Appendix L: 2013-022: Integrating fisher-derived and fishery-independent survey data to better understand and manage the Murray Cod fishery in the Murray-Darling Basin

Background

The Murray Cod is the largest Cod species found in the Murray-Darling Basin. Acknowledged for its ecological, recreational, economic, cultural, and scientific value, the Murray Cod is considered one of Australia's flagship species. The Murray Cod is highly susceptible to overfishing as it is a slow-growing and long-lived fish. While its natural distribution has remained unchanged, the decline in its abundance is well documented. Concerns were first raised in 1880. By 1930, Murray Cod population levels dropped to unprofitable levels forcing large-scale operators out of the industry. Despite being an economically and socially viable freshwater fish, little is understood about the biology and ecology of Murray Cod through its distribution. It is currently listed as "Vulnerable to Extinction" under the Australian Environment Protection and Biodiversity Conservation (EPBC) Act 1999.

Despite the national focus of the National Recovery Plan for the Murray Cod, populations are primarily independently managed by State and Territory fisheries agencies. Regulations to restrict harvest and restocking activities have helped offset the risk of extinction but do not address key threats to Murray Cod. The problem is exacerbated by a lack of scientifically robust data at a regional level that can help support the recovery and management of Murray Cod species populations.

Therefore, the Recfishing Research Annual Business Plan (2012-13) and Murray Cod Fishery Management Group identified a need to understand Murray Cod's status through its distribution by developing and implementing a consistent and cost-effective method of assessing Murray Cod populations. This project aimed to address this need to help achieve long-term sustainability for the population.

Description of the project

Table 90 Project summary of project 2013-022

Project code	2013-022
Title	Integrating fisher-derived and fishery-independent survey data to better understand and manage the Murray Cod fishery in the Murray-Darling Basin
Research Organisation	Greenfish Consulting Pty Ltd (at the time of initial contracting)
Principal investigator	Gavin Butler
FRDC project manager	Chris Izzo
Period of funding	2013-2020
FRDC investment	$1,003,191
FRDC program allocation	60% environment, 15% industry, 15% community, 10% adoption

Rationale	To facilitate the future management of Murray Cod by developing a program to provide timely cost-effective information on Murray Cod populations
Objectives	• Assess the status of the Murray Cod population in the Murray-Darling Basin by utilising fisher-derived and fishery-independent data sources in innovative and integrated ways • Develop an improved understanding of key factors (larval and juvenile survival) that influence the successful recruitment of Murry Cod especially concerning environmental factors such as flows and habitats
Activities and outputs	• Conducted a series of workshops with participants from across all States and Territories where Murray Cod occur • Conducted a literature review to identify the key factors and learnings that determined the success of previous sampling programs • Conducted an extensive audit and analysis of existing data collected from throughout the MDB to determine the applicability of current sampling strategies to describe recent historical trends in the overall Murray Cod population • Tested novel sampling techniques, particularly, the use of angler-based citizen science and its role in obtaining consistent and cost-effective sampling data • Undertook electrofishing in conjunction with tag-recapture after each angling event to quantify the detectability of Murray Cod by both the fishery and fishery independent techniques used • Conducted research into factors limiting the self-sustainability of wild species • Employed radio tracking and underwater cameras to describe the breeding behaviour of Murray Cod for the first time in a natural riverine setting • Quantified the abiotic and biotic factors that may be influencing breeding behaviour, spawning and early recruitment success • Described the behaviour of dispersing larvae and suggested a number of factors that may be influencing their survival through to juveniles • Produced a case study on learnings from the Dumaresq River Murray Cod program highlighting the importance of a defined scope, engaging highly motivated anglers from inception and ongoing support from government agencies to provide positive, meaningful outcomes that improved species management in the area
Outcomes	• Contributed to knowledge building of sampling methods available for Murray Cod fisheries, including finding that minor additions to current sampling methods will provide a cost-effective approach to utilise widespread monitoring data and therefore more effective species abundance and trend analysis • Contributed to knowledge around the use of angler-based citizen science, including that information obtained from anglers' sampling can complement fishery-independent research programs and support overall management objectives • Gained an understanding of the Murray Cod larval dispersal and breeding behaviour in wild river settings for the first time, highlighting the need for several potential management interventions

Potential impacts	• Empowering Murray Cod recreational fishers in supporting effective management of fish populations • Cost savings from utilising angler-based citizen science data collection as opposed to (solely relying on) traditional methods • Identified potential efficiencies for data collection programs by reducing duplicated effort and investment • Greater efficiencies from boat electrofishing use and improved quality of data obtained • Strengthened relationships among researchers, managers and anglers • Improvements in the management of Murray Cod recreational fisheries

Project investment

A breakdown of FRDC investment and contribution by others by financial year is shown in Table 91.

Table 91 Total investment in project 2013-022 from FRDC (nominal dollar terms)

Year ending June 30th	FRDC ($)	Others* ($)
2012/13	-	$30,000
2013/14	$182,980	$72,962
2014/15	$182,274	$201,917
2015/16	$237,105	$145,053
2016/17	$129,561	$102,448
2017/18	-	$100,000
2018/19	$20,000	-
2019/20	$57,405	-
2020/21	$42,674	-
2021/22	$115,060	$52,500
2022/23	$18,622	-
2023/24	$17,510	$18,000
Total	**$1,003,191**	**$722,880**

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 92 below provides a summary of the expected triple bottom line impacts (economic, environmental, and social) from the project.

Table 92 Triple bottom line impacts, including those valued as part of this evaluation (in bold)

Economic	• **Potential increases in economic values attached to recreational fishing resulting from improved management of Murray Cod stocks** • **Potential savings in management costs of Murray Cod recreational fisheries due to improved collaboration, increased knowledge and more efficient sampling methods** • Potential for findings to lead to increased economic and savings in management costs for recreational fishing of other freshwater species such as Golden Perch and Silver Perch
Environmental	• Increase in the future ecological sustainability of the Murray Cod and other freshwater species due to increased knowledge and better management
Social	• Improved cultural and recreational outcomes resulting from improved management of a nationally significant species • Strengthened relationships among researchers, managers and anglers • Recreational fishers are empowered to support effective management of fish populations

Public versus private impacts

The potential impacts identified from the project will accrue to both public and private beneficiaries. Management cost savings resulting from greater collaboration, improved knowledge and more efficient sampling methods will accrue to the public sector. Private benefits to recreational fishers are expected over time as a result of improved management of Murray Cod stocks. These benefits could extend to other freshwater species. Public and private impacts will result from greater collaboration amongst key industry stakeholders such as recreational fishers, managers and researchers. A better understanding of Murray Cod population distribution will have a positive public impact on the ecological environment as it is an ecologically important species in the Murray-Darling Basin.

Distribution of private impacts

Private impacts realised from this project will be distributed amongst recreational Murray Cod fishers in the Murray-Darling Basin and their supply chains. These benefits could extend to other freshwater species.

Impacts on other Australian industries

No direct impacts to other Australian primary industries were identified.

Impacts overseas

No direct impacts overseas were identified.

Quantification of impacts

For this BCA, the quantified impacts are centred around increased cost efficiencies in managing Murray Cod recreational fisheries and a marginal increase in the annual value of recreational fishing assumed to be realised through improvements to the management of Murray Cod stocks in the MDB. In the absence of information about the total annual expenditure from the respective State and Territory governments on the management of Murray Cod across the MDB, an assumed efficiency dividend has been applied against an average proxy cost of conducting stock assessments in each jurisdiction for Murray Cod. This estimate provides a means of quantifying the impact of increased cost efficiencies realised from the project, but is considered conservative.

Estimated benefits

Table 93 Benefit assumptions

Variable	Assumption	Source/ Explanation
Impact 1: Increase in value of recreational fishing due to more effective management		
a) Annual value of recreational fishing in the Murray-Darling Basin	$403M	MDBA 2023
b) The proportion of recreational fishing value in Murray-Darling Basin attributable to the Murray Cod	20%	Analyst's estimate based on previous economic studies undertaken by the Victorian Fisheries Authority (2021).
c) Value of proportion attributable to Murray Cod	$80.6M	a x b
d) Proportion of value assumed to be influenced by fisheries management	10%	Analyst assumption
e) The value of the recreational fishing assumed to influenced by management	$8.06M	c x d
f) Effectiveness dividend from improved management	10%	Analyst assumption
g) Annual benefit	$806,000	e x f, assumed for 10 years and then decreasing to half by year 20
Impact 2: Savings in management costs of Murray Cod recreational fisheries		
h) Annualised cost of stock assessments	$500,000	Analyst's estimate informed by consultation assuming the average cost of conducting stock assessments is $300,000 across the five jurisdictions and conducted every three years
i) Efficiency dividend	10%	Analyst assumption

j) Annual cost savings	$50,000	h x i, efficiencies are assumed to be realised for a ten year period before being superseded by new methods

Adoption costs

There are no expected costs associated with the modelled impacts.

Counterfactual

The counterfactual is that if the project had not been funded, the benefits estimated in this analysis would not be realised.

Attribution

The benefits quantified in this analysis are all attributed to this project as summarised in Table 94. It is noted, however, that consultation with FRDC project managers indicated that findings from this project have led to further research as part of another FRDC project however at the time of writing this report, the new project is still in the contractual phase. While it is understood that the new project will likely draw on findings from Project 2013-022, any additional benefits that may arise have not been quantified in this analysis.

Table 94 Attribution of benefits for project 2013-022

Variable	Assumptions
FRDC costs	61%
Other project party costs	39%
Total	100%

Adoption

Benefits 1 and 2 are expected to begin being realized during the project investment period, considering the extended timeline of this project. Both benefits are expected to begin in 2018/19 before increasing constantly for 5 years to reach the total values outlined in Table 93.

Results

Table 95 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 $10.46 million and a favourable BCR of 5.4. Table 96 shows FRDC investment returning a NPV of $6.41 million and a BCR of 5.4.

Table 95 Investment criteria for total investment in Project 2013-022 ($M)

Year	0	5	10	15	20	25	30

PV Benefits	$4.61	$8.14	$10.77	$12.31	$12.86	$12.86	$12.86
PV Costs	$2.40	$2.40	$2.40	$2.40	$2.40	$2.40	$2.40
NPV	$2.20	$5.73	$8.37	$9.91	$10.46	$10.46	$10.46
BCR	1.9	3.4	4.5	5.1	5.4	5.4	5.4
IRR	14%	20%	21%	22%	22%	22%	22%
MIRR	8%	10%	10%	10%	9%	9%	8%

Table 96 Investment criteria for FRDC investment in Project 2013-022 ($M)

Year	0	5	10	15	20	25	30
PV Benefits	$2.83	$4.99	$6.61	$7.55	$7.89	$7.89	$7.89
PV Costs	$1.48	$1.48	$1.48	$1.48	$1.48	$1.48	$1.48
NPV	$1.35	$3.52	$5.13	$6.08	$6.42	$6.42	$6.42
BCR	1.9	3.4	4.5	5.1	5.4	5.4	5.4
IRR	14%	20%	22%	22%	22%	22%	22%
MIRR	8%	10%	10%	10%	9%	9%	9%

The flow of total undiscounted costs and benefits from the project is presented in Figure 11 below.

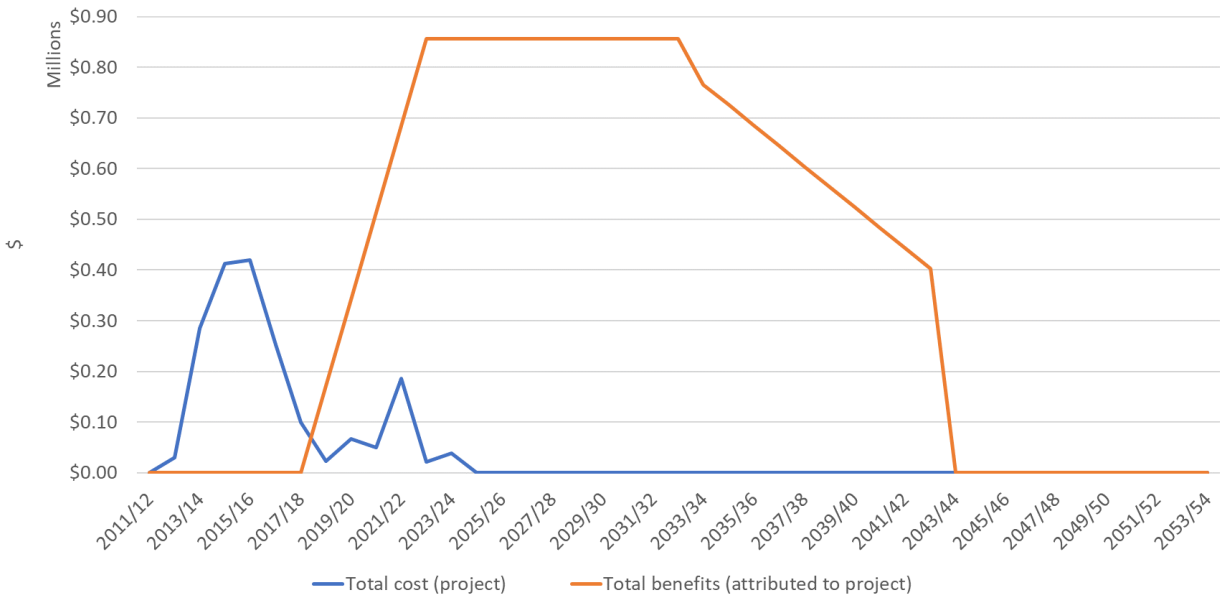

Figure 11 Flow of undiscounted costs and benefits from the project.

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 are presented in Table 97 and show that NPV ($M) remains positive across all scenarios.

Table 97 Sensitivity analysis

Changes to key variables	NPV ($M)	BCR	MIRR
Standard assumption	10.46	5.4	8%
Discount rate			
4%	11.16	5.6	8%
6%	9.84	5.1	9%
The proportion of recreational fishing value in Murray-Darling Basin attributable to the Murray Cod			
10%	4.32	2.8	7%
30%	16.60	7.9	7%

Confidence ratings

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 98.

Table 98 Coverage and confidence ratings

Factor	Rating	Comment
Coverage of benefits	Medium	Broader social and environment benefits have not been valued. The quantification of the cost savings from the project have also been limited to efficiencies in conducting stock assessments.
Confidence in assumptions	Medium	Assumptions around the value of recreational fishing for Murray Cod are considered reasonable based on prior published research.

Conclusions

Project 2013-022: Integrating Fisher-Derived and Fishery Independent Survey Data to Better Understand and Manage the Murray Cod Fishery in the Murray-Darling Basin contributed to the future management of Murray Cod populations by developing and testing cost-effective sampling methods. Sampling techniques are expensive, and invasive and often capture probabilities that may be inconsistent or low which leads to uncertainty in data available for managers. The project found that there is a case for utilising angler-based citizen science data collection as opposed to traditional methods, and that there can be efficiencies from boat electrofishing use and improved quality of data obtained. Importantly, the project contributed to strengthening relationships among researchers, managers and anglers, and made research findings that will lead to overall improvements in the management of Murray Cod recreational fisheries.

Based on the adopted assumptions total FRDC investment will provide a positive net economic return (BCR of 5.4), which remained positive under all modelled scenarios. The delayed timelines arising from changes in the project investigators inflated the project costs due to conversion to present-day values.

References

MDBA (Murray-Darling Basin Authority). (11 December 2023). *Fish.* The Australian Government. https://www.mdba.gov.au/basin/plants-and-wildlife/fish

Victorian Fisheries Authority. (01 June 2021). *Economic Study of Recreational Fishing in Victoria Murray Cod Assessment.* https://vfa.vic.gov.au/about/publications-and-resources/fisheries-reports/your-licence-fees-at-work-reports/2009-2010/economic-study-of-recreational-fishing-in-victoria-murray-cod-assessment

National Murray Cod Recovery Team. (2010). *National Recovery Plan for the Murray Cod Maccullochella peelii peelii*. Department of Sustainability and Environment, Melbourne. https://www.dcceew.gov.au/sites/default/files/documents/murray-cod.pdf

Kind, P., Baumgartner, L., Beitzel, M., Brown, P., Butler, G., Forster, A., Hutchison, M., Jaspirizza, S., Koehn, J., Kpwitz, L., Lintermans, M., Loats, R., Lyon, J., McPhail, J., Teakle, P., Todd, C., Turnell, P., Westaway, C., Ye, Q. (October, 2021). *Building a Stronger, More Resilient and Sustainable Murray Cod Fisheries.* NSW DPI – Fisheries Final Report Series No. 161. Project 2023-022, prepared for FRDC and provided to GHD Commercial in Confidence.

Acknowledgments

GHD would like to thank Chris Izzo, Project Manager at FRDC for their guidance and feedback throughout the impact assessment process. GHD extends particular thanks to Qifeng Yi, Co-Investigator from South Australian Research and Development Institute (Aquatic Sciences) (September 26th, 2024) for their time during the project's consultation phase.