

CSU Sustainability Grant Project Report

(Dot point answers are acceptable)

1. Title of project: How does behaviour influence the survival and fitness of Murray Cod in the Murray-Darling river system?

2. Project aims:

1	Collect juvenile Murray Cod from different rivers and fish hatcheries to determine whether individual fish exhibit differences in behavioural traits
2	Assess the flexibility of behavioural traits
3	Investigate the relationships between behavioural traits and phenotype

3. Project team and other key stakeholders:

<i>Name</i>	<i>Position</i>	<i>Department</i>
Raf Freire	A/Prof in animal behaviour and welfare	ILWS and SAVS
Keller Kopf	Research fellow in fish ecology	ILWS and SES
Leia Rogers	B Anim Sci (Hons)	SAVS
Ellie Sales	B Anim Sci (hons)	SAVS

4. In what year/timeframe did you receive funding for your project?

<i>From:</i>	<i>October 2018</i>	<i>To:</i>	<i>October 2019</i>
--------------	---------------------	------------	---------------------

5. Inputs: budget versus actual expenditure

Please complete the below table if you are unable to attach the grant acquittal statement.

<i>Expenditure item</i>	<i>Budgeted amount</i>	<i>Actual spent</i>
Personnel	3610	1030
Equipment	1050	2468
Travel	2660	2979
Fish from hatchery (not included in application)	0	826
TOTALS:	7320	7303

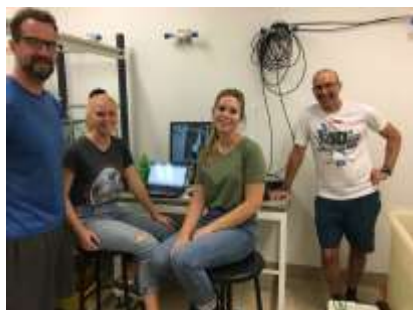
6. Project timeline:

Step	Brief description of activities implemented	Timing
1	Animal Care and Ethics and NSW parks and fisheries collection permits	End January 2019
2	Pilot study to develop behavioural tests	End March 2019
3	Collection of Murray Cod from River systems	End May 2019
4	Completion of laboratory study	End June 2019
5	Submission of end-of-project report	September 2019
6	Submission of paper for publication and press release	November 2019

7. Headline project achievements:

1	Hatchery-reared Murray cod are bolder than wild fish, which is likely to significantly impact their chances of survival when released
2	Decision-making in Murray cod is controlled by mechanisms similar to human emotions, termed affective states in animals, which suggests that behaviour is flexible and can be modified through rearing practices.
3	Comparison of Murray cod and carp behaviour indicates that the life history of native fish species needs to be carefully considered to determine the best approach to conservation.

8. Photographs/images: (Please attach before and after on ground activities, if relevant)



9. Project outputs: (As agreed to in the proposal Eg. courseware, tangible tools, maps, infrastructure, signs, catalogue etc.)

1	<p>Dissemination of findings:</p> <p>Accepted:</p> <p>Rogers, L, Sales, E, Kopf, RK and Freire, R (2019). Behavioural assessment of Murray cod decision-making and implications for conservation and welfare, Australian Society for Fish Biology, national</p>
---	---

	<p>conference, Canberra 14-18 October. (RF to present)</p> <p>Submitted:</p> <p>Rogers, L, Sales, E, Shamsi, S, Kopf, RK and Freire, R (submitted). Aggressive encounters leads to a negative affective state in fish. <i>Biology Letters</i>.</p> <p>Rogers, L, Sales, E, Shamsi, S, Kopf, RK and Freire, R (submitted). Aggressive encounters leads to a negative affective state in fish. Australian Freshwater Sciences Society. Waurn Ponds, 1-4 December. (LR to present).</p> <p>Sales, E, Rogers, L, Freire, R, Kopf, RK. Links between behavioural traits, phenotype and life history in freshwater fish. Australian Freshwater Sciences Society. Waurn Ponds, 1-4 December. (ES to present)</p> <p>In preparation:</p> <p>Sales, E, Rogers, L, Freire, R, Kopf, RK. Hatchery-reared threatened fish are bolder than invasive species. <i>Behavioural Ecology</i></p> <p>Freire, R, Sales, E, Rogers, L, Kopf, RK and Shamsi, S. Comparison of parasitic infection in wild and hatchery-reared Murray cod. <i>Parasitology research</i>.</p> <p>Lastly, We expect this project to be of interest to the local community, especially anglers, and would aim for a press release. As scientists, we would prefer if this is at the same time as our work is published in scientific journals.</p>
2	<p>Increasing capability in fish ecology:</p> <p>In addition to RF beginning to develop a track record of publications in this area, Leia Rogers will apply for a CSU post-graduate scholarship to continue research in this area in October 2019.</p>
3	<p>Basis for external funding:</p> <p>We have spoken to one stakeholder already (Taylor Hunt, Victorian Fisheries Authority). We have also started discussions with Cameron Westaway and Matthew McLellan of NSW DPI fisheries and will meet with them in the coming month. Our aim in the short term (this year) is to submit a grant application and in the longer term (2021) an ARC linkage grant. We are very committed to continue to build this area of research and gain support from external agencies, and thank CSU green for the opportunity to build a track record for us to show our capability to these stakeholders.</p>

10. Project outcomes:

- a. Participant/stakeholder **reactions** *(Include any quotes or feedback from stakeholders positive or negative.)*

I have spoken with Taylor Hunt, Fisheries Manager at the Victorian Fisheries Authority. Taylor was interested to hear of our work and we discussed future grant applications.

- b. To what extent has your project contributed towards any changes in **knowledge, attitudes, skills and aspirations** regarding sustainability? *(Please summarise your evidence.)*

In the six year period between 2009 and 2015, 84 million freshwater fish were released into Australian waterways to increase the populations of native fish species, though the impact of such re-stocking is largely unknown. Our project at this stage has mainly contributed to knowledge around the topic of the effectiveness of re-stocking rivers with hatchery-reared fish in order to increase the population of native species. Our findings clearly show that hatchery-reared Murray cod behaved very differently to wild Murray cod. Hatchery-reared fish were more “bold” than wild fish, as indicated by our tests which showed that they emerged from a shelter more readily and were less careful of bigger fish which were potential predators. These behavioural traits are likely to significantly impact the ability of hatchery-reared fish to survive when released. We expect these findings to fuel discussion around the approach taken to enhance wild fish populations in our local waterways.

- c. To what extent has your project contributed towards **behaviour change** around sustainability? *(Please summarise your evidence.)*

As our findings reach fisheries managers, scientists and other stakeholders, we hope to see discussion and changes to hatchery rearing practices to maximise the benefits from fish re-stocking programs.

- d. **Impact – The most significant change** approach involves generating and analysing personal accounts of change and deciding which of these accounts is the most significant – and why.

We expect to see an impact of our work in due course as we release our findings. We are planning to present at two national conferences (in October and in December) and this will provide an opportunity to gauge the perception and impact on stakeholders.

Briefly **list the changes** that occurred as a result of this project. *(Positive and/or negative)*

As mentioned above, it is early days to report changes, but we are working towards:

1	Investment and changes to hatchery practices to maximise the survival of hatchery-reared fish after release
2	Monitoring of river systems to assess the impact of re-stocking efforts on fish populations
3	Developing new approaches to enhance the population of fish in our local waterways.

- e. Select one change that you feel is **the most significant change** and **explain why** you selected this change? *(Justify)*

Our results confirm that hatchery-reared Murray cod are mostly ill-equipped to survive in wild environments. Our findings show that it is however possible to alter behaviour, most likely by modifying the rearing environment to produce fish that are better at surviving after release. In due course, we would hope to see changes in hatchery practices which enhance post-release survival.

- f. Briefly describe what was the situation like **before** your project?

Hatcheries take care to breed from suitable fish, but there is otherwise little evidence that they consider post-release survival in their operations. We hope to change this practice as our work and discussions continue.

11. Amendments to the project - What did not go so well?

1	The facilities in Albury restricted the number of fish we could keep at any one time. CSU and Faculty funding has now been secured to improve the fish facilities.
2	We received assistance from one student as part of her workplace learning commitments, but we could have done with more assistance. This wasn't so much a problem, but rather a recognition that if we'd had more assistance, we could have done even more work and extracted even more from this project.
3	

12. What were the key lessons learnt?

1	Fish behaviour is flexible and it should be possible to alter the hatchery rearing environment to enhance post-release survival
---	---

2	(And rather specialised). Fish decision-making is controlled by affective states.
3	

13. Recommendations for the future:

1	Murray cod rearing practices should consider the behaviour of fish in order to maximise the conservation benefits of re-stocking programs for our local waterways.
2	
3	

Please call Kym Witney-Soanes (34226) at the CSU Green Office if you have any issues populating this template.
Send your completed report to