Appendix F: 2018-070: Opportunities and impacts of range extending scalefish species: Understanding population dynamics, ecosystem impacts and management needs.

Background

Ocean warming is driving a shift in the distribution of marine species worldwide, with many species moving in a poleward direction. Due to disproportionate warming in Tasmania – driven by the extension of the Eastern Australian Current – this region is a hotspot for species either extending their range or becoming more abundant at their high-latitude range extremities. These species include Snapper, King George Whiting, and Yellowtail Kingfish. Stocks of these species off the southern Australian mainland are commercially and recreationally important. Thus, it is important to consider the Tasmanian population's attributes such as growth, mortality, and reproduction for developing and refining management arrangements to maximise new fishing opportunities for recreational and commercial fishers.

In addition, the broader ecosystem impacts of range-extending species, including competition with resident species at similar trophic levels, or increased predation to lower trophic levels are unknown but could have consequences for other recreationally and commercially important species or ecosystem function. Understanding these interactions will have benefits for the assessment and management of Tasmania's natural marine resources more generally, ensuring the mitigation of negative impacts and utilisation of opportunities due to climate change.

Description of the project

Table 46 Project summary of project 2018-070

Project code	2018-070
Title	Opportunities and impacts of range extending scalefish species: Understanding population dynamics, ecosystem impacts and management needs
Research organisation	University of Tasmania – Institute of Marine and Antarctic Studies (IMAS)
Principal investigator	Sean Tracey
FRDC project manager	Toby Piddocke
Period of funding	June 2019 - December 2020
FRDC investment	$249, 587
FRDC program allocation	33% Communities, 33% Environment, 34% People

Rationale	To understand the life-history, biology, distribution and trends of Yellowtail Kingfish, Snapper, and King George Whiting and the ecological implications of such changes to inform decision making in this changing environment.
Objectives	• Develop a program for ongoing collection of biological samples and data of key range shifting fish species using citizen science initiatives engaging with the recreational fishing community • Develop geographically discrete life-history parameters for key range shifting fish species in Tasmania to inform management decisions • Determine the diet composition of key range shifting fish species to refine parameterisation of an ecosystem model • Develop species distribution models that utilise oceanographic climate change projections to predict the future presence and persistence of the key target species in Tasmania • Utilise the Atlantis ecosystem model framework to predict ecological impacts of increasing abundance of key range shifting fish species in Tasmania
Activities and outputs	• Citizen science data was collected via the launch of the Tassie Fish Frame Collection Program • Additional fishery-independent sampling was conducted to account for fish outside of the legal size limits, and historical data from the IMAS database was also used • Life history parameters (age, population structure, reproduction, mortality) and diet were quantified for the three species, and Atlantis ecosystem modelling and species distribution modelling was undertaken • Modelling predicted an increase in habitat suitability across Tasmania for Snapper and King George Whiting, and reproduction was observed in Tasmanian waters • Modelling predicted an increase in temporal persistence of suitable habitat for the seasonal migration of Yellowtail Kingfish • Modelling predicted that ecosystem collapse due to the increased presence of the three species was unlikely
Outcomes	• Yellowtail Kingfish, Snapper and King George Whiting stocks were deemed 'sustainable' in Tasmania and therefore appropriate management for the three species could be determined, and commercial and recreational fishers can target these species • The project negated concerns that the three species would have a major impact on the existent ecosystems • The project provided insights into the benefits of using citizen science and provided recommendations for how this could be expanded in the future • Increased confidence in management decisions through proactive rather than reactive research
Potential impacts	• Increased opportunities for Tasmanian recreational fishers and Tasmanian commercial fishers to catch Snapper, King George Whiting and Yellowtail Kingfish • Proactive research improved decision-making, thereby increasing confidence in regulation and requiring less conservative management measures • Greater knowledge sharing and relationship building between researchers, fishers, and community • Improved understanding of management practices required

Project investment

A breakdown of FRDC investment and contribution by others by financial year is shown in Table 47.

Table 47 Total investment in project 2018-070 from FRDC (nominal dollar terms)

Year ending June 30th	FRDC ($)	Others* ($)
2018/19	$80,000	-
2019/20	-	$216,383
2020/21	$92,000	$118,591
2021/22	$77,587	-
Total	**$249,587**	**$334,974**

Source: Documents provided by FRDC.

*Contributions to the project cost not sourced from FRDC e.g. in-kind contributions

For the BCA, the cost of managing the FRDC funding was added to the FRDC contribution for the project using a management cost multiplier of 1.157. As per impact assessments in previous years, this multiplier was estimated based on a five-year average of the ratio of total FRDC non-project cash expenditure to project expenditure as reported in FRDC's Cash Flow Statement (FRDC Annual Reports, 2019-2023). No multiplier was applied to the investment by other contributors, as it was assumed that project management and administration were included in the value of funding provided.

In undertaking the impact assessment, all past costs were expressed in 2023/24-dollar terms using the Implicit Price Deflator for GDP.

Summary of impacts

Table 48 Triple bottom line impacts, including those valued as part of this evaluation (in bold)

Economic	• **Improvements in decision-making, increasing confidence in regulation and requiring less conservative management measures (pre-emptive management)** • **Confirmation of the opportunities for commercial fishers** • Validation of the current management practices
Environmental	• Better environmental outcomes due to improvements in the management of Tasmanian fisheries (Yellowtail Kingfish, Snapper, King George Whiting) • Knowledge building in the ecosystem impacts and demography of range extending scalefish
Social	• Improved relationships between fishery management and the recreational fishing sector through the citizen science component of the project building positive relationships between recreational fishers and fisheries managers • Improved fishery stewardship and acceptance of management changes • **Realisation of opportunities for recreational fishers, especially in a time of decreased allowable catch in key target species**

Public versus private impacts

The potential impacts identified from the project are likely to mainly accrue to public beneficiaries, particularly in the short-term. Specifically, through public benefits for recreational fishers and positive environmental outcomes.

Distribution of private impacts

Private impacts realised from this project are likely to only be realised in the longer term, distributed amongst commercial fishers in Tasmanian waters associated with catching Snapper, King George Whiting, and Yellowtail Kingfish.

Impacts on other Australian industries

No direct impacts to other Australian primary industries were identified.

Impacts overseas

The project has contributed to knowledge building indirectly on an international scale, as it was published in an international scientific journal and has relevance to other countries who are also experiencing species range extensions.

Quantification of impacts

For the BCA, the identified impact of increased opportunities for recreational fishing was quantified. This project has allowed management agencies a proactive understanding of the sustainability and potential opportunities apparent in range extending species.

One opportunity that has arisen is through re-focussing recreational fishing effort. Southern Sand Flathead has historically constituted around 68% of Tasmania's recreational fish catch, however, recent assessments have indicated significant management changes are needed to rebuild the stock. This has led to debate and contention between regulators and the recreational fishing community. This project has provided an opportunity to refocus some of the recreational fishing effort on the range extending species.

Although there is minimal data on the potential scale, there is also an opportunity for commercial fishing in these range extending species. This project has had a positive impact in clarifying this potential and validating current management practices. There is potential this project can be used as a basis for improving outcomes in this sector.

An outline of the assumptions supporting the estimates of future benefits and costs are reported below.

Estimated benefits

Variable	Assumption	Source/ Explanation
Impact 1: Substitutable value of range extending species for recreational sector		
a) Value of Tasmanian recreational fishing	$160M	Tasmanian recreational sea fishing strategy (2021-2030) (Tasmanian Govt, 2021)
b) Proportion of value attributable to sand flathead	68%	2017-18 Survey of recreational fishing in Tasmania (Lyle et al, 2019)
c) Indication of recreational fishers that would go	70%	2017-18 Survey of recreational fishing in Tasmania (Lyle et al, 2019)

fishing without access to sand flathead		
d) Comparative value of range extending species	65%	2017-18 Survey of recreational fishing in Tasmania (Lyle et al, 2019). The value of range extending species averages at 50% desirability compared to 77% desirability of flathead. 50%/77%.
e) Potential to substitute b) proportion of value attributable to sand flathead	10%	Analyst assumption, range extending species only represent a small % of other substitutable species.
f) Potential value of recreational opportunity for range extending species	$4,950,000	a x b x c x d x e
g) Attributable to this project in the short term	10%	Analyst assumption
h) Value attributable to this project annually for 10 years	$495,000	f x g
Impact 2: Commercial value		
i) King George Whiting caught in Tasmania	7,800kg	Tasmanian Scalefish Fishery Assessment 2022/23 (Sharples et al, 2024)
j) Value of King George Whiting ($/kg)	$21	Tasmanian Scalefish Fishery Assessment 2022/23 (Sharples et al, 2024)
k) Current value	$164,000	i x j
l) Expected increase / year	25%	Average over past 5 years is 75% annually, however, this growth rate is expected to slow quickly. Tasmanian Scalefish Fishery Assessment 2022/23 (Sharples et al, 2024)
m) Value in being able to optimise management, attributable to this project to this project	10%	Analyst assumption
n) Total value	$20,500	k x (1+l) x m, Increases per year as per l)
Impact 3: Avoidance of a similar future project (avoidance of reactive management)		
Cost of project under counterfactual	$620, 000	Analyst assumption, cost of this project expected to occur in year 2033/34

Adoption costs

To achieve benefits 1 and 2, it is expected there will need to be further investment in the extension of this project's findings along with adding findings into the management regime. This is assumed to total approximately $250,000 spread across 2022/23 and 2023/24.

Counterfactual

A similar project would likely be needed in time, the modelling assumes this would happen in the year 2033/34 following increased uncertainty around the management of the increasing populations. However, this is assumed to be a reactive approach whereby the benefits modelled would not be captured.

Government would be uncertain of any management decisions, and therefore would not be able to recommend fishers to target these fish and potentially restricting opportunities for commercial fishing (i.e. less certainty requires a more conservative approach to fisheries management).

Attribution

The attribution of benefits from the project - summarised in Table 49 – considers any past inputs and expected future development costs required to realise beneficial outcomes. Given the estimate of further work required to ensure social acceptability and adoption of project outcomes, the attribution of benefits from this project are estimated to be approximately 74%, of which 34% is attributable to FRDC's investment.

Table 49 Attribution of benefits for project 2018-070

Variable	Assumptions
FRDC costs	34%
Other project party costs	40%
Future development	26%
Total	100%

Adoption

Benefits are expected to begin in 2023/24 for both benefit 1 and 2, until the year 2033/34 where it is assumed that a similar project under the counterfactual is implemented.

Results

Table 50 below presents the modelled investment performance from the project. All past costs and benefits were expressed in 2023/24-dollar terms using the Implicit Price Deflator for GDP, while all future costs and benefits were discounted to 2023/24 using a discount rate of 5%. A reinvestment rate of 5% was used for estimating the modified internal rate of return (MIRR). The 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 (2023/24) to the final year of benefits assumed.

The results show the total investment returning a net present value (NPV) of $3.11 million and a favourable BCR of 5.2. Table 51 shows FRDC investment returning a NPV of $1.44 million and a BCR of 5.2.

Table 50 Investment criteria for total investment in Project 2018-049 ($M)

Year	0	5	10	15	20	25	30
PV Benefits	$0.74	$2.39	$3.86	$3.86	$3.86	$3.86	$3.86
PV Costs	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75
NPV	-$0.00	$1.64	$3.11	$3.11	$3.11	$3.11	$3.11
BCR	1.0	3.2	5.2	5.2	5.2	5.2	5.2
IRR	5%	27%	30%	30%	30%	30%	30%
MIRR	5%	9%	10%	10%	9%	9%	8%

Table 51 Investment criteria for FRDC investment in Project 2018-049 ($M)

Year	0	5	10	15	20	25	30
PV Benefits	$0.34	$1.10	$1.78	$1.78	$1.78	$1.78	$1.78
PV Costs	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34
NPV	-$0.00	$0.76	$1.44	$1.44	$1.44	$1.44	$1.44
BCR	$1.0	$3.2	$5.2	$5.2	$5.2	$5.2	$5.2
IRR	5%	28%	31%	31%	31%	31%	31%
MIRR	5%	9%	10%	10%	9%	9%	8%

The flow of total undiscounted costs and benefits from the project is presented in Figure 6 below.

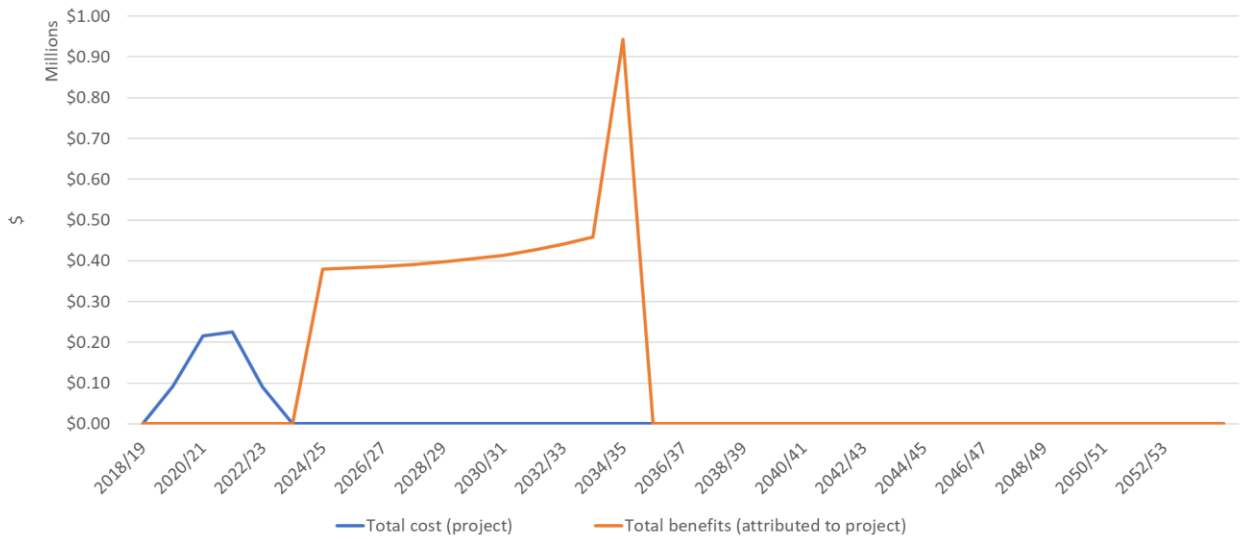

Figure 6 Flow of undiscounted costs and benefits from the project.

Sensitivity Analysis

A sensitivity analysis was carried out to determine how the investment performance (NPV, BCR and MIRR after 30 years) would change based on changes to the discount rate and other key variables. The results presented in Table 52 below show that the project will deliver a positive NPV ($M) across all modelled scenarios.

Table 52 Sensitivity analysis

Changes to key variables	NPV ($M)	BCR	MIRR
Standard assumption	3.11	5.2	8%
Discount rate			
4%	3.31	5.4	8%
6%	2.93	4.9	9%
Benefit 1: potential to substitute			
5%	1.51	3.0	7%
15%	4.72	7.3	9%
Benefit 1 and 2: Attribution to this project			
5%	1.31	2.8	7%
15%	4.52	7.1	9%
Benefit 2: Increase in value / year			
10%	2.91	4.9	8%
40%	3.57	5.8	9%

Confidence analysis

The accuracy of the assessment is highly dependent on:

- The extent to which the analysis captures and quantifies the various benefits from the project, including non-market benefits (i.e. coverage of benefits), and
- The level of confidence in the accuracy of assumptions used (i.e. confidence in assumptions).

An assessment of coverage and confidence ratings for this project is presented below in

Table 53.

Table 53 Coverage and confidence ratings

Factor	Rating	Comment
Coverage of benefits	Medium	The modelled benefits are seen as either occurring or likely to occur. However, there is a broad range of future scenarios in which the findings could be used.
Confidence in assumptions	Low	This assessment has leveraged detailed research in the recreational sector's value and comparative values of species; however, lower confidence assumptions have been applied to determine the impact of this project specifically.

Conclusions

Project 2018-070: Opportunities and Impacts of Range Extending Scalefish Species: Understanding Population Dynamics, Ecosystem Impacts and Management Needs aimed to quantify the abundance, biology and diet of three key range-shifting species in Tasmania (Yellowtail Kingfish, Snapper, and King George Whiting) and the ecological impacts and opportunities of their range extension into Tasmania. The project utilised engagement from the recreational fishing community and citizen science initiatives and historical data. The project deemed that the stocks in Tasmania for the three species were 'sustainable' and predicted that ecosystem collapse due to their range extension was unlikely. This has allowed for increased opportunities for recreational fishing. This could look like a re-focussing or substitution of recreational fishing effort away from the popular Southern Sand Flathead (due to declining population), onto these range extending species. There is also an opportunity for commercial value to be generated from the range extension. However, limited data has constrained the assumptions that can be made, resulting in conservative quantification of this benefit, estimating commercial benefits for only one of the three species.

The project has also had a positive impact through its proactive rather than reactive approach. With a proactive approach, there is increased certainty around the opportunities of these range extension species, thereby improving decision-making and allowing for less conservative management decisions.

Based on the adopted assumptions this analysis has estimated the project investment will likely deliver a positive economic benefit (BCR 5.2). The result remained positive across all modelled scenarios.

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