply chains within Australia and global markets. **2. Soil and Water** – improving the use of soils and water resources, both terrestrial and marine. **3. Transport** – boosting Australian transportation: securing capability and capacity to move essential commodities; alternative fuels; lowering emissions. **4. Cybersecurity** – improving cybersecurity for individuals, businesses, government, and national infrastructure. **5. Energy and Resources** – supporting the development of reliable, low cost, sustainable energy supplies and enhancing the long-term viability of Australia's resources industries. **6. Manufacturing** – supporting the development of high value and innovative manufacturing industries in Australia. **7. Environmental Change** – mitigating, managing, or adapting to changes in the environment. **8. Health** – improving the health outcomes for all Australians.	On 11 October 2021, the National Agricultural Innovation Policy Statement was released. It highlights four long-term priorities for Australia's agricultural innovation system to address by 2030. These priorities replace the Australian Government's Rural Research, Development and Extension Priorities which were published in the 2015 Agricultural Competitiveness White Paper. **1.** Australia is a trusted exporter of premium food and agricultural products by 2030. **2.** Australia will champion climate resilience to increase the productivity, profitability, and sustainability of the agricultural sector by 2030. **3.** Australia is a world leader in preventing and rapidly responding to significant incursions of pests and diseases through futureproofing our biosecurity system by 2030. **4.** Australia is a mature adopter, developer, and exporter of digital agriculture by 2030.

FRDC National RD&E Priorities

Through extensive consultation, the FRDC 2015-2020 RD&E Plan identified three national RD&E priorities to focus and direct FRDC investments. The three FRDC national RD&E priorities were:

1. Ensuring that Australian fishing and aquaculture products are sustainable and acknowledged to be so.
2. Improving productivity and profitability of fishing and aquaculture.
3. Developing new and emerging aquaculture growth opportunities.

Project 2017-057 addressed all three FRDC national RD&E priority 1 by contributing to improved future management of the QLD saucer scallop fishery potentially associated with an increase in future sustainable yields and environmental sustainability.

[1] Source: 2015 Australian Government *Science and Research Priorities*. https://www.industry.gov.au/data-and-publications/science-and-research-priorities.

[2] Source: 2021 National Agriculture Innovation Policy Statement. https://www.awe.gov.au/agriculture-land/farm-food-drought/innovation/research_and_development_corporations_and_companies#government-priorities-for-investment.

Valuation of Impacts

Impacts Valued

A single impact was valued in the assessment of FRDC Project 2017-057 is:

- Potential contribution to improved management of the QLD saucer scallop fishery in the future leading to an increase in future sustainable yields and environmental sustainability (Impact 1).

The valuation of this impact relies on the 2021 decision that QLD trawl fishers will no longer be able to retain saucer scallops when fishing waters in the central and southern parts of the State, as well as the assumption that, once the target of spawning biomass is reached due the limits on trawling, new management policies will have been developed to maintain stability in the fishery and its offtake. It is assumed that the investment in Project 2017-057 will have contributed in part to the new management policies. Specific assumptions for the valuation of Impact 1 are provided in Table 5 below.

Impacts Not Valued

Not all impacts identified in Table 3 could be valued in the assessment. The impact not valued was the social impact of enhanced capacity and capability of Australian fisheries scientists. This impact was not valued due to the lack of information on which to base credible assumptions. However, to some degree, some of the capacity and capability impact would have already been valued in the economic impact.

Summary of Assumptions

The assumptions for the valuation of Impact 1 for Project 2017-057 are provided in Table 5.

Table 5: Summary of Assumptions

Variable	Assumption	Source
Impact 1: Contribution to a sustainable future offtake from the saucer scallop fishery		
Estimate of value of offtake of the saucer scallop fishery in 1993	$30 m	Reported by QDAF (2019)
Estimate of value of sustainable future offtake in future	$7.5 m per annum	Agtrans Research, based on 25% of the previous value of the sustainable offtake in 1993 (25% x $30 m)
Contribution of project 2017-057 to future offtake value as other projects will have contributed	20%	Analyst assumption
Profit as a percentage of offtake value	10%	Sala et al (2018)
Year of first impact	2027	Analyst assumption
Risk factors		
Probability of output	100%	Analyst assumption
Probability of outcomes occurring	75%	
Probability of impact occurring given successful outcome	75%	

Results

All benefits were expressed in 2020/21 dollar terms. All costs and benefits were discounted to 2021/22 using a discount rate of 5%. A reinvestment rate of 5% was used for estimating the Modified Internal Rate of Return (MIRR). The base analysis used the best available estimates for each variable, notwithstanding a level of uncertainty for many of the estimates. All analyses ran for the length of the investment period plus 30 years from the last year of investment (2019/20) to the final year of benefits assumed.

Investment Criteria

Tables 6 and 7 show the investment criteria estimated for different periods of benefits for the total investment and FRDC investment respectively.

Table 6: Investment Criteria for Total Investment in Project 2017-057

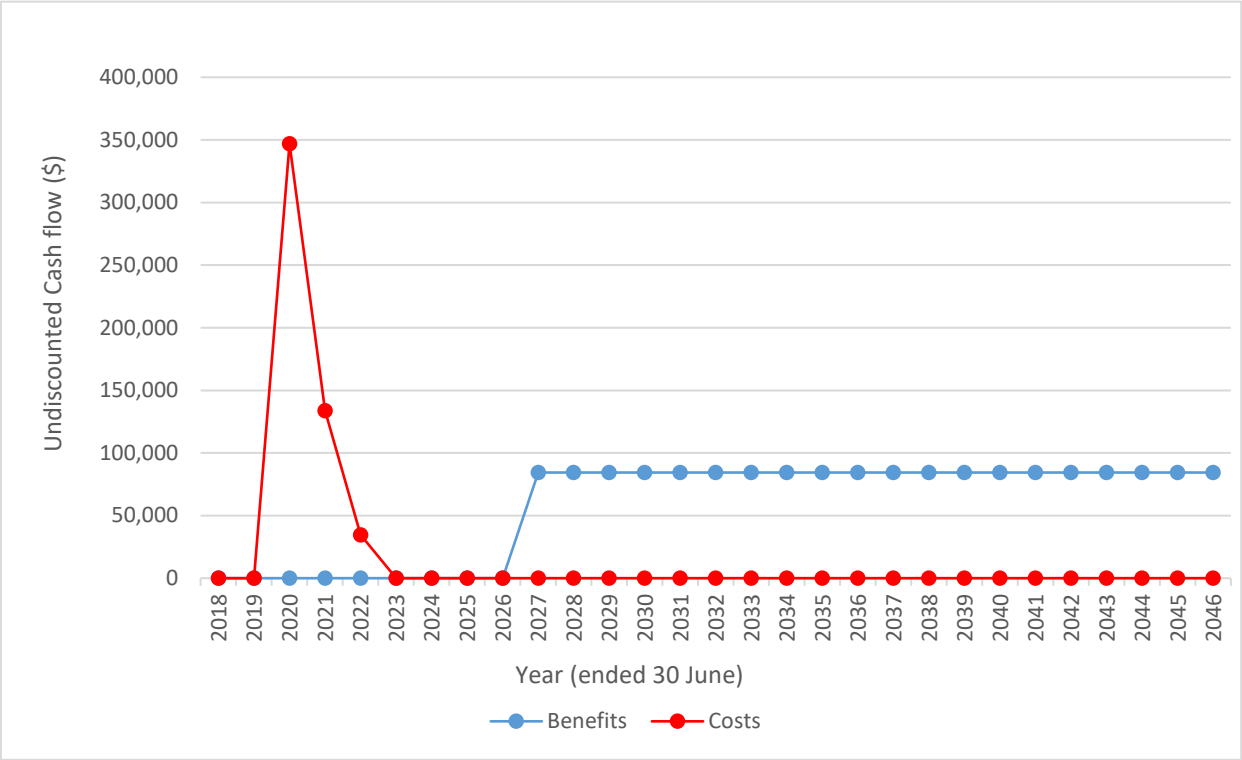
Investment criteria	**Number of years from year of last investment**						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present value of benefits ($m)	0.00	0.00	0.25	0.49	0.69	0.84	0.96
Present value of costs ($m)	0.61	0.61	0.61	0.61	0.61	0.61	0.61
Net present value ($m)	-0.61	-0.61	-0.37	-0.12	0.07	0.22	0.34
Benefit-cost ratio	0.00	0.00	0.40	0.80	1.12	1.36	1.56
Internal rate of return (%)	negative	negative	negative	3.1	5.8	7.1	7.7
MIRR (%)	negative	negative	negative	3.2	5.7	6.4	6.7

Table 7: Investment Criteria for FRDC Investment in Project 2017-057

Investment criteria	**Number of years from year of last investment**						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present value of benefits ($m)	0.00	0.00	0.09	0.18	0.25	0.30	0.35
Present value of costs ($m)	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Net present value ($m)	-0.22	-0.22	-0.13	0.04	0.03	0.08	0.12
Benefit-cost ratio	0.00	0.00	0.40	0.80	1.12	1.36	1.56
Internal rate of return (%)	negative	negative	negative	3.1	5.8	7.1	7.7
MIRR (%)	negative	negative	negative	3.2	5.6	6.4	6.7

The annual undiscounted benefit and cost cash flows for the total investment for the duration of investment period plus 30 years from the last year of investment are shown in Figure 2.

Figure 2: Annual Cash Flow of Undiscounted Total Benefits and Total Costs



Sensitivity Analyses

A sensitivity analysis was carried out on the discount rate. The analysis was performed for the total investment and with benefits taken over the life of the investment plus 30 years from the last year of investment. All other parameters were held at their base values. Table 8 presents the results. The results showed a high sensitivity to the discount rate, largely due to the benefit period assuming to commence some years after the project was completed.

Table 8: Sensitivity to Discount Rate
(Total investment, 30 years)

Investment Criteria	**Discount rate**		
	0%	**5% (base)**	**10%**
Present value of benefits ($m)	2.03	0.96	0.52
Present value of costs ($m)	0.52	0.61	0.73
Net present value ($m)	1.51	0.34	-0.21
Benefit-cost ratio	3.93	1.56	0.71

A sensitivity analysis was undertaken also on the assumptions regarding the contribution of Project 2017-057 to assist with maintaining a future sustainable catch. Results are shown in Table 9. For the project investment to break even, there would need to be approximately a 13% contribution to a future sustainability scenario.

Table 9: Sensitivity to the Contribution of Project 2017-057 to Future Fishery Sustainability

Investment Criteria	**Contribution of Project 2017-057**		
	30%	**20% (Base)**	**10%**
Present value of benefits ($m)	1.44	0.96	0.48
Present value of costs ($m)	0.61	0.61	0.61
Net present value ($m)	0.82	0.34	-0.14
Benefit-cost ratio	2.34	1.56	0.78

Confidence Ratings and other Findings

The results produced are highly dependent on the assumptions made, some of which are uncertain. There are two factors that warrant recognition. The first factor is the coverage of benefits. Where there are multiple types of benefits it is often not possible to quantify all the benefits that may be linked to the investment. The second factor involves uncertainty regarding the assumptions made, including the linkage between the research and the assumed outcomes.

A confidence rating based on these two factors has been given to the results of the investment analysis (Table 10). The rating categories used are High, Medium and Low, where:

High:	denotes a good coverage of benefits or reasonable confidence in the assumptions made
Medium:	denotes only a reasonable coverage of benefits or some uncertainties in assumptions made
Low:	denotes a poor coverage of benefits or many uncertainties in assumptions made

Table 10: Confidence in Analysis of Project

Coverage of Benefits	**Confidence in Assumptions**
Medium-High	Low

The coverage of benefits for the project was assessed as Medium-High. Of the two impacts identified in Table 3, the most important impact was valued; the value of the other impact identified was considered minor in value relative to the impact valued. For the impact valued, many of the assumptions used were realistic but the critical assumption of the contribution of the project to any future sustainability scenario was necessarily subjective. Hence, the overall rating of confidence in the assumptions was considered to be Low.

Conclusions

The principal output of the investment in Project 2017-057 was the provision of information about saucer scallop stocks that could potentially be used to assist future sustainability management of the Queensland saucer scallop fishery.

Funding for the project over three years totalled $0.61 million (present value terms). The single impact was valued at $0.96 million (present value terms). This gave a net present value of $0.34 million, a benefit-cost ratio of 1.56 to 1, an internal rate of return of 7.7% and a modified internal rate of return of 6.7%. However, the set of investment criteria estimated are uncertain due to their dependence on assumptions that relate to uncertain future policies and their impacts related to the investment in Project 2017-057.

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.

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