June 2021

LATERAL LINES

Australian Society for Fish Biology Newsletter

In this issue…..

Cover picture: A jungle perch by Brendan Ebner

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ASFB Executive 2019-20

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Lateral Lines is the Newsletter style journal for the Australian Society for Fish Biology (ASFB), published twice a year. It welcomes contributions from all its members. The ASFB was founded in 1971 with the aim of ‘promoting research, education and management of fish and fisheries and providing a forum for the exchange of information’.

Contributing to this issue

Brendan Ebner

Brendan Ebner is a fish ecologist working for TropWATER, James Cook University and is also a Visiting Scientist with CSIRO Land & Water in Atherton, Queensland. The scope of his work is basic fish biology and ecology focussing on understanding the niches of rare and threatened species.

Also contributing to this issue of *Lateral Lines* is……

Dr. Katie Doyle

Katie Doyle is a freshwater fish scientist at the Institute for Land Water and Society, Charles Sturt University with a research focus on invasive species ecology, fish migration and passage, otolith microchemistry and fish conservation.

Professor Lee Baumgartner

Lee Baumgartner is a Professor of Fisheries and River Management at the Institute for Land Water and Society, Charles Sturt University with research interests in fish passage and fish migration, the impact of human disturbance on aquatic ecosystems, developing solutions to global challenges in water resource management and the connections between people and inland fish.

Dr. Maggie Watson

Maggie J. Watson is a Lecturer in Ornithology at Charles Sturt University teaching into the Masters of Environmental Management program and has a research focus on parasites, immune function and species limits in the *Euastacus* crayfish, parrots and terns.

Professor Darren Baldwin

Darren S. Baldwin is the Principal of the environmental consultancy 'Rivers and Wetlands' and an adjunct at Charles Sturt University. He has nearly three decades experience in freshwater ecology—in particular understanding the factors affecting the movement and transformation of energy and nutrients in inland waterways.

Contributing to this issue

Also contributing to this issue of *Lateral Lines* is……

Luke Pearce

Luke Pearce is currently employed as the Fisheries Manager with NSW DPI Fisheries for the greater Murray region based in Albury. This role entails the implementation the aquatic habitat protection provisions of NSW Fisheries Management Act, to protect and enhance habitat for aquatic species.

Dr Dean Gilligan

Dr Gilligan is a Senior Research Scientist in Threatened Species, state-wide freshwater fish monitoring, environmental flows, threatened species biology and recovery, carp impacts and control, population genetics and species distribution modelling with the Freshwater Ecosystems Research unit with DPI Fisheries has had a 22 year career.

Professor Abigail Elizur

Professor Elizur joined the University of Sunshine Coast in 2004, she has built an internationally recognised research group with a major focus on the development and implementation of novel tools in the field of reproductive technologies in aquaculture species.

Dr Katherine Cheshire

Dr Cheshire is the Research Leader for Freshwater Ecosystems for 15 years I have worked in the interface between research and management/policy in delivery of freshwater flows and management of native fish.

Contributing to this issue

Contents

Inside this issue of *Lateral Lines*....

Editorial

Hello and welcome to the June 2021 newsletter! A very interesting edition with some great feature articles where we hear about the impacts the bushfires have had on our freshwater ecosystems, creating an ocean literacy toolkit, reestablishing a wild Macquarie perch population and a great article on photography I managed to coax out of Ebb.

We have some fantastic information in our state reports, with a lot of exciting work happening in NSW in particular.

It is also amazing to see a couple of articles under our Arts and Science section with Gina Newton kicking huge goals in the literary world! The fishy world is filled with talented artists (writers, illustrators and photographers). If you are one I really encourage you to submit to future newsletters!

Our Student Spotlights show off the great minds coming up in research, with some amazing work underway around Australia.

I hope you really enjoy this edition of *Lateral Lines*. Please keep sending me feedback or ideas on how you would like this newsletter to look. Enjoy everyone!

President's Preamble:

Happy Birthday to us!

2021 is a special year for our Society, as we celebrate our ***50th anniversary!!*** Thanks to our amazing 50th group, ably led by **Ebbs**, we have several activities planned to bring us together and to help us celebrate. To start with, have you checked out our website, where we're collating stories, images, and perspectives from members? We invite ASFB members, past and present, to help fill the gaps in our history by sharing their memories. We'll also celebrate with a few souvenirs (more details coming soon) and a special dedicated celebration evening at the World Fisheries Congress in Adelaide. So get amongst it – and help us all celebrate this great society and enjoy its past, present and its future!!

Of course, we're all getting very excited about the upcoming World Fisheries Congress, in Adelaide in September. Over two years in the making (thanks to the pandemic!), the Congress is shaping up to be

the biggest fisheries event in Australia in many years. We received over 1400 abstract submissions, and a draft program is now available on the website. There will be both live streamed sessions for global reach and traditional in-person sessions, and lots of other activities such as workshops, trade-booths, cooking demonstrations and social events. workshops, trade-booths, cooking demonstrations and social events. Early bird registration ends July 30th. When you register, don't forget to check the box that you want to attend the ASFB 50th celebration mixer on the Tuesday night. I hope to see as many of you all there as possible.

The June newsletter is packed full of exciting stories and feature articles to help us all explore what we've all been up to over the last six months. I'd encourage all members to consider writing a feature article or a small contribution to the State reports. Or if social media is more your style, check out our fantastic facebook page, twitter feed and blog. Our comm's team, **Andrew Katsis and Nick Boucher**, do an amazing job and are always keen for more stories.

In terms of other Society business, the Executive Council has been working on several new issues recently including: updating the membership database, revising the non-student awards, updating our website, the potential formation of a fish welfare committee, and considering how best we can attract and retain members. Executive council membership will be up for renewal at the next Annual General Meeting, so please get in contact with your current State members if you're interested in being involved.

This is my last "President Preamble" for the Newsletter before handing over the reigns to Gretchen Grammer, as our incoming president. So I would like to take this opportunity to sincerely thank everyone who I've worked with over the last two years— especially the two executive councils, our Sub-Committee Chairs, the Future of Society group, 2020 virtual conference committee, and the 50th Anniversary committee. I'm incredibly proud of what we've all collectively been able to achieve in very interesting, if not challenging, circumstances. In particular, I'd like to single out a few people who have been absolutely by my side over the last two years: **Harry Balcombe, Gretchen Grammer, Brendan Ebner, Charles Todd and Lenore Litherland**. I can't thank you all enough for your support, dedication and hard work.

Finally, I hope to see many of you in Adelaide in September, where we can share fishy stories, fishy science and management successes, have a few laughs and discuss the future of our fabulous Society.

Regards

Alison King

ASFB President

World Fisheries Congress

Abstracts for the 8th World Fisheries Congress abstracts have now been finalised and preparations for an exciting program are now under way.
The Congress will be held at the Adelaide Convention Centre from 20 to 24 September 2021, situated in the heart of Adelaide, South Australia and be available to delegates- in-person and online.

The program showcase selected leading intelligence of over 1,400 abstract submissions from the fisheries community across the world addressing sustainable fisheries, fish and aquatic ecosystems, fisheries and society, and the future of fish and fisheries through a technology innovation lens.

The Congress program will centre around the theme of 'Sharing the World's Oceans and Rivers,'.

The Opening Address to be given by the United Nations Special Envoy for the Ocean, Ambassador Peter Thomson, will focus on the Congress theme in relation to the United Nations Sustainable Development Goal 14, conserve and sustainably use the oceans, seas and marine resources for sustainable development.

Earlybird registrations are available until 31 July. Register at www.wfc2021.com.au

Gavin Begg

Chair, World Fisheries Congress

World Fisheries Congress 2021 Student Video Competition: Submissions Open Now!

Capture the audience of the World Fisheries Congress hook, line and sinker with your creativity and production aesthetics in a 3-minute showcase of your research area.

Entrants will be in the mix to grab themselves a $2,000 AUD prize (sponsored by the Harry Butler Institute, Murdoch University).

The Australian Society for Fish Biology (ASFB) is also offering an additional $1,000 AUD to the top ranked entry submitted by and (ASFB) student member. To be in the hunt for this additional prize pool, sign up for an ASFB student registration.

Visit Video Competition - World Fisheries Congress (wfc2021.com.au) for more information.

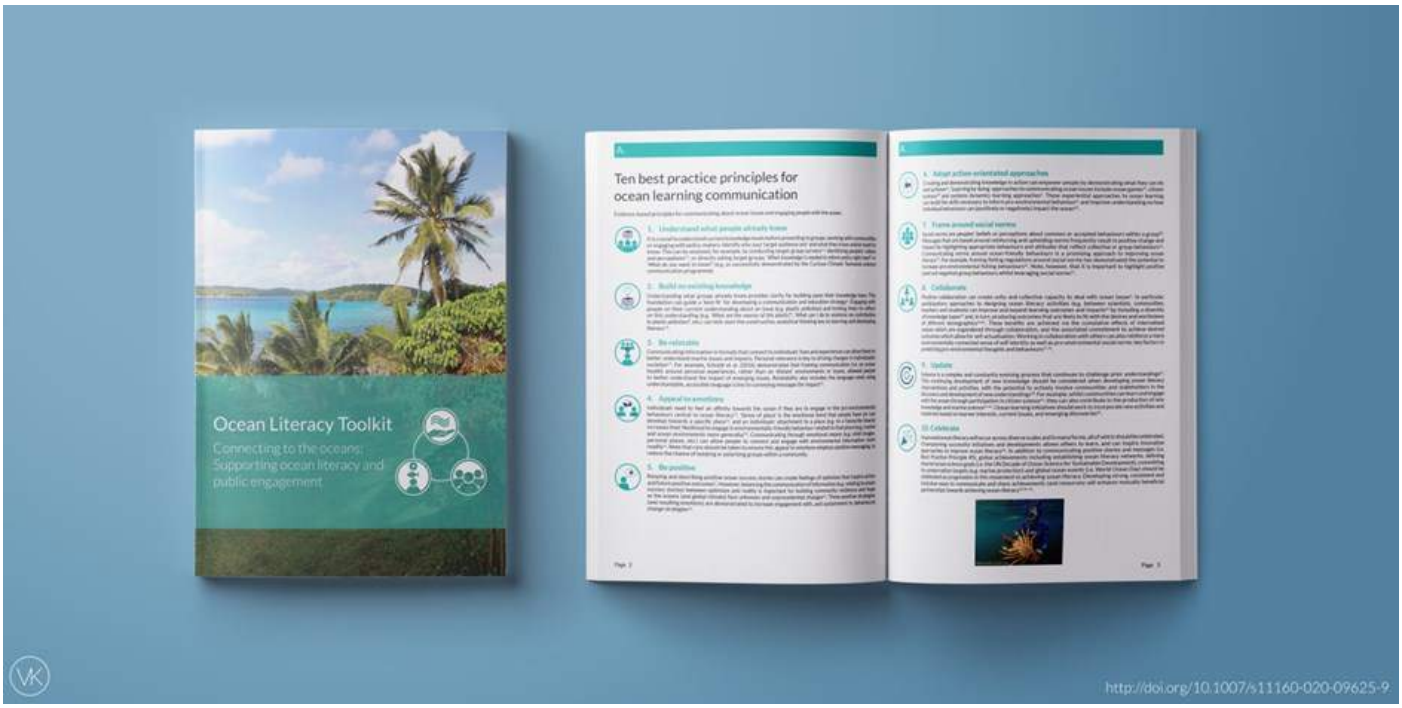
Connecting to the oceans: supporting ocean literacy and public engagement

Rachel Kelly, Karen Evans, Gretta T. Pecl

DOI: 10.1007/s11160-020-09625-9

Our recent paper *"Connecting to the oceans: supporting ocean literacy and public engagement"* is a collaborative perspective on ocean literacy and its role in achieving the outcomes defined by the UN Decade of Ocean Science for Sustainable Development (2021-2030), which commenced this year.

This paper was developed and evolved through the Future Seas 2030 initiative, which was spear-headed by the Centre for Marine Socioecology at the University of Tasmania. The large interdisciplinary collaboration brought together over 130 researchers from in and around Australia, as well as Indigenous representatives from around the world. It aimed to identify key ocean challenges and develop interdisciplinary teams who could develop evidence-informed narrative scenarios to envision what is needed to achieve 'the ocean we need for the future we want'.



Our team - which included members with expertise in marine ecology, marine socio-ecology, oceans policy, marine social science, climate impacts, ecosystem modelling, oceanography, environmental communications, psychology, philosophy, public health, maritime logistics and transdisciplinary science – focused on the challenges of connecting people with the ocean today. These challenges include a lack of awareness and understanding of the ocean and its role in sustaining society, associated with increasing urbanisation, 'indoor lifestyles', and disconnectedness from nature.

The aim of this specific collaboration was to synthesise existing knowledge and perspectives on ocean literacy from a range of disciplines and sectors.

Through a series of workshops held in Hobart, Tasmania in 2018 and 2019, the project team worked together to identify four key drivers for improving ocean literacy globally:

1. **Education** – including formal and informal ocean learning, and through activities including citizen science, National Science Week, and media such as film and television.

2. **Cultural connections** – recognising the need to value and incorporate Indigenous, traditional, and intergenerational knowledge in marine decision-making, and highlighting the role of ocean sports and recreational activities (i.e., surfing, fishing) in connecting people to the ocean.

3. **Technological developments** – using technology and social media to educate and engage broader audiences with marine environments, to inspire and motivate pro-environmental behaviours (e.g., plastic use and pollution).

4. **Knowledge exchange and science-policy** – emphasising a need for ocean literacy to be integrated in policy, and identifying means (e.g., knowledge brokering, participatory approaches) to achieve this.

Building upon these drivers, we developed an **Ocean Literacy Toolkit** which combines theoretical approaches to learning, frameworks for understanding communities and assessing ocean literacy activities, as well as practical examples of existing ocean literacy activities. When ocean literacy activities are tailored to relevant issues and communities, they increase community learning and engender attitudes of concern that can promote personal action.

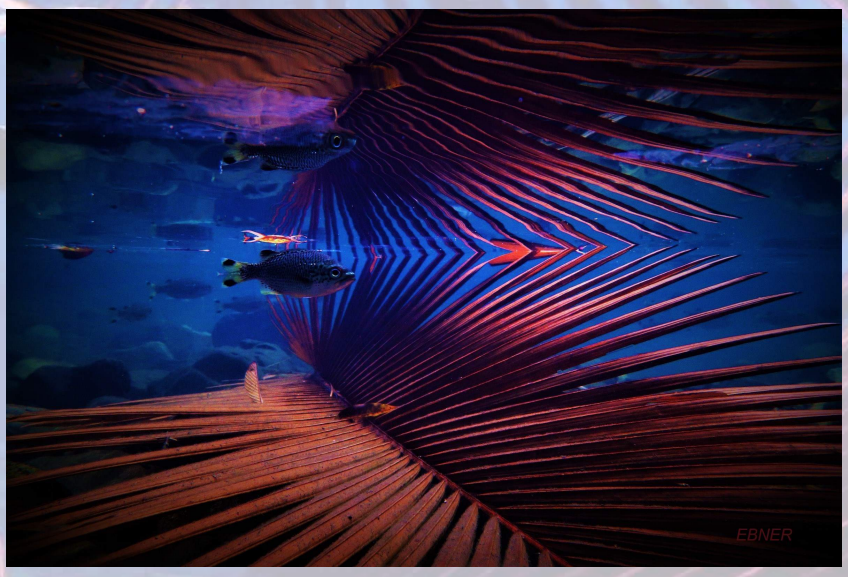
Dirty Divers and Freshwater Zen

By Ebb

ASFB Newsletter Editor Nick Boucher asks me to whip up an article because apparently, we are a bit light on for contributions this season. I respond, 'As long as you aren't after high quality, I can be your filler.' A few days later, and in the uncustomary space of not having much to say, I return and ask Nick what he wants me to write about. He replies, 'Anything as long as it has pictures.' 'Our readers love pictures'. So, my reflex is to think facetiously, 'Well that narrows the search down.' 'At least he is not a controlling editor I suppose, nor a micromanager from the salt mines.' Mmm this is what they term writer's block.

Well first paragraph is written, and the reader has been bored into a trance. Ok Nick says pictures are the key. Righteo, I flip back through my amateur underwater photography collection, and stumble across a few crackers (see Image 1), a small group of photographs are huddled together in what I would class as Ebner-A material. Then there are many folders comprised of several 'almost photos' (B's), and yet myriad folders full of type C. The latter are best described as 'well at least it shows the fish was present in that murky stream on an overcast day' type of shot.

So, what can I say about my journey with taking underwater images in the past ten years or so? First the disclaimer. I am not that long-off having handed in my learners' plates, so professionals can feast on a carcass elsewhere . In the beginning of my underwater photo journey, I recall asking long term ASFB stalwart, David Harasti, for advice on purchasing a camera. Dave takes seriously great shots, so go look at his website (www.daveharasti.com) if you want to get lost in underwater images of fish, sharks, seahorses, and more seahorses. At that time, I was not wealthy, and Dave really helped me. He basically said,



Above. *A jungle perch let us call him Michael Hutchence, enters a scene from an INXS clip, with back up musicians in the background. Who said native freshwater fish don't have the X-factor.*

'most upper range non-SLR's at the time will take a good shot. It is more about getting hours under the belt and working the craft'. We agreed that because I was mostly in very shallow streams that the portability of a camera was a key factor.

Right. *A school of Bony herring shimmer by in a dirty waterhole.*

Harasti-A shots are a bit of a space continuum apart from Ebner-A shots, but I am profoundly grateful for the advice Dave gave me back then. And more recently, I sat in on Dave's underwater photography tutorial at the 2019 conference in Canberra where we co-hosted a Fish Art and Imagery Workshop with Maggie Watson and Lindsay Marshall. It was an enjoyable workshop which had a really neat cross-section of fish people celebrating and trading tips on visual images of all different sorts.

Anyways, the first few years I really enjoyed getting out on weekends and photographing tropical native freshwater fish in the Cairns area. Most days I would take a bunch of shots and excitedly view them at home on the computer at the end of the day. I would save most of them in folders and feel a little dejected at how I was not doing the animals justice. One of my private frustrations was that because I could draw a bit, I naively thought I'd be ok at photography. But a few years into it I realized that I was not a natural photographer, and that drawing from the imagination was quite different to capturing what was directly in front of me. Eventually, I started crafting a few images and getting a feel for the manual settings of the camera and perhaps more importantly reading the environmental conditions.

Above. *Self-portrait at home photographing catfish in the Wet Tropics.*

Eventually I learnt that some days it just was not going to be a day for great photos. Either the weather was rubbish or the fish at a given location were not playing along, or a combination of the two. But I did start to get a good eye for when the magic was going to happen. Occasionally, the light was good the fish revealing stunning colours and quirky behaviours, and hopefully I was steady and calm. Shooting rapid fire seems connected with my frenetic side, but calm is king.

I started getting reasonable shots of the diver positive species and even started capturing shots of the shy species. And every now and then something new happens, and I realise all those hours underwater start to give me a new excitement, a new appreciation for subtleties in the fish assemblage and its sense of all of us, together in the water in the moment. A less glamourous interpretation is that as I get old and my basketball associated joints ache, all that I now have to fall back on is the claim of many miles on the clock watching fish in the wild.

Speaking of aches, the cool water seems to be soothing for them, good for the skin and good for the soul. Certainly, getting underwater puts me in a better state of mind when not all is rolling my way at work, or

grinding through the everyday challenges of stuff. We all have stuff, but how do I stop from becoming the whining complainer and champion of such stuff? Well, I hope that me sharing a few images is a small step in the right direction.

So by way of a quick mention of three images at the close of my rambling: Image 1 is just funky and arty and pretty vibrant for a shot taken in a darkened rainforest stream in just a foot of water. Image 2 is one that probably looks boring as hell to a coral reef biologist but I spent many weeks trying to capture this shot of a bony herring in context in dirty water where they often frequent. The bony brigade got to know me, and this shot really speaks to the niche of that species. Getting close enough to capture the scale patterns in natural sunlight but also capturing the murky water, is something that will win zero awards but makes me proud. And Image 3 is a recent one of me photographing catfish. This image took a couple of days to gain the trust of a shoal of catties, demonstrating that the time spent getting to know one another occasionally pays off. I suppose it is the time watching fish that anchors me and presumably many of us to the fishes that we love, study, and manage. Big shout out to Dr Harasti, his latest tip that I gleaned was getting people into some of the images.

Long-term effects of the 2019–20 Bushfires—water quality and Murray crayfish

Authors: Luke Pearce[1], Maggie J. Watson[2,3], Darren S. Baldwin[2], Katie Doyle[3], Lee Baumgartner[3]

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[2] School of Environmental Sciences, Charles Sturt University, Albury NSW

[3] Institute for Land Water and Society, Charles Sturt University, Albury NSW

Above. *A Murray cray—sadly deceased.*

The Black Summer fires of 2019–2020 hit hard—as of 9 March 2020, the fires had burnt an estimated 18.6 million hectares across Australia, and an estimated three billion terrestrial vertebrates were affected [1]. None of our freshwater animals were included in this estimate of death and displacement because of a lack of baseline data on their densities [2]. However, the immediate and devastating aftermath of the fires on our freshwater river systems were documented as hundreds of thousands of fish suffocated or starved in at least 14 separate fish kills [3][4] and countless invertebrates were seen crawling out of the ashy, oxygen-less sludge and dying [5].

Twelve months later and sixty kilometres downstream from the Talmalmo/Green Valley Fire along the New South Wales-Victoria border, another story linked to these fires began to unfold…

Concerns regarding poor water quality being released in the Murray River below Hume Dam near Albury, NSW were first identified by staff from the Hume Hydropower Station when they observed Murray Crayfish *Euastacus armatus* leaving the water and detected a strong sulphur smell on the 17th of February 2021. Generally, Murray Crayfish leaving the water is a response to low dissolved oxygen (DO) levels linked to hypoxic events associated with flood events further along the catchment. However, this event appeared quite unique with the cause at the time unknown.

Right. *A dead Murray cod in the Upper Murray — dying in the recent bushfires*

Inspections undertaken by NSW DPI Fisheries staff from the 19–21 February 2021 identified large numbers of Murray Crayfish leaving the water and numerous dead individuals lying on the bank. The DO levels were measured as low as 2.01mg/L and 23.5% saturation. Given that the trend in the DO levels was decreasing and the crayfish, many of which were quite large individuals (some in excess of 138mm OCL), were at significant risk to predation from birds and humans or were likely to become desiccated and die, the unprecedented decision was made to collect as many of the vulnerable crayfish as possible and hold them in captivity. The idea was that these crays would be held either until the water quality improved at the site or a decision was made to relocate them elsewhere with suitable water quality.

A total of 41 crayfish were collected and taken to The Fish Ecology Collaborative Research Unit's (FECRU) dedicated fish laboratory at Charles Sturt University (CSU) for safe keeping and recuperation. All of the crayfish that were collected were in very poor health, many were quite weak (unable to right themselves even in water) and all showed extensive staining on their exoskeleton. The staining was rust (either iron oxide or iron oxyhydroxide) [6] rather than melanisation of the carapace, as happens during an immune response in crayfish [7]. Like all solid objects in water, the exoskeleton of crays are coated in biofilms and in the biofilms there are bacteria that can oxidise reduced iron precipitating it out on the biofilm. It was the rust colour that hinted at what might be happening downstream of the dam with the water quality.

Right. *Rescued Murray crays. Photo credit: Luke Pearce.*

Left. *A stained Murray crayfish claw with the tape removed. Image credit: Lee Baumgartner*

Once rescued, the crayfish were transported under wet towels and moved into in two large tanks in a locked facility on the CSU campus. Initially the water was at 19°C, but as that is at the high end of the temperature tolerance for Murray Crayfish, chillers were used to drop the water temperature to 17°C over several days. They were fed

ad libitum fresh vegetables and provided PVC tubes and tubs for shelter. .Interestingly, some of the crayfishes' ectosymbiotic Temnocephalan flatworms [8] were able to survive the poor water quality. Over the time the crayfish were in captivity, the flatworms were observed dropping to the bottom of the PVC tubes and moving from host to host.

While the crays were being nursed back to health, investigations were undertaken to determine the cause of the poor water quality. Impacts on water quality had been flagged as an important and understudied impact of bushfires in a 2011 review done for the Australian Government Department of Sustainability, Environment, Water, Population and Communities [9]. This review found that large post-fire inputs of sediment and ash into streams resulting in low dissolved oxygen was the greatest threat to aquatic ecosystems following a fire. Most of their results indicated that post-fire pulses of sediment in waterways occurred soon after the fire resulted in many detrimental effects on the waterway, but quickly righted. There was no information on the longer-term impacts of fire on water quality in this report. More worryingly, a report, as part of an on-going assessment of water quality entering into Lake Hume from the 2019–20 fire fields, showed that even 18 months after the fires had been extinguished, large loads of sediments and associated constituents (particularly carbon) were still being flushed into Lake Hume with each large storm event [10].

Satellite imagery showed that high sediment laden water had passed through the lake along the old river channel and became integrated into the stratified sections of Lake Hume. Under normal circumstances and in most years, Lake Hume stratifies over the summer—the surface waters are warmed by the hot summer sun (epilimnion) and the bottom water stays cold (hypolimnion) and the two layers do not mix.

Above. *A large rescued female Murray crayfish with its claws taped. Image credit: M Watson*

Below. *Released Murray crayfish. Photo credit: Katie Doyle*

Because the bottom waters are not in contact with the atmosphere, the oxygen levels in this layer began to fall and became anoxic.

There are a number of bacterial groups that can survive in the absence of oxygen, instead they use chemicals like iron (Fe), manganese (Mn), sulfur (S) and nitrogen (N) for respiration—producing ferrous iron (Fe^{2+}), manganous ion (Mn^{2+}), sulfide (S^{2-}) and ammonium ion (NH_4^+) respectively. There was a significant increase in the carbon load (greater than 300 tonnes/week) entering the Lake since the fire, especially in early February 2021, this carbon was most likely metabolised by the anoxic bacteria producing compounds that react with oxygen (especially Fe^{2+} and S^{2-}), removing the oxygen from solution.

When these compounds in the water were released from Lake Hume, they reacted with the oxygen to deplete the DO levels within the released water, creating a hypoxic event. As a further stressor, sulfide itself (the smell the Power Station workers identified) is toxic to many organisms and may have contributed to the Murray Crayfish leaving the water.

Hypoxic events have previously been identified as one of the major factors involved in population decline in Murray Crayfish [11]. Murray Crayfish are a large, slow-growing, and long-lived freshwater crustacean that are listed as threatened throughout their entire range (Vulnerable in New South Wales, Endangered in Australian Capital Territory, Near Threatened in Victoria, and Protected in South Australia). The Murray Crayfish is still recreationally harvested despite experiencing a substantial decline in distribution and abundance over the past 50 years [12].

On the 31st of March 2021, 40 Murray Crayfish (27 females, 13 males) were returned to the wild after water quality monitoring both within the Lake and downstream clearly showed that the Lake had de-stratified and the dissolved oxygen levels had recovered to acceptable levels. Waiting for the seasonal de-stratification to dissipate was probably more important than release location in this case. Rather than returning them to the exact site at Power Station where they were collected, it was decided to release them near the main release valves which produce a large spray arc and has well-aerated water.

As a short-term marking option, all the crayfish were marked with permanent paint numbers on their carapace. Other studies have suggested that these marks may last from 3 months to 1-year post release [13]. In a few weeks, we will begin trapping in the area to see if we can relocate any of the rehabilitated crayfish.

Right. *A happy tagged Murray cray Image credit: M Watson*

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Macca's Back in the Macquarie after a 70 year Absence

Authors: Luke Pearce, Dean Gilligan, Abigail Elizur and Katherine Cheshire

The first Macquarie perch collected by white man, was by the French naturalist Rene Lesson who collected the type specimen from Bathurst in February 1824. Fast forward about 120 years and through a culmination of anthropogenic impacts and the introduction of alien fish the species was wiped out from the catchment in which it was discovered, was named after and had resided in for over 657 thousand years (Faulks et al., 2010). Now after an absence of over 70 years Macquarie Perch have been re-introduced into their spiritual homeland of the Macquarie Catchment approx., 20km away from where Lesson collected the initial specimen almost 200 years ago!

This historic event occurred in March 2021, over 7000 Macquarie Perch fingerlings were released into the Winburndale Dam and Rivulet just east of Bathurst. The site was chosen for a range of reasons; including it's fantastic habitat, but very importantly because above the dam does not have any redfin perch, a species known to cause declines and even wipe out Macquarie perch.

Above. *The three scientist that made it happen, Dean Gilligan (NSW DPI), Abigail Elizur (USC) and Stewart Fielder (NSW DPI)*

This reintroduction was only made possible through some exciting new developments in hormone technology, developed by the University of the Sunshine Coast in a collaborative project with DPI Fisheries.

The released fish were bread at the Narrandera Fisheries Centre using this technology, which saw 100% spawning success of all females implanted with the hormone. This is a major step forward in the reliable ongoing production of Macquarie Perch in the hatchery environment and a major leap forward in the recovery of this species. Macquarie Perch are normally very hard to breed in captive conditions.

The next steps in the project are to now trial the hormone technology on other populations of Macca's and further refine some of the husbandry to increase egg and larvae survival.

This reintroduction has been strongly supported by the local fishing community in the region, with one of the risks to Macquarie perch re-establishing in the Winburndale system being a large resident population of brown trout. With the support of the local fishing club a major trout translocation event will occur this winter to try and reduce trout numbers in the system to give the Macca's the best chance at establishing. These trout won't be going to waste, they will be translocated into some nearby dams at Portland, where the will be accessible to the recreational fishing community.

Left. *Macca's being released into the Winburdale Rivulet*

We hope the continued success of this program will allow more reintroduction events in the Macquarie Catchment and which will support reestablishment and recovery of the species back in their spiritual homeland.

<u>References</u>

FAULKS, L. K., GILLIGAN, D. M. & BEHEREGARAY, L. B. 2010. Evolution and maintenance of divergent lineages in an endangered freshwater fish, Macquaria australasica. *Conservation Genetics,* 11**,** 921-934.

Right. *Macca's being released into the Winburdale Rivulet*

State Reports

Australian Capital Territory

ACT

Compiled by Ben Broadhurst & Hugh Allen

University of Canberra

The team at University of Canberra has been busy tagging trout cod to monitor and characterise spawning behaviour of a population in an upland reservoir. Tagging went well, with 17 adult trout cod now roaming the reservoir with acoustic transmitters. An array will monitor these fish over the coming spawning seasons. Also from the team at University of Canberra, adult Macquarie perch abundances in Cotter Reservoir had been undergoing a general decline since operation of the enlarged reservoir commenced in 2016. This was mainly due to a lack of recruitment whilst the reservoir was filling from

Above. *A large fish being measured before tagging and one of the transmitters use to monitor trout cod movement*

2013 – 2015. Good recruitment in 2016 and 2017 has seen this cohort now entering the size class captured by adult sampling. The coming year or two should see this increase continue.

Work on stocky galaxias (*G. tantangara* Raadik 2014) has continued in Kosciuszko National Park, with recent investigations detailing the application of small drones and high-resolution aerial photography for locating, characterising and monitoring significant barriers to fish passage in upland streams. This work was funded by the Threatened Fishes Grant from the ASFB Threatened Fishes Committee. Results are promising, and will form an critical part of selecting and assessing translocation sites for future

conservation efforts. Additionally, a paper outlining the species' reproductive ecology was published in March (Allan et al. 2021).

Australia New Guinea Fishes Association

Peter Unmack and volunteers from the Australia New Guinea Fishes Association spent a weekend out at Aramac in the centre of Queensland rescuing Edgbaston Goby from a recently capped bore. Some fish were translocated to a spring at Edgbaston, some were retained in captivity and some will hopefully persist in the remaining flow in the bore drain.

Monitoring of areas affected by the 2020 fires

Conservation Research has been busy in the areas affected by 2020 fire. The vulnerable two-spine blackfish which has declined by 80% in the fire area did show recovery in 2021 although some limited breeding was observed with significant areas subject to sediment slugs. Recently remote cold and icy bogs and streams have been assessed for Spiny Crayfish. Approximately 95% of the ACT distribution of Rieks Crayfish *Euastacus rieki* was impacted by fire in 2020 and results from scats showed very high incidence of predation even 8 months after the fire. Re-growth of vegetation in many areas has been impressive with shade cloth and coir log weirs places directly after the fire to assist bog stabilisation and recovery. A number of crayfish were caught including one berried crayfish was caught. Conservation Research will be assisting with sampling for genetic work on this species and other species of Crayfish in the coming months.

Recent publications

- Piggott, M.P., Banks, S.C., Broadhurst, B.T., Fulton, C.J. and Lintermans, M., 2021. Comparison of traditional and environmental DNA survey methods for detecting rare and abundant freshwater fish. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *31*(1), pp.173-184.
- Allan, H., Duncan, R.P., Unmack, P., White, D. and Lintermans, M., 2021. Reproductive ecology of a critically endangered alpine galaxiid. *Journal of Fish Biology*, *98*(3), pp.622-633.
- Lintermans, M., Geyle, H.M., Beatty, S., Brown, C., Ebner, B.C., Freeman, R., Hammer, M.P., Humphreys, W.F., Kennard, M.J., Kern, P. and Martin, K., 2020. Big trouble for little fish: identifying Australian freshwater fishes in imminent risk of extinction. *Pacific Conservation Biology*, *26*(4), pp.365-377.

Blackwater Events and Fish

Dr Gina Newton

Wetting and drying cycles

Australia's river-floodplain ecosystems are adapted to cycles of wetting and drying. These cycles are driven by stream inflow and flooding of adjacent land, which is in turn influenced by prevailing climate and water regulation. Wetting and drying cycles determine the two-way transport and exchange of organic and other matter (including seeds and young or dormant life stages of animals) back and forth between the river channel and the floodplain. During overbank flows, matter from the channel is transported to the floodplain where it is 'transformed' - broken down and stored. This contributes to the productivity of wetlands.

Build-up of floodplain litter

The floodplain is characterised by various zones of vegetation, ranging from the emergent plants of the riparian zone at the river's edge, through to bushes such as Lignum, and larger trees further afield, like river red gum and black box. Litter from leaves, woody debris and organic matter from this vegetation builds up on the floodplain. This is an important source of nutrients and biota back into the river channel during times of hydrological connection. But, the longer the dry period between wetting events (i.e. the dry spell), the more the build-up of floodplain litter occurs.

Above. *Keyes Pt water (left bottle) vs Tarma black-water (right bottle). DO = 5.56 vs 0.24 ppm. Photo credit: Keith Ward*

Blackwater events

Blackwater is the term given to river waters that appear black or dark brown due to high levels of dissolved organic carbon (DOC).The DOC comes mainly from leaf and woody debris from the floodplain. This is an important source of carbon, which enters the food web increasing zooplankton and macroinvertebrates, which are in turn eaten by vertebrates such as fish and birds. However, severe drought, combined with increased duration between flood events, can lead to extreme build-up of the floodplain litter load. In such cases, when large floods occur, large loads of litter are washed into the river channel – leading to a 'blackwater event'. Flooding after a severe bushfire can also lead to blackwater events, as slugs of burnt woody debris, ash and soil are washed into waterways.

Trends and influencers

Historically there has been an increase in the number of blackwater events in Australia, particularly over the past thirty years. Blackwater events are natural events, but they are influenced by a number of factors, including:

- water temperature (worse when warmer)
- types of vegetation
- the load of floodplain litter (including any extra carbon from nearby agricultural lands)

- the frequency, duration and area of inundation (flooding on floodplain)
- the duration of dry spell, including extended drought
- levels of water extraction
- bushfire, and
- the ability of river channel flow to dilute the blackwater.

Impacts

Above. *Murray crayfish crawling out from blackwater. Photo credit: Alison King.*

Impacts of blackwater events result from naturally occurring bacteria rapidly consuming the sudden windfall of nutrients including DOC. The increased microbial activity can lead to hypoxic conditions (reduced or zero dissolved oxygen in the water), as the oxygen is used up faster than it can be replaced.

Blackwater events can happen suddenly, sometimes within hours, but their impacts can last from days to months. Fish and other aquatic animals may try to escape but the speed and size of the event and the presence of barriers can prevent this. The reduced oxygen levels caused by a blackwater event can lead to the suffocation of fish. It may also lead to the emergence, and often mortality, of crustaceans such as yabbies and crayfish. At times, high levels of polyphenols, the chemicals in river red gum leaves, can also be toxic to fish.

Blackwater events may result in mass fish deaths, such as those which occurred in 2010-11 at the end of the Millennium Drought (1800 km of the River Murray) and in the southern Murray-Darling Basin (MDB) in 2016 - the wettest May – September period on record for the MDB. The Murray-Darling Basin is Australia's largest riverine-floodplain system, supporting many internationally important wetlands, many threatened species and ecological communities, and around 40% of Australia's agriculture.

Left. *Leaf art in Tarma Lagoon (Keith Ward)*

What can be done?

Only some of the factors leading to blackwater events can be controlled, although many can be considered while making decisions about water management and river operations. For example, smaller and regular watering of floodplains reduces the load of litter build-up. However, planning the release of the right amount of water at exactly the right time and place can be difficult, and sometimes there is no stored water available.

Under implementation of the legislative Basin Plan, the Commonwealth Environmental Water Holder works with MDB state governments to develop strategies to support the mitigation of blackwater events. Given the threat of climate change exacerbating both natural and anthropogenic stressors, such an adaptive management approach is essential to curtail blackwater events and support the health of our native fish. The *Native Fish Recovery Strategy*, published in 2020, has further information on supporting native fish (https://www.mdba.gov.au/publications/governance/native-fish-recovery-strategy).
To find out whether there are current blackwater events in MDB catchments, check the MDBA's water quality risk map https://www.mdba.gov.au/water-management/mdbas-river-operations/water-quality

To report mass fish deaths contact:

- New South Wales Fishers Watch hotline: 1800 043 536
- Victoria Environmental Protection Authority pollution hotline: 1300 372 842
- Queensland Department of Environment and Science: 1300 130 372
- South Australia Fishwatch Hotline: 1800 065 522
- Australian Capital Territory Access Canberra: 13 22 81

The MDBA's Fish Death Contact Officer is Greg Ringwood, on 0428 519 446 and nfrs@mdba.gov.au

Above. *Murray crayfish crawling out from blackwater. Photo credit: Alison King.*

State Reports

New South Wales

NSW

Compiled by Kat Cheshire & Joel Williams (DPI NSW)

Things are returning to the 'new' normal in NSW fish research and management with fieldwork and long-term monitoring programs resuming. Over the last six months there have been a number of significant publications and project launches.

In the marine world, NSW ASFB members have busy collaborating with their interstate counter parts publishing two large national-wide studies that highlights the value of using standardised methods that allow for this nationwide research. A number of NSW ASFB members where involved in a **continental-scale acoustic telemetry studied** and network analysis that revealed new insights into stock structure (https://doi.org/10.1111/faf.12565). This study demonstrates the value and importance of having a consistent and long-term network of data loggers across NSW and Australia. Hot off the press, a number of NSW ASFB members were involved in one of the largest marine parks studies in Australia (https://doi.org/10.1111/gcb.15635). This significant paper published in Global Change Biology demonstrate that increased connectivity and depth improve the effectiveness of marine reserves. Furthermore, NSW DPI Fisheries published their findings from a 6-year rocky reef marine park monitoring program in Ecosphere (See article page 33). The authors demonstrate higher abundances of fishery targeted species inside no-take sanctuary zone, including 2.5 times higher abundances of snapper inside no-take zones (http://doi.org/10.1002/ecs2.3447).

There is always something happening in the shark research world. In May NSW members published an article in Fisheries Management and Ecology that demonstrated the **effectiveness of Shark-Management-Alert-in-Real-Time (SMART) drumlines** as a tool for catching white sharks, Carcharodon carcharias, off coastal New South Wales (https://doi.org/10.1111/fme.12489). There was also a bit of excitement when a satellite tag that belonged to a bull shark started 'pinging' at the University of Wollongong. Are sharks going to uni? No, turns out a café owner found the tag washed up on the beach and was unsure what to do with it and this made news headlines around the country (https://www.news.com.au/technology/science/animals/shark-tag-running-around-uni-of-wollongong-campus-researchers-want-it-back/news-story/79e74f6d314286201dbc59d5caf3fa70).

Distribution of juvenile and adult pink snapper *Chrysophrys auratus*

Dr Matt Rees and a team from NSW DPI Fisheries Research have completed one of the most comprehensive biological surveys of the Greater Sydney region's coastal reefs. The team deployed over 300 stereo baited underwater cameras on rocky reef between Newcastle, Sydney and Shellharbour.

Using the dataset, their latest research has modelled the habitat associations of juvenile and adult snapper in the region. This DPI research was funded by the Marine Estate Management Strategy and has filled a significant gap in the NSW DPI Fisheries State-wide monitoring program on rocky reef fishes. To read more visit: https://www.sciencedirect.com/science/article/pii/S027277142100250X

Above. *An adult snapper observed on the baited remote underwater video camera.*

Right. *Juvenile snapper observed on the baited remote underwater video camera*

Investigator at sea! Sampling larvae of eastern Australia

Research Vessel Investigator is 150 km off Brisbane and North Stradbroke Island (3 May-4 June) to retrieve and re-deploy the 6 deep ocean mooring array, that monitors the activity of our East Australian Current.

Every 18 months the moorings are turned around, which is a remarkable process to watch. The acoustic releases allow it to float to the surface and the ship manoeuvres beside to begin winding on the 4.8 km of cable, floats and instruments. After a day of deckwork, the new mooring is slowly deployed while the ship creeps up to (and beyond) the deployment site, and then with a tug of the shackle it is "bombs away" as the 1.5 tonne stack of railway wheels gently drags the array down to the bottom.

While the mooring crew rests, the nocturnal plankton crew keep the ship busy towing a 70 cm diameter bongo net, to complement the long-term observing at the IMOS national reference mooring off North Stradbroke. Until the September 2019 voyage, there has never been a survey of larval fish off SE Queensland, when PhD student Charlie Hinchliffe and the IMOS researcher Dr Paloma Matis discovered a multitude of sardine, anchovy and mackerel (Scomber) in a frontal eddy, that scooped them off shelf just south of Fraser Island. This year we have a similar feature of a big cyclonic eddy just east of North Stradbroke Island, which we will sample next week as we head inshore, to pick up moorings closer to the shelf. So far we've had calm weather so we may have some spare time to explore the Fraser Island Eddy.

RV Investigator is a fantastic ship, just returned from a successful krill study in the Southern Ocean. With 300 operational days per year it seems to be doing everything, as it heads north to Darwin and Fremantle after us. Our voyage left Hobart last week and we sampled adjacent to the Maria Island mooring near Hobart (37 degrees S); then the Port Hacking mooring off Sydney (34 degrees S); and then in the inner shelf water off Port Macquarie (just south of Smoky Cape, 31 degrees S) where we estimate over 2,000 larvae in a 15 minute tow (1000 m3). Off Brisbane (27 degrees S), the EAC has swept down from the southern GBR; we picked up a dramatic post-larval Beryx larva (a deepwater fish, see below).

Above. *Larvae of the genus Beryx, captured as part of the sampling trip.*

Larval fish are useful and cost-effective indicators of fish presence, reproduction and of environmental status; the publicly available IMOS-larval fish monitoring (ILFM) dataset has nearly 485 net tows, sorted 553 samples; and nearly 40,000 larvae on record, distributed across 218 standardised taxa (and up to 240 taxa with improving knowledge, imagery and genetics, including rare and endangered taxa) back to 1983; and monthly since 2015; and all carefully aligned with zooplankton and oceanographic data.

Unfortunately, all this comes to an end next year along with the EAC mooring array, as part of the IMOS refresh strategy.

Left. *Larvae sampling on the R.V Investigator.*

Mapping and characterising reef habitat and fish assemblages of temperate mesophotic ecosystems in the Hunter Marine Park

A five-year study led by Dr Joel Williams and Dr Tim Ingleton in collaboration with the University of Tasmania has come to a conclusion with the publication of the final report (https://www.nespmarine.edu.au/document/mapping-and-characterising-reef-habitat-and-fish-assemblages-hunter-marine-park). The research was funded by the NESP Marine Biodiversity Hub.The project mapped 125km^2 of seabed in the newly established Hunter Marine Park and identified 5.5 km^2 of temperate mesophotic rocky reef. Towed video transects identified a range of

benthic and pelagic organisms within the Hunter Marine Park across depths of ~35 – 110 m. Imagery from reefs in shallower areas (Outer Gibber) indicated benthic communities dominated by branching and turfing brown algae with encrusting and branching sponges, ascidians, sea stars and sea whips .

These reefs were then sampled using baited remote underwater stereo-video (stereo-BRUVs) to collect data on fish assemblages. The team have been able to map some new fascinating reef features in 80-120 m of water and that support amazing sponges and corals, and a diverse assemblage of 112 species of fish, including fishery targeted species pink snapper, pearl perch and teraglin. Also of interest, the presence of eastern rock lobster, grey nurse sharks, tiger sharks and white sharks were also recorded. Species distribution modelling revealed that the location of the reef and reef structure were important factors in explaining the variability in the distribution and lengths of fish species of interest. This is an important study in the management of this marine park as it provides the baseline data required to detect changes in fish assemblages through time.

With the announcement of the new NESP Marine and Coastal Hub the authors are hoping to continue this research.

Left. *A sample of the footage from the towed video in the deeper waters of the Hunter Marine Park.*

Left. *A sample of the footage from the towed video in the shallower (Outer Gibber) waters of the Hunter Marine Park.*

NSW DPI Freshwater Update

NSW DPI Freshwater Teams have been busy enjoying the return of water across most of the state, although of course the volumes present their own set of challenges. Team Screen are continuing to test and trial **fish friendly screens** with installation of modern state-of-the art screens being installed on a range of farms. 2020 saw amazing success with breeding **Macquarie perch** using hormones to manipulate spawning in captivity, and release of these fish – see our feature article, we are preparing for another hormone trial is being planned for Oct 21. Our **Threatened Species** captive breeding program at Grafton has been producing Oxylean Pygmy Perch and Southern Purple Spotted Gudgeon which are being stocked into natural systems following their rescue during the 2019/20 drought so far 8200 SPSG fish have been released this year and ~500 OPP. NSW DPI is continuing to collaborate with all the other partners in **Long Term Intervention Monitoring of Environmental Water FLOW-MER** – some interesting results this year including that for the first time young-of-year Golden perch have been caught in fish community monitoring of the lower Lachlan River between 2015–2021 using the standard method. The early snow fall hitting the mountains recently has triggered our **Snowy Lakes trout** to commence their spawn run. For a few years now we have been able to track the spawn run through our live fish counter in Swamp Creek, a tributary of the Eucumbene River (see the latest on the Eucumbene counter here http://www.riverwatcherdaily.is/Rivers). We are making great progress in the **eDNA** technology arena with our FRDC funded project exploring the utility of eDNA concentration for fisheries stock assessments, including a cracker review paper (https://onlinelibrary.wiley.com/doi/10.1002/edn3.185). We are also developing a range of our own eDNA assays for Murray-Darling Basin threatened fish species to support our future monitoring work in 21/22. With the **return of flows in the Northern Murray Darling Basin** the team has been making the most of the Joint Venture Monitoring and Evaluation **broad scale acoustic telemetry array** funded by MDBA and the Basin States, we're in the process of tagging 150 golden perch and adding additional receivers to increase spatial coverage and resolution. Prior to the main pulse arriving we installed additional receivers and tagged 48 golden perch from Louth to Wilcannia.

The **Menindee Lakes System** is filling as the floodwaters have made their way through the **Darling-Baaka River** system in northern New South Wales, to the relief and delight of the severely drought-affected communities. Watching the water flow into the Lakes is moving - there's something so spectacular about water in deserts. It revives the soul, and you feel this reflected in the people who live out there – the towns are busy, tourists are everywhere and the locals are happy. In recent years it has become widely accepted in contemporary population models that the Barwon-Darling and Lower Darling are critical source spawning and recruitment areas, and that the Menindee Lakes System provides a key nursery area supporting mass-recruitment. Golden perch that originate in the Barwon-Darling and Menindee Lakes can disperse widely and contribute substantially to sub-populations throughout the entire MDB. In spring of 2020 adaptive environmental water was used to increase and maintain river base flows during the annual spring Murray cod breeding season. The extra flow create nesting sites and helps transport larvae to nursery habitat when they leave the nest after a week or so. It also gives the river food-web a healthy boost which helps larvae feed and grow. NSW DPI Fisheries have been busy restocking thousands of fingerlings, mainly native golden perch and Murray cod, into the river that were bred from the fish we rescued during the fish kills. It is part of the effort to recover fish populations lost in the drought. We are starting to see juvenile Golden perch in and around the Lakes – these are likely moving down the systems from the upper tribs! Although the water has come back – these systems still have a long way to go before they recover. Stay tuned as we get out and about and find out more about what's going on.

Charles Sturt University fish team

The ***CSU fish team*** (based out of Albury) has been quite active in early 2021. **Martin Mallen-Cooper** and **Lee Baumgartner** participated in the NSW Parliamentary Inquiry into dams and weirs which included a site visit to Menindee; the site of the 2018/19 fish kills. Here they met with a range of parliamentarians to discuss the needs of the Darling moving forward. **Katie Doyle, Luke Pearce** and **Cam McGregor** have been working with NSW DPI and Murray local land services to understand the state of the Macquarie Perch population in Mannus Creek which was affected by the 2020 bushfires. They have set fyke nets for several hundred hours of "soak" time but, in mid-May, the team finally located some fish that survived the bushfires. Protecting and supporting these fish is now the key priority to ensure reestablishment of the population. Phd students have also been active. **Joachim Bretzel** completed his first season of fieldwork analysing the performance of a revolutionary new fish screen on the Macquarie River. His work is focusing on determining the success at preventing native fish entrainment into irrigation systems. **Lauren Stoot** continued her PhD studies investigating fish migration patterns in the Clarence River. Lauren is using a combination of otolith microchemistry, genetics and acoustic tagging to predict the possible impacts of the clarence river scheme on migratory fish. The CSU team, through **Jarrod McPherson, Kyle Weatherman** and **Peter Collier** also worked with NSW DPI staff to rescue some Murray crayfish from a hypoxic event in the Murray River near Hume Dam. 38 crayfish were rescued and transported to the aquatic research laboratory at the Thurgoona campus where they were held for a month and nursed back to health. The crayfish were released in April when water quality had improved.

NSW Marine Park study shows striking patterns in fish abundances and diversity on NSW rocky reefs

Fisheries Research (NSW DPI) have published results of a comprehensive survey of rocky reef fishes across the NSW coastline over a six-year time span. This included sampling sites within no-take marine reserves and fished areas within marine parks and other sites in areas outside of marine parks. The publication can be accessed via this link http://doi.org/10.1002/ecs2.3447

The study demonstrates the utility of marine park sanctuary zones as scientific reference sites and provides data on the changes in the fish assemblages through time relative to other marine park zones and the general NSW coastline.

Above. *One of the snapper observed. Snapper showed stunning increases within marine park sanctuary zones across the NSW coastline. [Photo: David Harasti]*

There were consistent statewide effects with significantly more snapper (*Chrysophrys auratus*) in sanctuary zones compared to fished areas in the same *regions*, and this effect was continuing to grow. In some bioregions, this difference had increased to 2.5 times more snapper in sanctuary zones than the other zones. Several other targeted fish species were more abundant in sanctuary zones, but this often varied among marine parks.

The study also provided great deal of information on the distribution and abundance patterns of a wide range of target and non-target fish species on NSW rocky reefs. For example, the highest numbers of fish species were always found around Port Stephens than further to the north or the south of the state's waters. Snapper numbers were also the highest along that stretch of coastline and stayed relatively high along much of the north coast, but were generally less abundant along the south coast. These data provide a picture of the state's fish assemblages that we previously did not have.

The data from this study provide a fishery independent measure of the NSW rocky reef fish assemblages (providing the only data available for many species) and will enable changes related to climate change and other potential human stressors to be assessed through time. This study will be continued and has now become part of the NSW Marine Integrated Monitoring Program covering rocky reef fishes.

Above. *A baited remote underwater video on the seafloor on a NSW coastal reef. These baited systems attract fishes into the bait so they can be identified, counted and measured to assess the condition of the fish assemblages on rocky reefs along the NSW coastline. This image shows two Port Jackson sharks and a green moray eel at the bait bag while a maori wrasse swims past the stereo-video camera system. [Photo: Nathan Knott]*

Left. *An image of a baited remote underwater video from Port Stephens showing the great diversity of fishes found on these NSW coastal reefs. [Photo: David Harasti]*

Right. *This still image from one of the BRUV cameras shows the diverse fish assemblages along the north coast of NSW. This image shows snapper, pearl perch and maori cod on a Solitary Islands reef. [Photo: Hamish Malcolm]*

Phoenix Fish Rising from the Ashes

Authors; Luke Pearce, Katie Doyle, and Cameron McGregor

The 2019/2020 Black Summer bushfires caused untold devastation to people, property, wildlife and vegetation. One area that is often overlooked is the impacts on the aquatic environment, caused initially by the fire front, but then more so by subsequent flow rainfall events post fire.

This story focuses on the Mannus Creek system in the Upper Murray region of NSW, which is home to one of the last 4 remaining natural populations of Macquarie perch (*Macquaria australasica*) within NSW and the only remaining population in the NSW Murray Catchment.

Above. *A section of Mannus creek devastated by the Green Valley/Talmalmo Fire*

The Mannus Creek Macquarie perch population was only discovered in the mid 2000's (Gilligan et al., 2010) and subsequent detailed surveys between 2017 and 2018 detected a small self-sustaining population persisting in Mannus Creek, inhabiting a 9-km section immediately downstream of Mannus Falls and within Bogandyera Nature Reserve (Silva et al., 2018).

The Mannus Creek Macquarie perch population is highly significant from a genetics perspective and is therefore the focus of much ongoing research and management to secure the population. There is also strong community and local support to see the habitat conditions and the species recovered within Mannus Creek. A number of long-term recommendations were formulated by Silva et al. (2018) to sustain and protect the population.

On the 12th January 2020, the Macquarie perch population of Mannus Creek became severely threatened by the Green Valley/Talmalmo Fire, with the entire 9km stretch of Mannus Creek that contains the threatened population of Macquarie perch was severely impacted by the fire all of which burnt at very high intensity (pictured above).

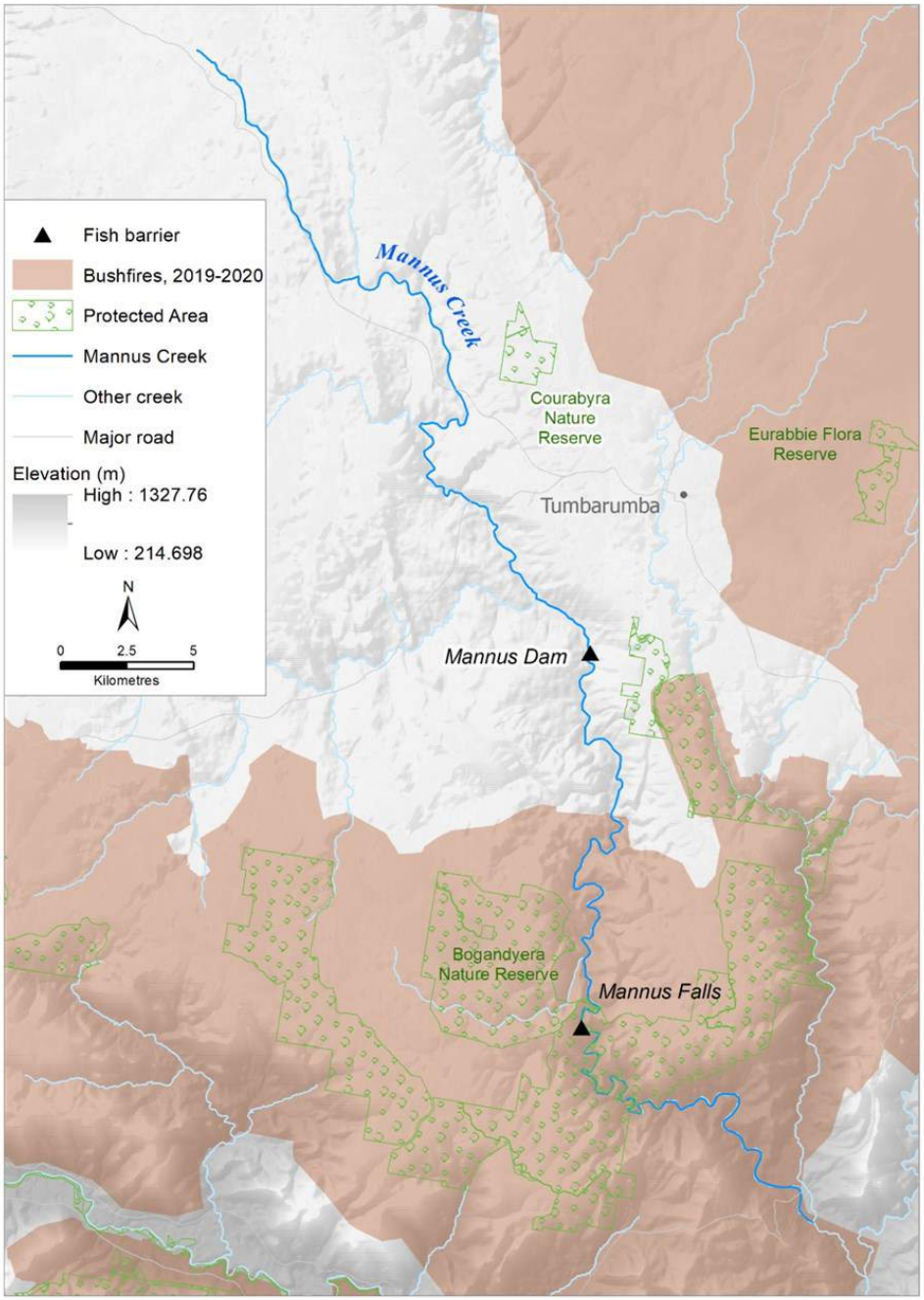
Initial surveys in January 2020, only 3 days after the fire had ravaged the area, reviled that Macquarie perch were still present and had largely survived the initial fire front, but the real danger for these fish was yet to come. With storms forecast for the following week it became a race against time to try and capture as many Macquarie perch out of the system for safe keeping before the inevitable first flush of ash and sediment occurred.

The following week a rescue operation was enacted, access was difficult, conditions were terrible and catch rates were low, after 5 days of sampling only 11 Macquarie perch were captured, 10 of these fish were transported to the Narrandera Fisheries Centre for safe keeping while plans for increased numbers of staff and more intensive sampling was planned for the following week.

Unfortunately, the storms beat us with a large thunder storm in the catchment on the Sunday 19th January, when crews arrived to rescue more Macquarie perch on Monday 20th January they were greeted by a flowing stream of black porridge (Baumgartner, 2020). The conditions did not allow any further sampling or collection of Macquarie perch and there were grave fears for their survival as the dissolved oxygen levels rapidly deteriorated and plummeted to virtually zero, with a subsequent fish kill occurring over the following days.

There was now significant concern that the population might be have been lost and that Mannus Creek may no longer contain suitable habitat for the species to survive. With funding provided by the Australian Governments' National Bushfire Recovery Grants the team from Charles Sturt Uni set out to quantify the changes in the habitat and fish community post-fire and to determine if there were any Macquarie perch still remaining in the system.

Habitat mapping of the entire system was undertaken to compare with results from the pre fire mapping data from 2017/18, not unsurprisingly there was little to no change in the habitat in the unburnt sections of the creek, however there was significant changes to the habitat within the burnt sections of the creek. The main changes were reduced pool depth, large amounts of burnt debris, sediment and ash depositions and the loss of native riparian vegetation. Similarly with the fish community there were no changes within the unburnt sections, but within the burnt section of the creek there was substantially fewer fish present and the fish that were there were dominated by alien species, in particular redfin perch (*Perca fluviatilis*) and largely smaller individuals that had likely recolonised post fire and subsequent flow events.



Left. *The 2019/20 bushfire layer (red shading) mapped for Mannus Creek. Previously identified Macquarie perch habitat (Silva et al. 2018) is represented by a black box below Mannus Falls. Figure credit: Deanna Duffy.*

Much to our disappointment there were no Macquarie Perch detected despite significant effort; 1020 net hours and 18,000 seconds of electrofishing. We were starting to think that the population was likely lost.

Given these results the decision was taken not to release the rescued Macquarie perch back into Mannus Creek, but rather use them to boost the number and genetic diversity of the nearby Adjungbilly Creek population with the 10 recused fish released into Adjungbilly Creek in November 2020.

Quite unexpectedly we then received a reported siting of a Macquarie perch in Mannus Creek by a spray contractor undertaking willow control works for National Parks along the creek, his report sounded very credible so a further round of sampling was undertaken, and much to our surprise and delight we finally detected not one but three Macquarie perch at 2 separate locations within the system. How these fish survived not only the fire but the subsequent flows and zero DO levels still remains a mystery, but we were elated that after all the work and effort that some had survived, and the population had not been lost.

Now that we have confirmed the Maccas are still present, it is now essential we do everything we can to ensure they persist and recover. A number of actions have been undertaken to give them the best chance of survival and recovery including the stocking of 2500 Macquarie perch fingerlings, very kindly provided by the Victorian Fisheries Authority.

A very sincere thanks to Adele Moyes and the team at Snobs Creek Hatchery for producing these fish and to Taylor Hunt and Anthony Foster for making it happen. These fingerlings will boost not only the number of individuals but also the genetic diversity of the population and assist in hastening the recovery of this population, we hope this is the first of many similar events in the future. There has also been a weed control program and some planned habitat enhancement and bank stabilisation works that will be undertaken throughout the year to improve conditions. The final action being undertaken to improve conditions for Macquarie perch in the system is the removal of alien species predominantly redfin and carp, there has been 2 extensive pest fish removal events and further planned. This is aimed at reducing competition for the limited resources and predation and we believe it is a vital component to the recovery of Macquarie perch in the post fire environment. As previously mentioned, the majority of fish detected in the burnt zones are alien species that have likely recolonised.If left unchecked these species have the ability to rapidly re-colonise these areas to the point where they exclude native species including Macquarie perch, so we are capitalising on the opportunity to come in whilst their number are low and try to keep them down to allow native species to get a foot hold again.

So what started out as story of real despair and fear that we had lost a very significant and important population has now turned into a story of hope as we have seen these fish survive what we thought was a certain death. We have seen them rise up out of the ashes and we now have an active program and path forward to recovering this population.

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- SILVA, L. G., PEARCE, L., MABON, S., HORTA, A., DUFFY, D., KOPF, S., NING, N. & BAUMGARTNER, L. 2018. Macca's in the Mannus, Macquarie perch refuge in the Upper Murray.

Shamsi's Fish Parasitology lab, Charles Sturt University

Professor Shokoofeh Shamsi

Hi everyone,

This is the first contribution from our team. We are part of the School of Animal and Veterinary Science, on the Wagga Wagga Campus of Charles Sturt University.

Here is a snapshot of some of our current projects and news:

Above. *Some of the team members; From left to right: Megan porter (PhD Candidate), Dr Di Barton, Asoociate Professor Shokoofeh Shamsi, and Honours students: Alice Banfield, Michael Trinidad and Susan Everitt*

Megan has become among Wagga Wagga campus finalists for 3MT presentation. We wish her good luck for her CSU finalists' presentations on 23rd June to be held in Wagga Wagga Playhouse. Her research is about **Parasitism in the black spotted-croaker**. The black spotted-croaker represents one of many crucial research objects for parasite studies in Australian waters. Parasites are omnipresent components of biodiversity and play an integral role in the continued functioning of ecosystems, yet most parasitic organisms have not been properly identified and studied. The focus of Megan's research is investigating the parasitic burden affecting the black-spotted croaker. By identifying and describing parasite assemblages in different populations of this important fish species, the research findings will contribute greatly to our knowledge on parasitic burden and resulting host status and lead to the development of practices that will ensure the sustainability of this species and the marine ecosystem in which it is found. Here are some of the beauties she found:

Over the last few years with Associate Professor Raf Freire we started to investigate the impact of parasites on behavioural change of fish hosts. A/Prof Raf Freire examines animal behaviour processes in a number of species, including fish. Recent findings have revealed emotion-like states in fish, and that parasite infection has the potential to alter fish behaviour considerably. Being based in the Murray-Darling basin, his research also tackles the impact that the hatchery environment has on the ability of native fish to survive after release. We will provide more news about this line of research in the next newsletter showcasing our PhD candidate's research, Leia Rogers.

Above. *A/Professor Raf Freire*

Another research that is well under way is characterising Trypanorhynchid tapeworms in a number of fish from Northern Territory waters. In the aquatic food chain, the infected fish play an important role to infect sharks with these parasites. Susan Eeveritt is our Honours student working under supervision of Di and Shokoofeh on this topic.

Alice is interested in looking at the role of freshwater snails in parasite transmission to our native fish in the Murrumbidgee catchment area.

Some of our recent publications include:

1. Shamsi, S., et al., *Do parasites influence behavioural traits of wild and hatchery-reared Murray cod, Maccullochella peelii?* Parasitology Research 2020. **120**(2): p. 515-523.
2. Shamsi, S., et al., *Wild fish as reservoirs of parasites on Australian Murray Cod farms.* Aquaculture, 2021: p. 736584.
3. Moravec, F., D.P. Barton, and S. Shamsi, *Philometra longa n. sp. (Nematoda: Philometridae), a new parasite from the abdominal cavity of the eastern sea garfish Hyporhamphus australis (Hemiramphidae, Beloniformes) off Australia.* Systematic Parasitology, 2021.
4. Hossen, M.S., S. Wassens, and S. Shamsi, *Integrative species delimitation and community structure of nematodes in three species of Australian flathead fishes (Scorpaeniformes: Platycephalidae).* Parasitology Research, 2021. **120**(2): p. 461-480.
5. Shamsi, S., E. Steller, and X. Zhu, *The occurrence and clinical importance of infectious stage of Echinocephalus (Nematoda: Gnathostomidae) larvae in selected Australian edible fish.* Parasitology International, 2021. **83**: p. 102333.
6. Moravec, F., D.P. Barton, and S. Shamsi, *Two species of philometrid nematodes (Philometridae) newly recorded from marine fishes off South Australia, including Philometra inconveniens n. sp. from Hyporhamphus melanochir (Valenciennes) (Hemiramphidae).* Systematic Parasitology, 2021.
7. Hossen, M.S., S. Wassens, and S. Shamsi, *Occurrence and abundance of zoonotic nematodes in snapper Chrysophrys auratus, a popular table fish from Australian and New Zealand waters.* Food and Waterborne Parasitology, 2021. **23**: p. e00120.
8. Moravec, F., S. Shamsi, and J.-L. Justine, *Redescription of Ascarophis distorta Fusco et Overstreet, 1978 (Nematoda, Cystidicolidae) from the stomach of some butterflyfishes off New Caledonia.* Acta Parasitologica, 2021.
9. Rahmati, A.R., et al., *World-wide prevalence of Anisakis larvae in fish and its relationship to human allergic anisakiasis: a systematic review.* Parasitology Research, 2021. **119**: p. 3585–3594.
10. Suthar, J. and S. Shamsi, *The occurrence and abundance of infective stages of zoonotic nematodes in selected edible fish sold in Australian fish markets.* Microbial Pathogenesis, 2021. **154**: p. 104833.

State Reports

Queensland

QLD

Compiled by Mischa Turchwell and Leanne Currey

Threatened species assessment and recovery in burnt coastal wallum wetlands

Mark Kennard and Luke Carpenter-Bundhoo – Australian Rivers Institute, Griffith University

Acid wetlands of coastal wallum and dune systems are critical habitat for multiple threatened species of fishes, frogs and crayfish. Much of this habitat was affected by the 2019/2020 fires. The extent of fire-related habitat degradation and impacts on these threatened species is currently being assessed in a project funded by the Australian Government's Wildlife and Habitat Bushfire Recovery program.

The project hosted by the Australian Rivers Institute, Griffith University and involves natural resource management groups, traditional owners, community volunteers, and government who are collaborating to:

- comprehensively survey threatened fish, frogs and crayfish in coastal wallum wetlands in SE Qld and Nth NSW to document distribution, abundance, and threats
- develop methods for ongoing monitoring
- identify and prioritise critical habitat and rehabilitation and recommend actions for recovery

Left. *Some of the beautiful sampling sites. Photo Credit: Luke Carpenter-Bundoo*

Above. *Some of the beautiful sampling sites. Photo Credit: Luke Carpenter-Bundoo*

Project outcomes include:

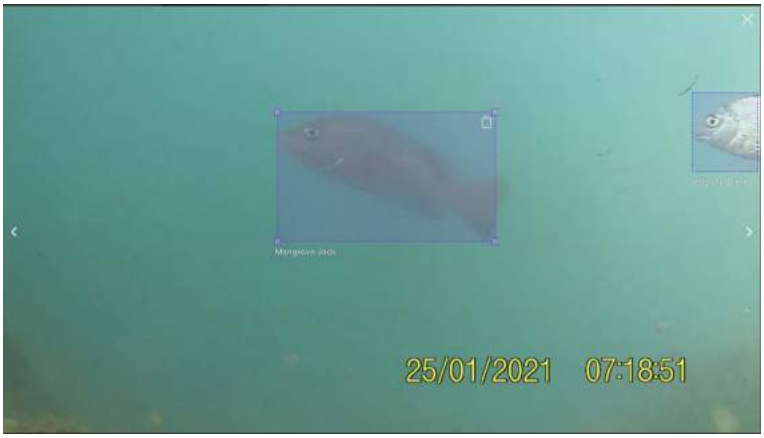
- improved understanding of the impact of fires and other threats on threatened aquatic species in coastal wallum wetlands
- increased community awareness of threatened species
- improved knowledge base and enhanced capacity for threatened species management

Project partners include the Mary River Catchment Coordinating Committee (MRCCC), Burnett-Mary Regional Group (BMRG) and the Australia New Guinea Fishes Association QLD Inc. (ANGFA QLD)

Benefits of automatic detection of fish and tracking of movement for ecology

Sebastian Lopez-Marcano – Australian Rivers Institute, Griffith University

Automated and remote techniques are becoming increasingly common in monitoring, management, and conservation of the environment. These techniques can provide users with the high-resolution data needed to understand complex interactions and behaviours that occur in the natural environment. For marine ecosystems in particular, the application of automated techniques is challenging due to highly dynamic environmental conditions. For example, water clarity changes with the tidal cycle and the accuracy of visual systems is often impeded. However, advances in computer vision now allow us to expand our monitoring capacity and collect data in ways that were not previously possible. In Seb's latest paper (published in Ecology and Evolution), he showed that automated fish tracking in underwater ecosystems is possible. With a 91% fish detection accuracy and 84% tracking accuracy, his pipeline successfully tracked many individuals across range of visibility gradients.



Left. *Automated fish detection and tracking in action. Photo Credit: Sebastian Lopez-Marcano*

Seb hopes this new generation of methods for collecting and analysing movement data can aid in the uptake of automated techniques into aquatic conservation by:

1. Increasing our monitoring and reporting efficiency from underwater footage.
2. Complementing traditional data collection techniques.

Check out the paper (open access) below. And what a bonus, all training images and annotations, movement dataset annotations, images and videos, and tracking and data wrangling scripts are freely available.

- Lopez-Marcano, S., L Jinks, E., Buelow, C. A., Brown, C. J., Wang, D., Kusy, B., ... & Connolly, R. M. (2021). Automatic detection of fish and tracking of movement for ecology. Ecology and Evolution. DOI: 10.1002/ece3.7656

Above. *Automated fish detection and tracking in action. Photo Credit: Sebastian Lopez-Marcano*

TropWATER update

Brendan Ebner – TropWATER, James Cook University

The first half of 2021 has seen the ever-reliable contributor Brendan Ebner (thanks Ebb!) re-learning how to draw fishes and spending minimal time in the field. His couple of publications for the year include a cheeky little piece about an eel skeleton and a more comprehensive study detailing the fish assemblages in steep tropical streams of the Wet Tropics. The latter paper draws attention to the key role that waterfalls play in disrupting the distribution of amphidromous fishes within streams and provides correlative evidence for crustaceans being strongly affected by jungle perch position along the stream.

Check out his papers below:

- Ebner, B. C., Donaldson, J. A., Marshall, J., Starrs, D., & Freeman, A. B. (2021). Diving beetles strip eel to the bone. Food Webs 27 (2021) e00188
- Ebner, B. C. Donaldson, J. A. Murphy, H., Thuesen, P. Ford, A., Schaffer, J. & Keith, P. (2021). Waterfalls mediate the longitudinal distribution of diadromous predators structuring communities in tropical, short-steep-coastal-stream. Freshwater Biology 66, 1225-1241.

Ground-breaking new Lungfish and Cod Research

David Roberts—SeqWater

Above. *David Roberts in action in the field with a Murray cod.*

A new manuscript accepted for publication in *Molecular Ecology Resources* will pave the way for future fisheries conservation and management through developing a non-lethal ageing technique using DNA methylation. The title "Non-lethal age estimation of three threatened fish species using DNA methylation: Australian lungfish, Murray cod, and Mary River cod" (Article ID: MEN13440; Article DOI: 10.1111/1755-0998.13440) was a collaboration between CSIRO, Queensland Government, Seqwater, NSW DPI, University of Queensland and University of Western Australia. David and the team found not only does this method predict age across species separated by more than 100 million years of evolution, it is also applicable across closely-related species using a common 'epigenetic clock'. The Maccullochella 'clock' worked well for both Murray and Mary River cod, and we believe after some testing, it would also work for the Eastern and Trout cods.

This work was assisted through sourcing known age Australian Lungfish (*Neoceratodus forsteri*) and Mary River Cod (*Maccullochella mariensis*) produced at a commercial hatchery, combined with samples aged using traditional otolith methods for Mary River and Murray cod (*Maccullochella peelii*) and novel bomb radiocarbon-dated scales from Lungfish. These recent findings will no doubt improve conservation management of these species, and with more ageing models being developed for other Australian fish species, the future looks a lot brighter for threatened species research capability.

Left. *One of our national treasures, 'the Lungy'*

Laboratory research on the Australian lungfish has been near impossible historically due to a lack of available research material. Their protected status, unpredictable wild spawning, and unicorn like status of juvenile in the wild, made planning research almost impossible. Lack of available research material has hindered the advancement of various aspects of the ecology, physiology and evolution for one of our national treasures, 'the Lungy'. Some of these challenges have now been overcome as research material is now more readily available from a licenced commercial Lungfish and Mary River cod breeder at the Hinternoosa Hatchery. If your lab is interested in Lungy research, contact hatchery owner Darren Knowles (darren@hinternoosahatchery.com.au) to discuss your interests, or David Roberts (David.T.Roberts@seqwater.com.au) to discuss collaboration opportunities.

Above. *One of our national treasures, 'the Lungy'*

State Reports

South Australia

S.A.

Compiled by Jasmin Martino and Owen Burnell

Understanding recruitment variability of snapper (FRDC 2019-046)

Tony Fowler, Troy Rogers, Nat Navong, Mick Drew, Jeremy Bussell, Tom Clarke (Flinders Uni)
Finfish Fisheries Sub-Program, SARDI Aquatic Sciences

The population dynamics and fishery productivity for snapper in South Australia are fundamentally driven by temporal variation in the recruitment of 0+ juveniles. The different trends in catches and population biomass for the two main stocks reflect different temporal trends in recruitment over the past 20 years. That is, the significant decline of fishable biomass for the Spencer Gulf / West Coast stock since 2007 reflected very low to negligible recruitment during the 2000s and 2010s. Whilst for the Gulf St. Vincent stock, the considerable decline since 2015 reflected poor recruitment during the 2010s. For species that demonstrate such variable recruitment, developing a pre-recruit index as an indicator of future abundance provides a powerful tool to predict future changes in population size and fishable biomass. Furthermore, understanding the environmental influences that mediate the survivorship of eggs and larvae would provide for even stronger predictability, particularly under changing environmental conditions associated with climate change. Subsequently, the snapper recruitment project (FRDC 2019-046) aims to: (1) develop a pre-recruit index for snapper in South Australia; and (2) understand the processes and environmental conditions that regulate recruitment during the early life history stages.

Annual recruitment surveys for snapper using a specialised otter trawl were undertaken in northern Spencer Gulf from 2000 to 2010. The catches of 0+ juveniles were low, and in several surveys no snapper were captured at all. At the time it was difficult to determine why this was case. However, we now know from the population age structures that recruitment in Spencer Gulf was negligible during this time period.

Above. *A juvenile (0+) snapper showing the sagittal otoliths. The fish is 64 mm CFL.*

As part of the current project, we recently completed (April 2021) an intensive field study to compare the utility and effectiveness of four different sampling methodologies to monitor the abundance of 0+ snapper. The methods were otter trawling, trawling with a small beam trawl, baited traps and BRUVS. The outcomes of the study will be used to develop an appropriate sampling strategy that can be applied in future years to provide an estimate of recruitment. Whilst the data analysis is not yet complete, we did capture some 0+ snapper in Spencer Gulf which provides evidence of low-level natural recruitment. The otoliths of these fish will provide valuable information regarding key early life history processes and for understanding population connectivity.

Below. *A post-flexion snapper larva (24 dph) reared at SARDI Aquatic Sciences.*

The sustainability of octopus fisheries

Erica Durante, PhD candidate, University of South Australia (Principal Supervisor: Dr Zoë Doubleday)

In many places in the world, octopus are a big part of many people's diet. In recent years, the demand and interest for octopus in Australia has rapidly increased, so new fishing opportunities are being explored. To conserve and properly manage the wild stocks of our eight-legged friends, some baseline information is first needed. The first being age - knowing how long they live for or at what age they mature, can inform us on growth, age-population dynamics, and ontogenetic changes. In my PhD and in collaboration with the South Australian Research and Development Institute (SARDI), I will collect age data for a commonly caught species in South Australia, the Southern Keeled octopus (*Octopus berrima*). This information will be valuable for future management of the species. Validating age involves keeping the octopus in tanks, staining them by injection of a fluorescent dye, and after a known length of time investigating increments in hard parts (internal shell and beak). I will be able to investigate if the number of rings is equal to the number of days passed and confirm whether they form daily. This will allow us to age any octopus of that species. I will then use this technique to age *Octopus berrima* that have been caught from the wild across the South Australian coastline. My overall hope for my PhD is to gather more information about cephalopod ecology and biology to support conservation and sustainable management.

Right. *Erica feeding a day octopus (Octopus cyanea) at Kanaloa Octopus Farm in Hawai'i where she was a research biologist (2019)*

Quantifying post-release survival and movement of snapper (FRDC 2019-044)

Troy Rogers, Mick Drew, Paul Rogers, Nat Navong, Tony Fowler, Hugh Pederson (Innovasea)

Finfish Fisheries Sub-Program, SARDI Aquatic Sciences

Above. *Nat Navong holding a snapper fitted with a V9AP acoustic transmitter. A total of 60 snapper were fitted with acoustic tags during the recent post-release survival study.*

It is estimated that up to 75% of snapper captured by the recreational sector and 40% caught in charter boat fishery in South Australia are released after capture. Meanwhile, discard rates for the commercial sector are poorly understood and are likely to differ considerably between gear types. The majority of released snapper are either: (1) undersized fish (< 38 cm TL) encountered as bycatch when targeting King George whiting (*Sillaginodes punctatus*); or (2) large fish (60 to 100 cm) that are targeted for catch and release by recreational fishers, or are discarded once daily trip limits are reached. Several interstate studies have demonstrated that depth of capture is the most influential factor to post-release survival of small snapper, although limited information is available for large fish that are characteristic of the South Australian populations. Subsequently, this project aims to understand the key factors that influence post-release survival across a broad range of sizes and depths, in order to develop practical strategies to optimise survival in each sector of the fishery. One component of the project was an acoustic telemetry study that quantified the survival of snapper released at three depths (17, 25 and 32 m) using two release

methods (surface and descender device). At each depth, 20 snapper were externally fitted with Innovasea V9AP transmitters and released into a fine-scale array of 12 acoustic receivers (~2.5 km^2 range). The survival rates from the acoustic telemetry study will be used to retrospectively estimate post-release survival in the fishery by interpreting the tagging data concurrently with fish size, depth, barotrauma injuries, and fishing methods. Furthermore, this information will refine estimates of fishing mortality that can be incorporated into stock assessment models to inform fishery management.

State Reports

Tasmania

TAS

Compiled by Jonah Yick (IFS)

Inland Fisheries Service: Carp Management Program Report

By CMP Program Leader Jonah Yick

The 2020/21 carp season (July 2020 to June 2021) resulted in only 3 carp caught (Table 1), which brings the total number of carp removed from Lake Sorell to 41 499 since their discovery in 1995. This was less than the 5 carp caught last season, despite having a higher amount of gill net effort employed (Figure 1). All three carp were caught in gill nets (Table 1). Gill nets were set over a wide area of the lake, with structure and habitat continuing to be a priority. Trammel gillnets were the main type of gill net used due to their high catch efficiency. Most nets were set around the shallow regions of the lake in response to rising water temperatures in spring and early summer. Some nets were also set in deeper water over the rocky reefs where carp have historically been known to favor. In addition to gillnets, other fishing methods were also used (Table 1). These included big fyke nets stitched into barrier nets, the boat electro-fisher and backpack electro-fishers. All these methods select for adult and any potential juvenile carp (which are not susceptible to gillnet capture). Locating and catching carp this season was increasingly difficult, with a high level of fishing effort employed resulting in very few carp caught. As many as 77 gill nets averaging 90 to 250m in length were set each day during the peak spawning period from October 2020 to January 2021. Despite increasing and maintaining the fishing pressure over the last few seasons, the total carp catch and catch per unit effort (CPUE) has continued to decline (Figure 2a,b).

Right. *The carp team celebrate the first carp of the season, which was also the biggest carp of the season; a mature female weighing 1.4kg.*

The capture of the three carp this season occurred over a four day period in mid January, which was associated with a hot weather event, where the water temperature in Lake Sorell reached its peak of approximately 18-20°C. Despite a falling lake level, these high temperatures were enough to trigger the remaining carp to begin moving more actively around the lake to feed. Of the three carp caught, one was a female while the other two were males. All three fish were very small (839 to 1400gm) for their age, given they are likely to be over 11 years old. Not only are the majority of carp in poor reproductive condition, but the presence of the jelly gonad condition (JGC) in male carp continues to increase (Figure 1). Although the affected fish do not exhibit any apparent external deformities, the gonads begin to develop watery blisters, and in the advanced stage of the condition, the fish become reproductively unviable. This increasing presence of the JGC in male carp is playing an important positive role in the final stages of eradication.

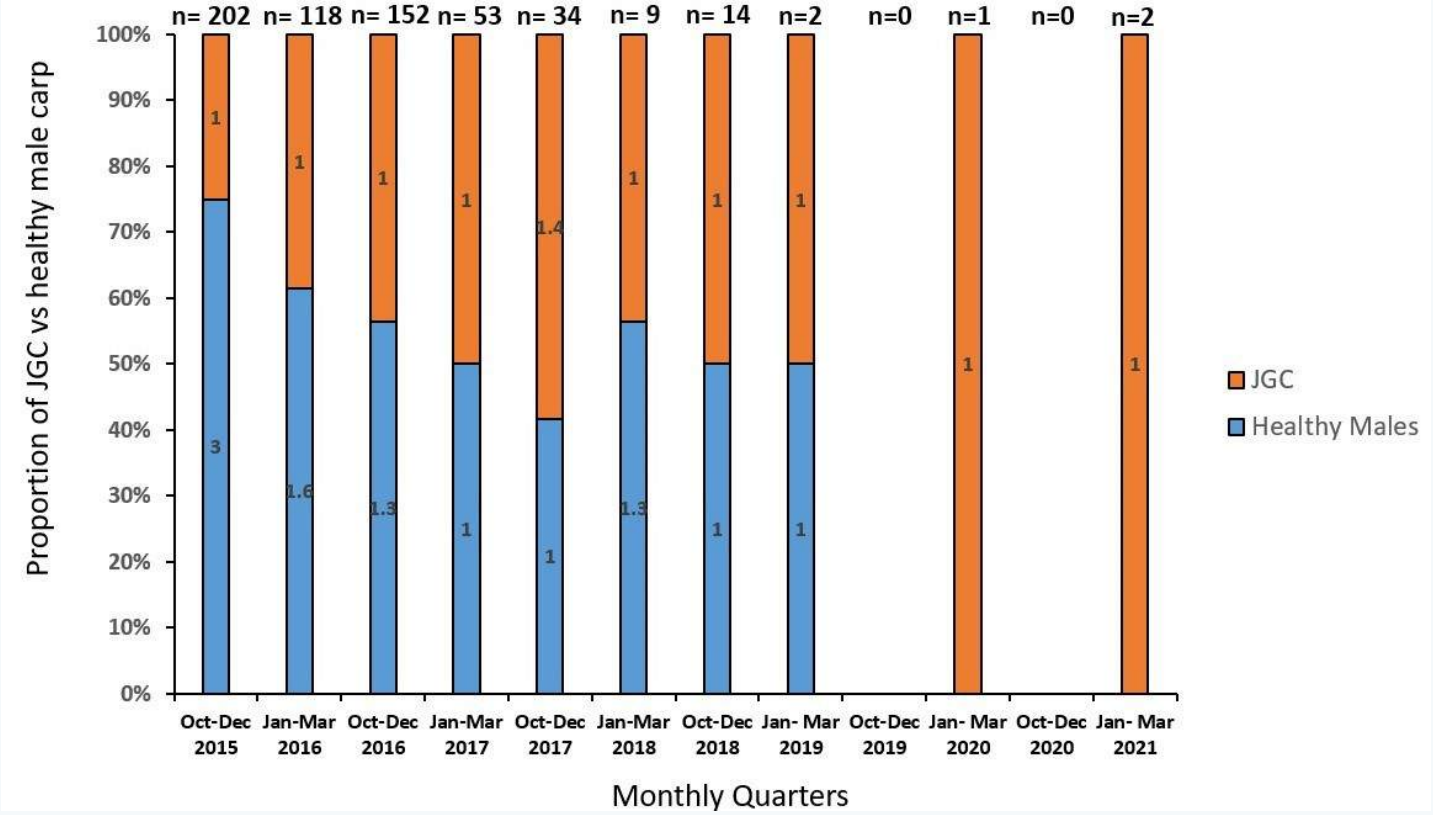


Figure 1. *The change in ratio of jelly gonad condition (JGC) males to healthy males from 2015 to 2021, compared by October to December and January to March quarters.*

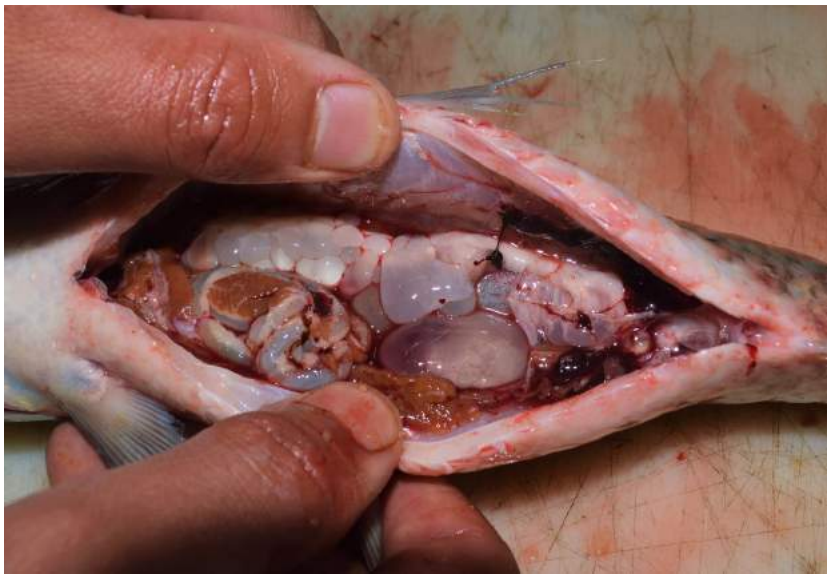
The female carp had 230gm of eggs, however they were completely intact indicating she had not spawned, while the two males were both affected with advanced stages of the JGC. Given there hasn't been a significant successful spawning event since 2009, it is increasingly likely that the current carp population is unable to breed. The last healthy, sexually mature male carp was caught on 16 December 2018. Despite intensive netting efforts continuing through to the end of January, no further carp were caught. Due to the low catch rates and the decreasing water temperatures in late summer, all fishing efforts ceased in early February, and the lake was re-opened to the public on 6 February 2021.

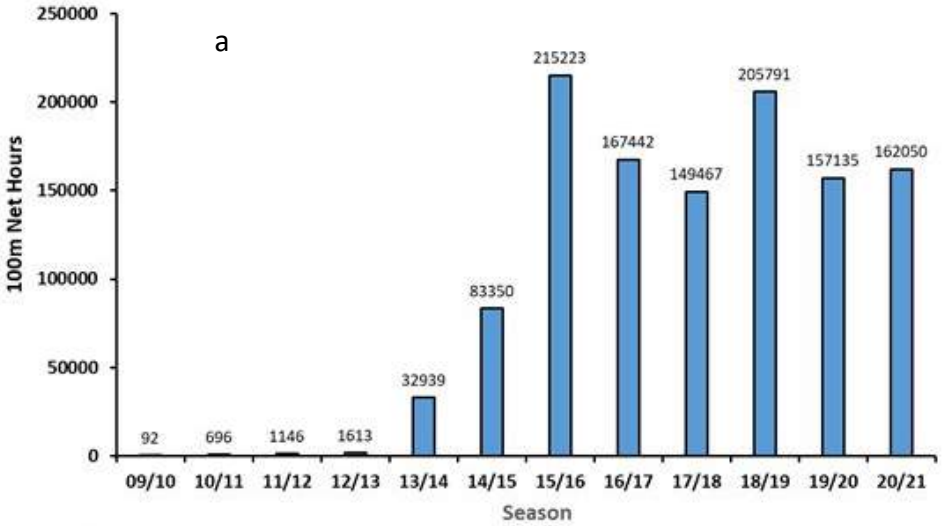
Sampling for spawning in Lake Sorell begun in January, culminating with a large survey in March which involved a total effort of 398 backpack electrofishing minutes, 6068 fyke net hours, and the use of fine mesh dip nets. This resulted in numerous eels and golden galaxiids caught, but no sign of any young of the year carp.

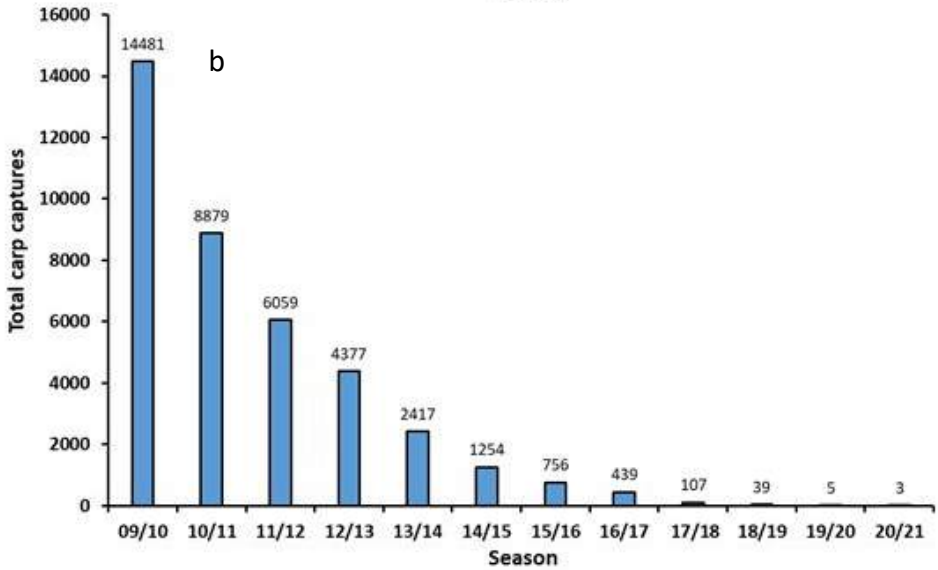
Gear Type	October	November	December	January	February	March	Total
Non-targeted gill nets	0	0	0	3	0	-	**3**
Barrier fyke nets	0	0	0	0	0	-	**0**
Backpack electro-fisher	0	0	0	0	0	-	**0**
Boat electro-fisher	0	0	0	0	0	-	**0**
Gillnets behind barrier nets	0	0	0	0	0	-	**0**
Total	**0**	**0**	**0**	**3**	**0**	**0**	**3**

Table 1. *Total carp captured from all methods used in Lake Sorell over the 2020/21 season*

Right. *The gonads of one of the small male carp caught this season, exhibiting large watery blisters, an indication of the advanced stage of JGC and associated sterility.*







After 26 years the Tasmanian carp battle is finally drawing close. It is estimated that there are few, if any carp remaining from the 2009 population, and when you take into account the stunted average size, poor general condition, and high proportion of males affected with JGC, the odds are not in their favour. The risk of transfer of carp from this water is now deemed to be highly unlikely, therefore since February 2020, Lake Sorell has been reopened intermittently to the public. Eradication and monitoring efforts will still continue over the next few years.

Left. *Figure 2. (a) Total netting effort in 100m Net Hours used in Lake Sorell (2009-2021).*

(b) Total carp captures from Lake Sorell (2009-2021).

NEW PUBLICATION: The eradication of common carp from Lake Crescent, Tasmania

By Jonah Yick, Inland Fisheries Service

Above. *Former Carp Management Program Team Leader Chris Wisniewski with the last carp caught from Lake Crescent in 2007.*

Lead author and Carp Management Program Team Leader Jonah Yick (Tasmanian Inland Fisheries Service) compiles and describes the strategies and techniques used to eradicate common carp (*Cyprinus carpio*) from Lake Crescent (23km^2) in Tasmania's central highlands.

Carp were first discovered in lakes Crescent and Sorell in January 1995, and immediately contained to these waters using screens to prevent their escape down-stream, followed by swift legislation to enforce closure of the lakes to the public. Beginning with undirected removal, techniques progressively evolved to more sophisticated targeted removal with assistance from biotelemetry, in conjunction with gill netting and electro-fishing. Spawning opportunities were blocked, while also concurrently capturing mature fish.

Following 12 years of adaptive and integrated effort, 7797 carp (fry, juvenile and adult) were captured from Lake Crescent, with the last carp being caught in December 2007. The subsequent 14 years of monitoring has not resulted in the capture of any carp, confirming the successful eradication of carp from Lake Crescent. These management practices have continually evolved, and replicated in the larger connected Lake Sorell (54km^2), where 41,499 carp (fry, juvenile and adult) have been removed. It is now estimated that there are few, if any, carp remaining in the lake.

Fishes: https://www.mdpi.com/1008178

Pedder galaxias population in good health

By Jonah Yick, Inland Fisheries Service

The Pedder galaxias (*Galaxias pedderensis*) was previously found only in the original Lake Pedder, Tasmania. Unfortunately, due to the flooding of the Huon and Serpentine catchments for hydro power generation during 1972, and with the subsequent invasion of brown trout (*Salmo trutta*) and the climbing galaxias (*Galaxias brevipinnis*), the pedder galaxias population collapsed. By 1990 they had become very rare and were thought to be almost extinct. During 1992 as a last effort to save the species, 31 fish were translocated to Lake Oberon in the Western Arthur Range. This lake provided a safe refugia free from invasive species. Subsequent monitoring of this population has confirmed the species is now thriving in their new habitat. Additionally, fish were later translocated from Lake Oberon to a secondary refugia site at Strathgordon, where they are now well established.

Above. *A pedder galaxias prior to release*

Left. *Fyke nets set around the edges of the translocation site*

A recent survey conducted during April to monitor and assess the Strathgordon population, resulted in over 250 fish being captured in one night using 12 fyke nets. Fish were from a range of sizes, representing multiple year classes. Continuing high levels of recruitment have now been evident for several years.

The Pedder galaxias was regarded as Australia's most endangered freshwater fish. Although now extinct in its natural habitat, it is the first fish in Australia to be saved from extinction and translocated to another location in the wild. While they are still listed as critically endangered, the future of these fish continues to look positive.

Left. *A couple of native crayfish species caught in the fyke nets alongside the pedder galaxias*

NEW PUBLICATION: The Southern Hemisphere lampreys (Geotriidae and Mordaciidae).

By Jonah Yick, Inland Fisheries Service

Lead author Allison Miller from the University of Otago in collaboration with researchers from the Tasmanian Inland Fisheries Service and other scientists from New Zealand and Chile, have recently gathered and compiled extensive information on the five Southern Hemisphere lamprey species.

Lampreys are jawless eel-like fishes that are commonly referred to as "living fossils" due to their evolutionarily consistent body morphology (over 360 million years old). Of the three families of lamprey, two (Geotriidae and Mordaciidae) are found only in the Southern Hemisphere and include five species: *Mordacia mordax*, *M. lapicida*, *M. praecox*, *Geotria australis*, and *G. macrostoma*. Certain species of Southern Hemisphere lampreys hold cultural and ecological significance. For example, *G. australis* (kanakana in Te Reo Māori and filoko in Mapudungun) is harvested by Māori, Mapuche, and Nyungar people in New Zealand, Chile, and Australia (respectively) and all five species are energy-rich prey sources for native and IUCN endangered species. Relative to many of their Northern Hemisphere relatives, Southern Hemisphere lampreys have been poorly studied and the scholarship that did exist focused either on taxonomy and systematics, or were minor portions of larger reviews. To resolve this we gathered information regarding the taxonomy, systematics, distribution, biology, ecology, genetics, threats, and importance of the five Southern Hemisphere species and present it in a comprehensive review. We collected this information from multiple sources (e.g., agency reports, Indigenous knowledge, and peer-reviewed publications that date back to the late 1800's) to clarify for a wide audience (technicians, managers, researchers, and stakeholders) what is already known and to identify information gaps to which must be addressed. This article is timely as Southern Hemisphere lamprey species are threatened by lamprey reddening syndrome (LRS), climate change, and other anthropogenic stressors.

Reviews in Fish Biology and Fisheries: https://rdcu.be/cgIN1
Citation: Miller, A.K., Baker, C., Kitson, J.C. *et al.* The Southern Hemisphere lampreys (Geotriidae and Mordaciidae). *Rev Fish Biol Fisheries* (2021). https://doi.org/10.1007/s11160-021-09639-x

Figure 1. Southern Hemisphere lamprey species. For each row from left to right, **a** *Geotria australis*: oral disk, anterior dorsal, anterior lateral, **b** *Mordacia mordax*: oral disk, anterior dorsal, anterior lateral, **c** *M. praecox*: oral disk and adult (fresh water, mature gravid female) adult, **d** *M. mordax* adult (anadromous, migrating beginning stage), **e** *G. australis* adult (anadromous, migrating beginning stage), **f** *G. australis* juvenile (recently metamorphosed).

Photos credit: a oral disk by Jonah Yick; **b** oral disk and **d** by Arron Strawbridge; **c** by Dean Gilligan; **f** by Stella McQueen

Conservation genomic studies of Tasmanian galaxiid fishes

By Bruce Deagle, Science Leader at the CSIRO Australian National Fish Collection (ANFC)

New funding from Bioplatform Australia's Threatened Species Initiative (TSI) has been earmarked to help build genomic resources and to understand intraspecific genetic diversity of threatened Tasmanian galaxiids fishes. In the pilot phase of the TSI project (currently underway) DNA samples of Swan galaxias (*Galaxias fontanus*) have been submitted to carry out genome sequencing and to investigate population genomics of natural and translocated populations. The genome sequence will become a public resource available for anyone with an interest in galaxiid genetics. The population-level genetic data will be used to inform management decisions aiming to conserve remaining diversity

Left. *Collecting Clarence galaxias (Galaxias johnstoni) in a Tasmanian central highland lake (Chris Burridge and Charlotte Jense pictured).*

Above. *Swan galaxias (Galaxias fontanus) collected for genetic analysis. Image: CSIRO Australian National Fish Collection.*

and genetically distinct groups. Population genomic work on the Clarence galaxias (*Galaxias johnstoni*) has also been supported by the TSI and future funding rounds may be of interest to others studying threatened fish species (see https://threatenedspeciesinitiative.com/updates/ for updates on funding opportunities).

Left. *Rob Freeman (Senior Fisheries Management Officer, Inland Fisheries Service) electrofishing for Swan galaxias (Galaxias fontanus) in a small headwater stream in eastern Tasmania.*

Tasmania working out the bugs for individual season limits for recreational fishers

By Rod Pearn & Sven Frijlink

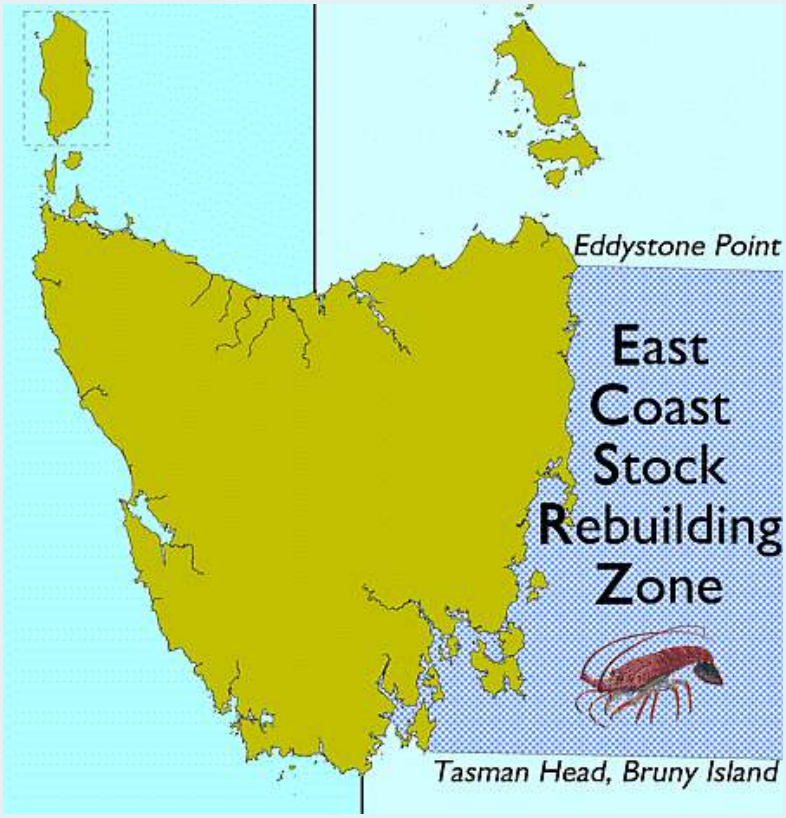
One of the biggest challenges in fisheries management is how to best allocate finite community-owned resources among competing users. While methods to address this perennial issue are becoming increasingly sophisticated, resource sharing between and within user groups remains challenging.

For the Tasmanian rock lobster fishery, management arrangements exist to regulate and monitor catches of commercial and recreational fishers. Commercial catches are tightly constrained to an annual total allowable commercial catch (TACC). A statutory resource sharing arrangement also guides recreational management with a total allowable recreational catch (TARC) of 10% of the TAC or 170 tonnes, whichever is greater. The recreational fishery consistently catches well with in the TARC.

Over the last decade however, stock challenges on Tasmania's east coast – where recreational catches are concentrated – necessitated a separate East Coast Zonal strategy to limit the commercial and recreational catch. Here, a separate and conservative notional TAC operated to rebuild stocks.

While managing the commercial share is relatively effective through a zonal commercial catch cap, managing the recreational sector within its notional allocation through traditional management tools (i.e. bag limits and season closures) proved more challenging. In recent years the Government has not implemented further bag limit or season reductions to address the recreational overcatch in the Zone.

A new Strategy is being developed. As we move to this phase there is an increasing need to have confidence and expediency in estimating the recreational catch and to have additional management levers beyond the traditional bag limit and season adjustments.



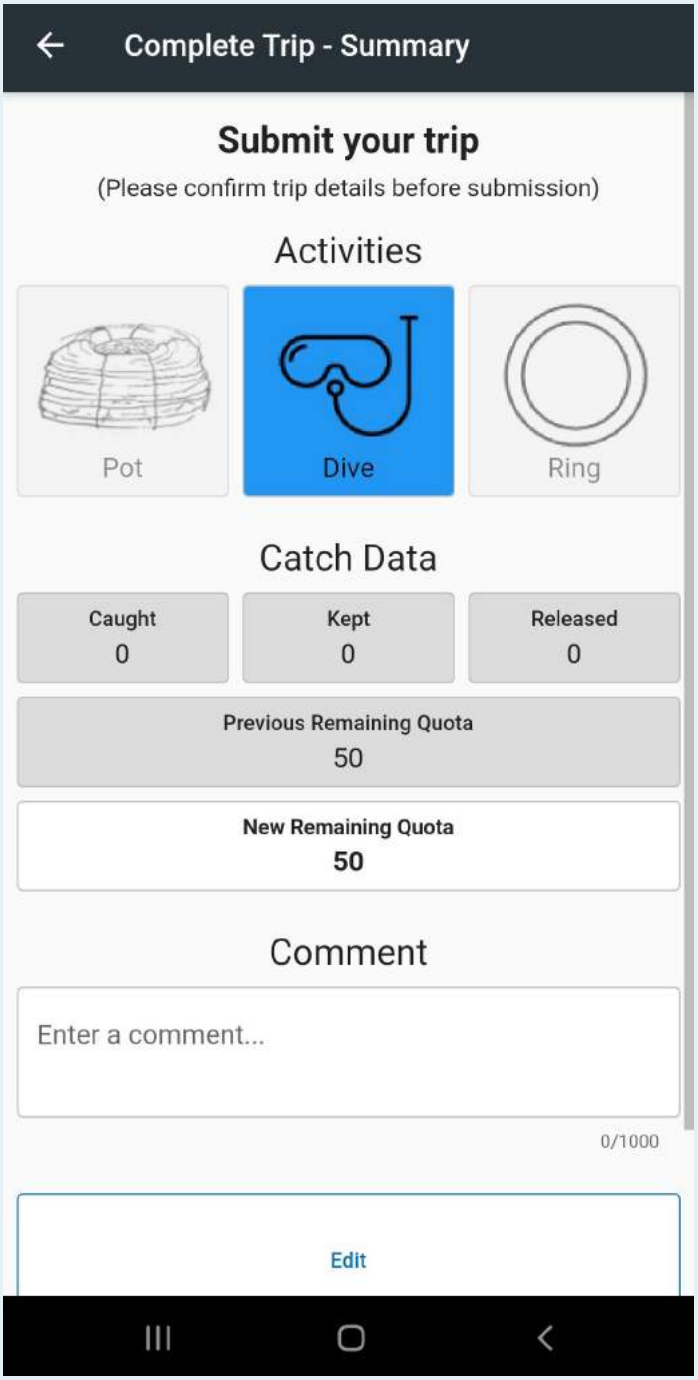
Above. *The area of the Tasmanian Rock Lobster Fishery under increasing fishing pressure from different fishing sectors.*

In response the Tasmania's Department of Primary Industries, Parks, Water and Environment (DPIPWE) are working with an IMAS FRDC funded project seeking options to: 1) report on the recreational catch more expediently -ideally real time and 2) for monitoring and regulating an individual recreational fishers' lobster catch in a season.

A global literature review of recreational fisheries management systems for monitoring and regulating recreational lobster catches is progressing with catch tags, catch cards, phone reporting systems and phone applications being explored.

Trials involving catch tags and apps are being piloted by volunteer recreational fishers to better understand their local effectiveness and practicality. IMAS are also surveying fishers to understand broader perceptions about app and tag effectiveness, anticipated challenges and opinions on acceptable individual season catch limits. As well as allowing managers to understand and regulate recreational catches more effectively, tags and apps may facilitate greater equity among individual fishers.

A report will be available later this year. For further information see DPIPWE's **Recreational Rock Lobster and Abalone Research** web page.



Left. *A screenshot of the section of the app where the recreational fisher would report their catch from a trip.*

Tasmania launches a new draft Recreational Sea Fishing Strategy

By Sven Frijlink and Rod Pearn

Tasmania has recently launched the draft Recreational Sea Fishing Strategy. The Strategy sets a forward-thinking approach to marine recreational fishing that recognises the importance of recreational fishing while addressing the challenges of maintaining healthy fish stocks in a changing environment.

The Strategy outlines 52 actions across six outcomes to progress prevailing issues and meet future challenges. Key foci include the engagement of fishers in fisheries management and research, enabling better fishing access, promoting stewardship and ensuring the long-term sustainability of fisheries and habitats.

The draft has been developed by engaging stakeholders including recreational fishers. Feedback has been sought through interviews with key stakeholders, a public questionnaire and a discussion paper released in September 2020.

The draft Strategy can be found here and is open to public comment until 26 July.

For further information see DPIPWE's Recreational Sea Fishing Strategy web page.

State Reports

Victoria

VIC

Compiled by Tiffany Sih & James Shelley

Behind-the-scenes at the museum

Last year, while most of Victoria was "locked down" riding out the rise and fall of COVID-19 cases in April 2020, the Marine Reponse Unit at Zoos Victoria was called out to Brighton Beach (in the north-east corner of Port Philip Bay) for a large stranded mobulid ray. It was decided that the best option was to euthanize this individual. The staff at Museums Victoria was called to see if they wanted to keep the specimen and it was maintained frozen in a large walk-in freezer at the Melbourne Museum.

Above. *Making a 3D scan of the Japanese Devilray.*

Above. *Detail of the devil ray skin. The skin is rough, like a slimy elephant, and the visible crystals are ice.*

Below. *A sneak peek at the 3D scanner in action.*

In May 2021, just before Melbourne Lockdown v4 this specimen was thawed, preserved and added to the natural history collection. This is the **first physical specimen of the family Mobulidae** (includes mantas and mobulas) collected on the entire southern Australian coast. While reports from fishers have reported seeing large rays in southern Australia, and most mobulid ray species are circumglobal (occurring widely), having a physical specimen collected has unforetold value. This 2-m wide specimen is a juvenile male Japanese Devilray (*Mobula mobular*). While the specimen was being thawed (a multi-day process), the museum took the opportunity to create a 3D scan.

Above. *Senior curator Martin Gomon being interviewed by Rob French (MV videographer).*

While large specimens are logistically difficult to display, 3D models can be created to give accurate representations that can be studied and appreciated by everyone! A reminder that in Victoria, if you see a marine animal that needs help the Marine Response Unit can be reached at **1300 245 MRU** (1300 245 678). *Program it in your phone today!*

Above. *Close-up with the devil (ray). The eye is located at the base of the cephalic lobe.*

Right. *The inner concave portion of the cephalic lobe. These fleshy protrusions help in feeding but may also be used for social communication.*

Little Aussie Battler: Australian Grayling making a comeback in the Glenelg River

Above. *An Australian Grayling captured during a Native Fish Report Card survey on the Glenelg River at Dartmoor. Photo by Andrew Pickworth*

In 2020, an Australian Grayling *Prototroctes maraena* was captured in the Glenelg River by Arthur Rylah Institute (ARI) scientists undertaking a survey for the Native Fish Report Card project, funded by the Department of Environment, Land, Water and Planning (DELWP) and the Victorian Fisheries Authority. This was a particularly exciting find, given the species had last been recorded in this river 122 years previously, back in 1899. A second individual was captured during a repeat survey in 2021. These records are an encouraging sign for the species in the Glenelg River system. The Glenelg Hopkins CMA has been implementing a suite of river restoration actions along the Glenelg River over recent years to benefit Australian Grayling, including improving fish passage by establishing fishways and providing flows at crucial times throughout the year.

Once abundant throughout the coastal rivers of south-eastern Australia, Australian Grayling has declined throughout most of its range, due largely to altered river flows, water extraction and barriers. The species is considered nationally Vulnerable under the Environment Protection and Biodiversity Conservation Act (EPBC) 1999.

The Australian Grayling is diadromous, meaning it migrates between fresh and salt water to complete its lifecycle. Our research has shown that the species requires certain flows at different times of the year to trigger and enable breeding migrations between freshwater and the ocean. The fish benefit from flow pulses or 'freshes' to stimulate spawning migrations and juvenile dispersal. Adults move downstream to spawn, and then eggs and larvae are washed out to sea. Juveniles then return to freshwater after about six months when flows are suitable where they mature into adults.

Many other native fish species are also benefiting from suitable flows and increased river connectivity, including Tupong *Pseudaphritis urvillii* and recreational angling species Estuary Perch *Macquaria colonorum* and Black Bream *Acanthopagrus butcheri*.

Left. *An Australian Grayling captured during a Native Fish Report Card survey on the Glenelg River at Dartmoor. Photo by Andrew Pickworth*

Using satellite tags to track eel migration

Anguillid eels are declining globally due to deteriorating habitat condition, migration barriers, overfishing, climate change, pollution and parasites. Two eel species occur in Victoria: the Long-finned Eel (*Anguilla reinhardtii*) and Short-finned Eel (*A. australis*). These eels are an important part of Victoria's biodiversity and support commercial and recreational fisheries. They also have significant cultural values to Traditional Owners; for example, eel traps of the Lake Condah region of western Victoria have been used for thousands of years to capture Short-finned Eels.
Both Long-finned Eels and Short-finned Eels have amazing lifecycles, travelling thousands of kilometres. Adults are believed to spawn somewhere in the Coral Sea, although the exact location has remained unknown. Their eggs, and larvae, then drift with the currents. They grow into glass eels and then elvers, which move into freshwater to become adults and then one day return to sea.

The Arthur Rylah Institute, DELWP, began a project in 2018, using innovative technology, to identify the eels' migration routes and spawning areas and describe the environmental conditions experienced during migration. Archival pop up satellite tags were attached to adult migratory stage eels in southern Victoria, to track them over large distances and to record environmental data such as temperature, depth and light.
To date, key findings include:

- Some eels were tracked for up to five months and travelled about 3000 km from their release site.
- Tags were detected as far north as 22° latitude, including to near a presumed spawning area in the South Pacific Ocean.
- The eels moved up and down in the water; mainly between depths of 700–900 m in the day and 100 –300 m at night, probably to avoid predators and for thermoregulation.
- Many migrations ended soon after the eels' release, most likely due to predation by sharks, tuna and whales, which highlights their role as a food source.

This work continues, and its findings can help assess and mitigate interactions between eels and human activities in the marine environment. It represents a collaboration between DELWP, the Gunditjmara Traditional Owners, the Glenelg Hopkins Catchment Management Authority, Melbourne Water and Professor Kim Aarestrup from Denmark. See ARI website for details.

The plight of our native eels as well as our research has garnered much recent interest, including Landline, ABC News, The Eels of Dandenong Creek video; One eel of a story: the slippery truth of a fishy underground migration (The Age); Eel be back (Gippslandia); 3MGB Far East Gippsland Radio and ABC Gippsland interviews.

Right. *Wayne Coster with a long-finned eel*

Quantitative Aquatic Ecology and Evolution Lab – University of Melbourne

By Nick Fawcett and John Morrongiello

The Quantitative Aquatic Ecology and Evolution Lab (QAEEL) has had a busy start to the year. Early 2021 saw a return to some semblance of normalcy after the prolonged shutdown of labs and fieldwork in 2020, and with it, several of our dedicated members are nearing the completion of their research. Our newest additions to the team have also achieved significant progress in the early development of their projects. The remainder of 2021 promises to be an exciting time for our lab.

New Developments at QAEEL

MSc student Sarah Willington is investigating the effects of climate change and fishing pressures on the size diversity of 29 species across the world, with the goal of understanding species' ability to withstand environmental variability and perturbations. Sarah's research is linked to a broader joint ICES-PICES working group co-chaired by John Morrongiello focused on the impacts of warming on growth rates and fisheries yields.

We welcome our newest member, Honours student Jenny Santaannop, whose research is exploring how eucalyptus leachate, a naturally occurring endocrine disruptor, affects reproduction in the Murray Rainbowfish (*M. fluviatilis*). Jenny is working closely with MSc student Gemma Walker who is investigating the impacts of prolonged leachate exposure on reproductive and movement behaviours.

PhD student Trish Koh joined us at the start of 2020 and is studying how environmental variability and human impacts affect non-native fish species. Trish will use otolith specimens and bioinformatics practices to help determine growth rates, abundance, thermal performance and adaptation in naturalized trout populations across Victoria.

Jess (Above Left) and Trish (Above Right) out in the field.

Two of our members have been forced to start their PhDs remotely overseas. Jessica Randall (started 2021) is currently based in Washington State and is exploring the effects of climate change and fishing pressures on the growth rates of Pacific fishes. Jess' project will span the Pacific basin, examining questions on growth in both the northeast and southwest pacific. Alex Vaishampayan's PhD (started mid 2020) project will enhance our understanding of Victoria's trout fishery by examining the motivations and values of fishers, determining areas for improved cooperation between fisheries managers and researchers, and studying ecological factors important to the long-term success of the fishery such as spawning triggers and impacts of bushfire. Alex is currently based in California. Remote study has its obvious challenges and both Jess and Alex should be commended for their fantastic progress and engagement, despite the time zone differences!

Postdoctoral Fellow Emily Fobert joined the lab midway through 2020. Emily is working with John Morrongiello and others on two projects- an FRDC-funded investigation into the demography and stock structure of pipis on Victoria's coast, and an ARC Discovery project investigating the drivers of growth and fisheries productivity across the Pacific.

Despite COVID, John Morrongiello has managed to maintain and active international collaborative network, with large projects in the North Atlantic (with Steve Campana), North Pacific (with Bryan Black) and globally (joint ICES-PICES working group, EU COST Action) well under way.

Heading towards completion – and returning for more.

We are pleased to congratulate several of our lab for their completed (or soon to be) research. Josh Barrow is in the final months of his PhD, which has focussed on the associations between movement, environmental variation, and growth of golden perch across the Murray-Darling Basin. Josh's first chapter was published last year, and his second chapter titled "Lifetime movement history associated with variable growth in freshwater fish" was accepted into the Journal of Animal Ecology. After an accomplished post-graduate career (thus far) and many sessions of electrofishing for trout across Victoria, Josh is excited about the prospect of handing in his PhD! Like Josh, Henry Wootton is also nearing the completion of his PhD. Henry's project was severely impacted by 2020's University shutdown as it came during the last 8 months of what turned out to be a 2.5 year long, multi-generational experiment into the joint impacts of fishing and warming. Henry was granted special permission to continue the experiment and with characteristic good humour and dedication, managed to finish data collection despite the extremely trying circumstances. The end result was his recent paper published in the Proceedings of the National Academy of Sciences and a couple more to come. Well done Henry and Josh!

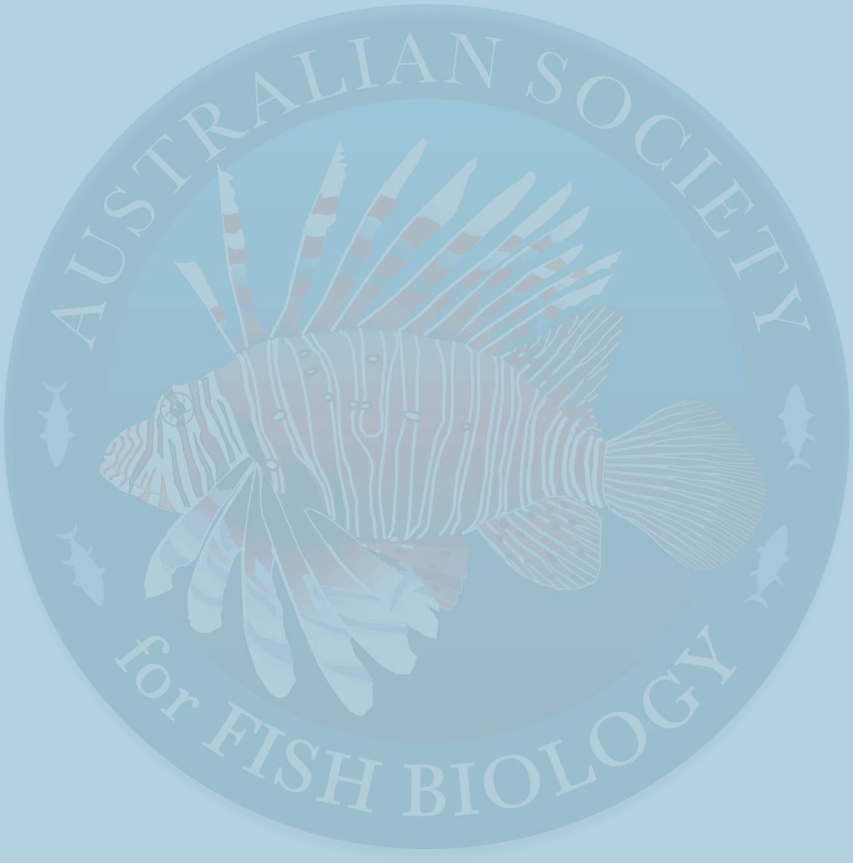
Congratulations to Brien Roberts from CDU (co-supervised with Dave Crook, Alison King, Dave Morgan) and Giorgia Cecino (Melbourne, co-supervised with Eric Treml) for their terrific effort in submitting their PhDs in the last six months.

Ruby Stoios is in the final writing stages of her MSc, which studies the effects of climate change on phenotypic plasticity and population adaptive capacity in freshwater shrimp. After acclimatising three populations of *Paratya australiensis* to 5 different temperatures across 15 weeks, Ruby measured their growth and burst swim speed. Analysing individual reaction norms led to the conclusion that warmer temperatures will slow growth rates, leading to smaller adults within populations. However, the shrimps' smaller size did not have an effect on their acute predator avoidance behaviour.

Above – Juan and Josh on location during electrofishing.

Finally, Juan Wang, who completed his MSc in the lab in 2020, has come back for more. Juan's MSc found that fish do indeed learn from past experience, with the "catchability" of fish who had been caught – or witnessed other conspecifics being caught – being significantly lower than those not exposed to fishing pressures. Additionally, individual risk-taking behaviour played

a role in “catchability”, with bolder individuals being more vulnerable to angling. His research indicates that fisheries management is currently over-simplified in relation to angling dynamics, and offers valuable insights for long-term fisheries from a behavioural and evolutionary perspective. Juan’s PhD research is a collaboration with Jed Macdonald and Simon Nicol from the Pacific Community (SPC) and will focus on reconstructing temperature-dependent life-history patterns (e.g., spawning) using otolith samples from tuna and dolphinfish.



State Reports

Western Australia

W.A.

Compiled by Alissa Tate

Department of Primary Industries and Regional Development - DPIRD, WA

Size matters: large spiny lobsters reduce the catchability of small conspecifics.

Emma-Jade Tuffley (Emma-jade.tuffley@dpird.wa.gov.au)

Catch rates are often used in both ecology and fisheries science to derive indices of abundance and population demography. This relationship, however, is dependent on constant catchability; that is how susceptible an animal is to being caught in a particular fishing gear.

Catch rates of lobsters are most commonly obtained from lobster pots or traps. However, there is evidence in many clawed lobster species, as well as some spiny lobster species, that lobsters already caught in pots effect the catchability of approaching lobsters. Previous research has indicated that these effects are usually size and sex specific, for example, in clawed lobsters large lobsters reduce the catchability of smaller lobsters through antagonistic encounters.

The western rock lobster, *Panulirus cygnus*, which is endemic to Western Australia, is the basis of Australia's most valuable single species wild caught fishery. This fishery is governed by stock assessment models, which use, in addition to other data sources, catch rates from breeding stock surveys. Over recent years, changes in management to this fishery have resulted in dramatic changes in the population demography, with likely more large animals now present. As the effect of intraspecific interactions on catchability of *P. cygnus* had not previously been investigated it is unknown what effect the increased relative abundance of large animals will have on pot-based size and sex-structured catch rate data used in stock assessment modelling.

Through three studies; (1) aquaria trials, (2) pot seeding experiments, and (3) field surveys, we demonstrate that large *P. cygnus* reduce the catchability of small conspecifics; large males by 26-33%, and large females by 14-27%.

Conspecific related catchability should be a vital consideration when interpreting the results of pot-based surveys, especially if population demography changes, as it has in the West Coast Rock Lobster Managed Fishery.

Read the full article here: https://www.int-res.com/articles/meps_oa/m666p099.pdf

ICWL 2020
12th International Conference and Workshop
Lobster Biology and Management
18-23 Oct, The Esplanade Hotel, Fremantle | WESTERN AUSTRALIA

The Organising Committee of the 12th International Conference and Workshop on Lobster Biology and Management have been reviewing the likelihood of ICWL being able to proceed in 2021. Given the current status of COVID-19 internationally we consider that it is unlikely that international travel will return to normal in 2021 that would allow the successful hosting of the conference and workshop in a face to face capacity.

Therefore, the Organising Committee has again reluctantly decided to postpone the 12th International Conference and Workshop on Lobster Biology and Management to **October 2022**.

Please refer back to the website for updates or sign up to our mailing list.

The Department of Primary Industry and Regional Development (DPIRD) and the Western Rock Lobster Council (WRL) were very much looking forward to hosting scientists, managers and industry participants in Western Australia in 2021. However, we are committed to hosting ICWL in 2022.

Don't hesitate to contact the Conference Managers, Arinex at icwl2020@arinex.com.au with any queries.

Please stay safe and we look forward to seeing you in 2022.

Nick Caputi

(nick.caputi@dpird.wa.gov.au)

Nic Sofoulis

(sofs1@bigpond.com)

12th International Conference and Workshop on Lobster Biology and Management

Co-Chairs

Student Spotlights

Exploring the use of Southern Rock Lobster (*Jasus edwardsii*) as a predatory control on Longspined Sea Urchins in Tasmania

Jennifer Smith, PhD student, Institute for Marine and Antarctic Studies, University of Tasmania

Email: je.smith@utas.edu.au

Supervisor Details: Dr John Keane, Dr Michael Oellermann, Dr Craig Mundy, Prof Caleb Gardner

About my project

In response to climate change and warming waters along the East Coast of Tasmania, Longspined Sea Urchins (*Centrostephanus rodgersii*) have been extending their range southwards from NSW and are causing huge damage to Tasmania's underwater biodiversity. Uncontrolled urchin grazing on kelp transforms healthy reef into urchin barrens, which can trigger the loss of up to 150 species! Multiple methods to control these urchins are being researched and tested. My project specifically looks at using the native Southern Rock Lobster (*Jasus edwardsii*) as a predatory control on these Longspined Sea Urchins. As the primary predator on Tasmanian reefs, the Southern Rock Lobster is capable of eating these urchins, but I'm looking into whether they would choose to eat them if they had other prey options – such as Abalone, Periwinkles or native Shortspined Sea Urchins. In short, I'm currently looking at what the Southern Rock Lobster's favourite food is, and whether lobster size or where they come from influences their choices. Down the line, I'm going to explore why lobsters might prefer different prey species and whether this can be useful in management and planning for the control of the pesky kelp-destroying Longspined Sea Urchins.

Above. *Jennifer holding one of the pesky longspined sea urchins.*

Interesting fact: The first Longspined Sea Urchin was found in Tasmanian waters in the 1970s, now the population in Tasmania is over 20 million individuals. This increase in population has been caused by climate change (1) inducing the extension of the East Australian Current, transporting urchin larva further south and (2) warming waters, allowing the urchins to survive and settle further south than ever before.

Left. *Jennifer with a nice sized southern rock lobster*

Student Spotlights

Attracting native Australian freshwater fish into the Tube Fishway

Maryam Farzadkhoo – PhD Student, School of Civil and Environmental Engineering and School of Biological, Earth and Environmental Sciences, University of New South Wales, Sydney

Supervisors: Dr. Stefan Felder; Adjunct Prof. William Peirson, Prof. Richard Kingsford, Prof. Iain Suthers, and Adjunct A/Prof. John Harris

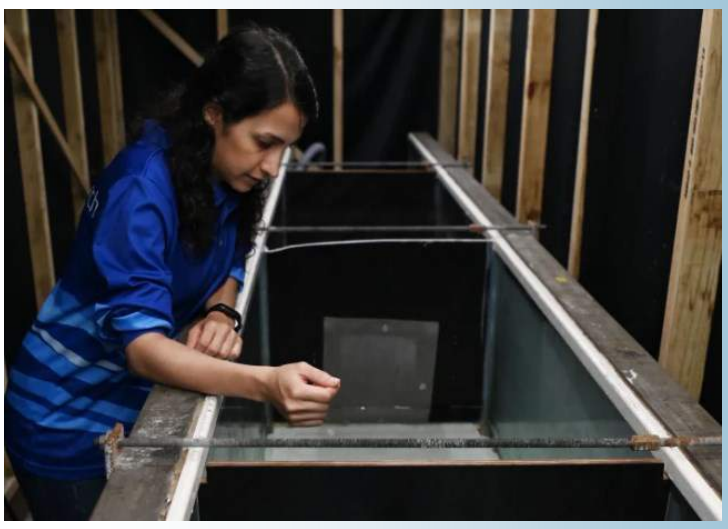
About my project

River barriers such as dams and weirs are major threat for migratory fish species worldwide. Fishways aim to restore river connectivity. A novel fishway design, the UNSW Tube Fishway, was recently developed by a team of fish ecologists and hydraulic engineers. A key component of the Tube Fishway operation is to attract fish into a 'transfer' chamber before the fish are lifted across a barrier at near-atmospheric pressure, over the barrier. The aim of my PhD is to optimise the attraction of fish into the Tube Fishway. To achieve this, my research aims to fundamentally understand fish attraction behaviour by varying entry geometry, transfer chamber sizes, attraction flow properties as well as fish species and sizes. Attraction experiments with silver perch (*Bidyanus bidyanus*) and Australian bass (*Macquaria novemaculeata*) have shown strong attraction of fish into the Tube Fishway, while further optimisation with a fish trap and upstream guiding structures are ongoing. Further Australian native fish species will be tested to expand the operation range of the Tube Fishway.

About me

I joined the UNSW Water Research Laboratory and Centre for Ecosystem Science as a Scientia PhD Scholar in 2019. The broad interdisciplinary nature of this research project captured my attention because it not only provides the opportunity to learn about the interactions of fish ecology and hydrodynamics, but more generally to reduce the detrimental effects of artificial barriers on fish populations.

Below. *Attracting silver perch into the transfer chamber*



Above. *Maryam conducting laboratory experiments to attract freshwater fish species into the UNSW Tube Fishway. Photo taken by Nick Moir*

Student Spotlights

Increasing our understanding of Southern Hemisphere lampreys using a two seq (RADseq and RNAseq) approach

Allison K. Miller – Doctoral candidate, Gemmell Lab (https://gemmell-lab.otago.ac.nz), University of Otago.

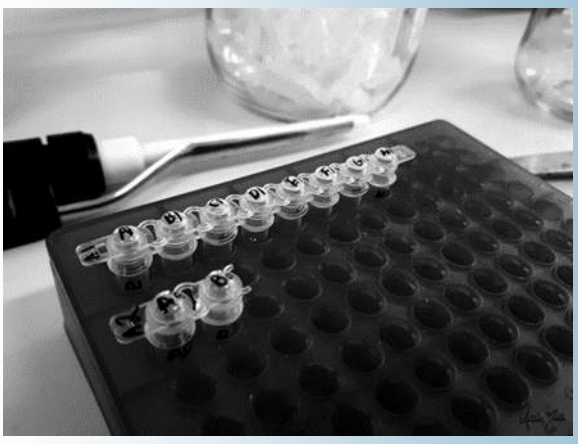
Supervisors: Prof. Neil Gemmell (Uni Otago), Dr. Cindy Baker (NIWA), Dr. Alana Alexander (Uni Otago)

About me

Kia ora!/Hello! My name is Allison Miller and I am a PhD student studying kanakana/lamprey at the University of Otago. I received my undergraduate degree (B.Sc.) from the University of California San Diego and my master's (M.Sc.) degree from the University of Guam. Afterwards, I practiced natural resource management as a biological technician with the US National Park Service. My interests include ecology, evolution, fisheries, marine invertebrates (especially echinoderms), and coral reef biology.

About my project

As a PhD student, I am utilizing restriction site associated DNA markers (RADseq) and RNA sequencing to better understand the structure, systematics, viability, and health of Southern Hemisphere lamprey populations (with an emphasis on the pouched lamprey [Geotria australis]). The pouched lamprey, or kanakana in Te Reo Māori, is an important customary (or hereditary) fishery and my research will fill multiple key knowledge gaps while providing insight on ways to restore and enhance kanakana populations around New Zealand. I will also be assessing the genetics of the only other Southern Hemisphere lamprey genus, Mordacia, to better understand the systematics of lamprey overall.

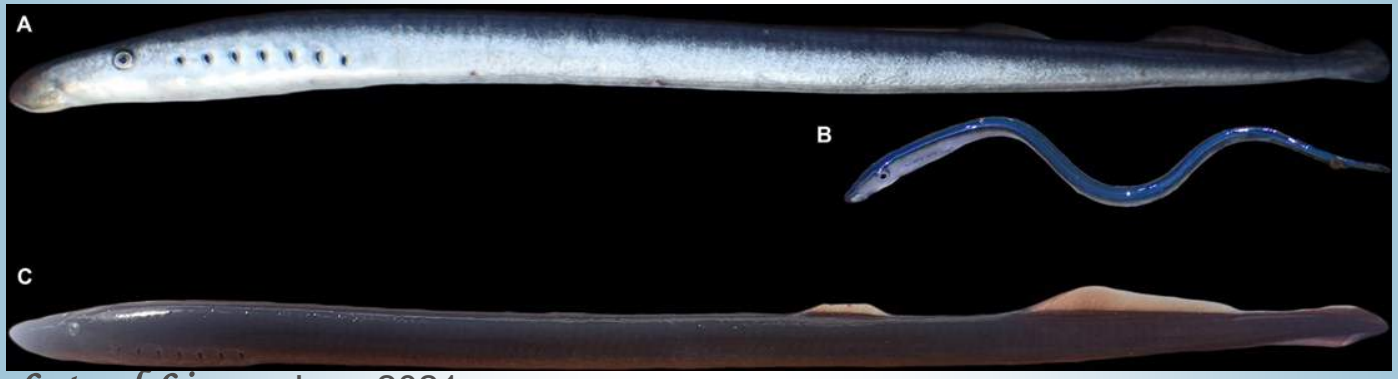


My citizen science projects:

- FISHYbites: https://a3miller.wixsite.com/fishybites
- iNaturalist project Lamps_for_champs: https://www.inaturalist.org/projects/lamps_for_champs-9d14be44-0fd6-4f57-8774-4be2451c16be

Interesting fact: Our pouched lamprey research is helping us better understand coronaviruses

Below. *A. pouched lamprey (Geotria australis) adult B. pouched lamprey juvenile (photo: Stella McQueen) C. short-headed lamprey adult (Mordacia mordax, photo: Arron Strawbridge)*



12-month Fish Fellowship Opportunity!

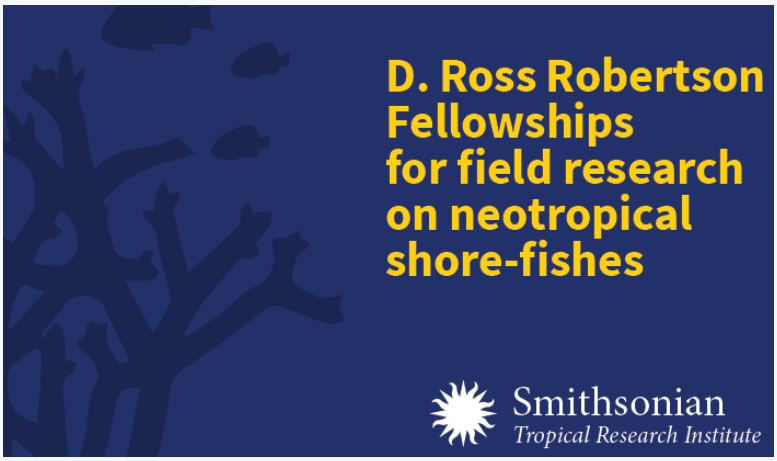
D. Ross Robertson fellowships for field research on neotropical shore-fishes

Description

Supported by an endowment created to further the accomplishment of field research on the evolution, ecology, natural history and related taxonomic and systematic issues, of marine and brackish-water fishes found in nearshore, tropical and subtropical waters of North, Central and South America, and the Panama Canal. This includes research in neotropical countries other than Panama, although the fellow is expected to be based at STRI during at least part of the tenure of the fellowship.

Eligibility

PhD students formally enrolled at a university.



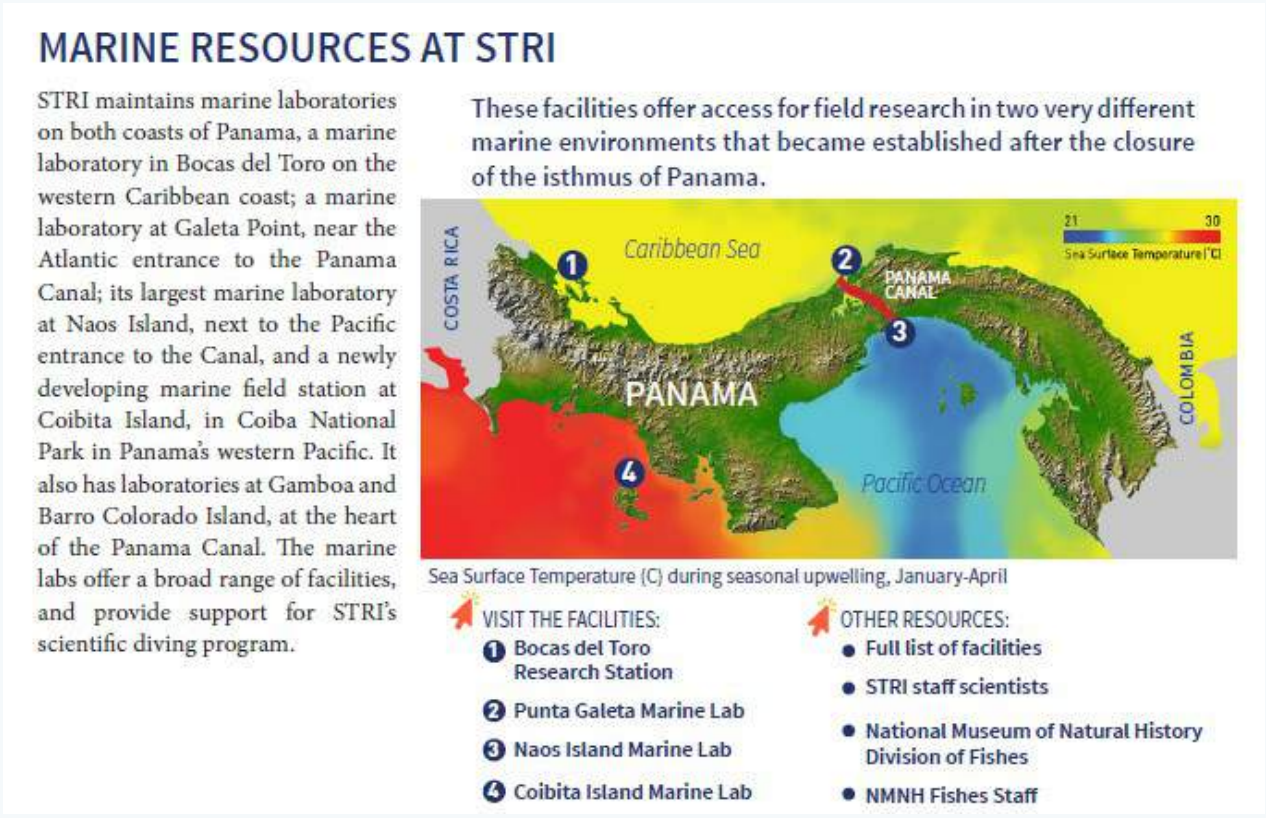
The 2021 fellowship is a 12 month predoctoral fellowship for a student pursuing a PhD.

- STIPEND:
  $44,000 USD /year
- RESEARCH ALLOWANCE:
  Up to $25,000 USD
- TRAVEL ALLOWANCE:
  Round trip airfare to Panama
- HEALTH INSURANCE:
  up to $2,500 USD /year

Guidelines and Applications

English: https://stri.si.edu/academic-programs/fellowships

https://stri.si.edu/sites/default/files/rossrobertsonfellowhip.pdf



In Memoriam

Remembering Dr Christopher Timothy Walsh ("Walshy") 16.05.1967 – 28.03.2021

Contributors: Dylan van der Muelen, Julian Hughes, Jerom Stocks, Kat Cheshire (NSW Department of Primary Industries, Fisheries Research).

Published with permission from Wendy Walsh.

PhD, University of Wollongong, 2012,
MSc, University of Technology, Sydney, 2003,

BSc, Macquarie University, 1994

Dr Christopher Timothy Walsh's research career spanned over 25 years. "Walshy" first started his research career working for the NSW Department of Primary Industries as a technician at Gaden Trout Hatchery in Jindabyne in 1994, before moving to the Cronulla Fisheries Research Centre. Chris completed a PhD through the University of Wollongong in 2012 on the 'Ecology and movement behaviour of two co-occurring estuarine dependent fishes *Macquaria colonorum* and *Macquaria novemaculeata'.* His dedication to research saw him achieve the position of Senior Research Scientist at the Batemans Bay Fisheries Centre. But he took great pride in having started his career as a technician at Jindabyne, he kept his field skills up and could always return "to stripping trout at The Hatch".

Chris was determined to get the absolute most out of life which he shared with his wife Wendy and their two kids Aimee and Dylan – fishing anywhere there was water, cycling anywhere there was road (and many places where there wasn't), skiing all over the world, dragging a 50 year old caravan around Australia, building a house in the Snowy Mountains and owning shares in a couple of racehorses.

Chris loved temperate coastal estuaries and freshwater rivers, which is where he focussed his research on fish ecology. Walshy was a keen fisher before he made a career from his passion. He understood fish ecology in a way that couldn't be taught just from books. Chris was the ultimate example of a 'Fisheries True Believer' (a term that he adapted from the Labour 1993 movement) - someone who works for the good of the fish - instead of improving their own personal career. Chris took the opportunities to regularly go fishing outside of work and ensure he kept this passion alive. Chris made a significant contribution to fisheries science through a successful academic career publishing over 27 research articles, numerous technical reports, supervising honours and PhD students and working collaboratively on several cross-jurisdictional projects.

Chris' numerous research achievements focussed on improving management activities of the diverse species he worked on – eels, garfish, prawns, bass and perch, as well as a suite of other freshwater fish species. He gathered scientific information for age, growth, reproduction, fish stocks, migration and spawning, and explored the influence of environmental flows, fish passages, and intervention monitoring. He made significant contributions to development and refinement of modern analytical techniques (e.g. acoustic telemetry, otolith microstructure and stable isotope analysis).

Chris' legacy will live on through the projects that he was working on, and helped to initiate that are becoming a reality, these include the Fitzroy Falls Spiny Crays Project, The Rec Trust: Managing the black bream fishery in southern NSW – understanding genetic spatial distribution; Estuary Perch Population Model (a collaboration with the Arthur Rylah Institute, Victoria), many species in of the South Coast Bushfire Recovery Surveys and the Coastal Fish and Flows Programs. He was motivated and produced high quality research which earned him an international reputation. Chris presented at local and international conferences taking him to places like, Japan, New Zealand and the Netherlands, where his passion for fish biology and ecology could be combined with a spot of fishing.

Walshy was generous with his time and wonderful team player; he was always willing to roll up his sleeves and help the team achieve great things. Chris played to the strengths of other 'Fisheries True Believers' around him and got the best out of people. Chris really enjoyed supporting upcoming researchers and supervised numerous honours, masters and PhD students. The legacy of students is a far reaching one, that will ensure the passion and dedication of the scientist continues. No doubt, Walshys laid back, funny and encouraging approach to teaching and mentoring, combined with his expert knowledge has inspired a legacy of people dedicated and committed to carrying on his work.

Chris was incredibly supportive of his colleagues, making many great mates through a shared passion for fish. Walshy had a wonderful sense of humour, an amazing appreciation for the ridiculous and a great gift for the telling of a good yarn. He will be fondly remembered as talented, determined and productive researcher, but most of all as a much-loved gentle, relaxed, friendly and funny person. Many of us will feel the absence Walshy leaves in our daily professional lives, but his legacy is far reaching and we know more about our freshwater and estuarine ecosystems because of Chris' work.

The Australian Society for Fish Biology passes on our sincerest condolences to Chris' wife Wendy, their two children Aimee and Dylan, and all of Chris' extended family and friends.

The family have advised that where people wish, remembrance donations can be sent to:

- For research: Lung Foundation Australia https://lungfoundation.com.au/research/our-research/lung-cancer/
- For financial assistance to cancer patients on the South Coast NSW: Can Assist - Eurobodalla Branch https://www.givenow.com.au/canassisteurobodalla

2021 Publications:

- Stocks J. R, Davis S, Anderson M. J., Asmus M. W., Cheshire K. J. M., van der Meulen D. E., **Walsh C.T.** and Gilligan D. M. (in press). Fish and flows: Abiotic drivers influence the recruitment response of a freshwater fish community throughout a regulated lotic system of the Murray-Darling Basin, Australia. Aquatic Conservation: Marine and Freshwater Ecosystems
- Stoessel D., Todd C. R., Brown T., Koehn J. D., **Walsh C. T**, van der Meulen D. E, Williams J. and Birleson M. (*in press*) Accessing outcomes of environmental flows for an estuary-dependant fish species using a stochastic population model. *Estuaries and Coasts*

Arts and Science

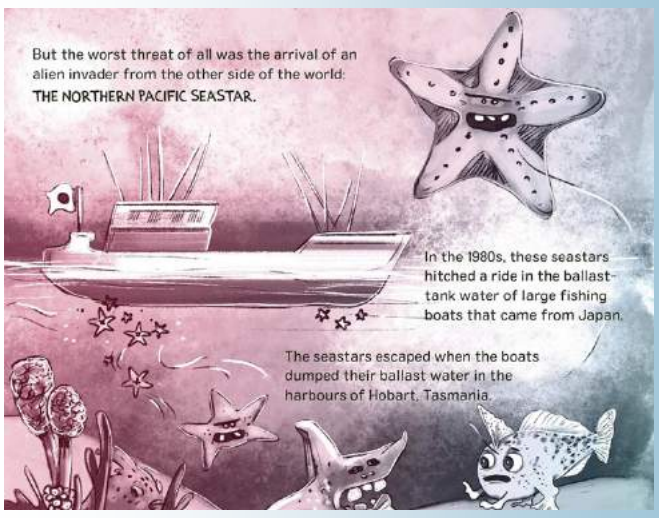
Hold On! Saving the Spotted Handfish – Shortlisted & Staying Alive!

Dr. Gina M Newton

In the December 2020 edition of Lateral Lines we brought you the story of an interesting blending of art and science in the form of a children's information picture book, which is now in the spotlight. Gina explains.

Each year the Children's Book Council of Australia (CBCA) votes on the 'Book of the Year' for five categories of children's books published in Australia in the preceding year. These awards are akin to the Oscar's for the children's book industry. Authors, illustrators, and publishers nervously await the three sets of announcements. In February, the 'Notables' are announced. *Hold On!* made it onto the list of 15 books for the Eve Pownall Award category for information children's books. Then in late March, the 'Shortlist' was announced (via a YouTube video set in the South Australian Museum). YAY! I'm so excited to say, *Hold On! Saving the Spotted Handfish* (CSIRO Publishing, 2020) made the next cut – down to six books.

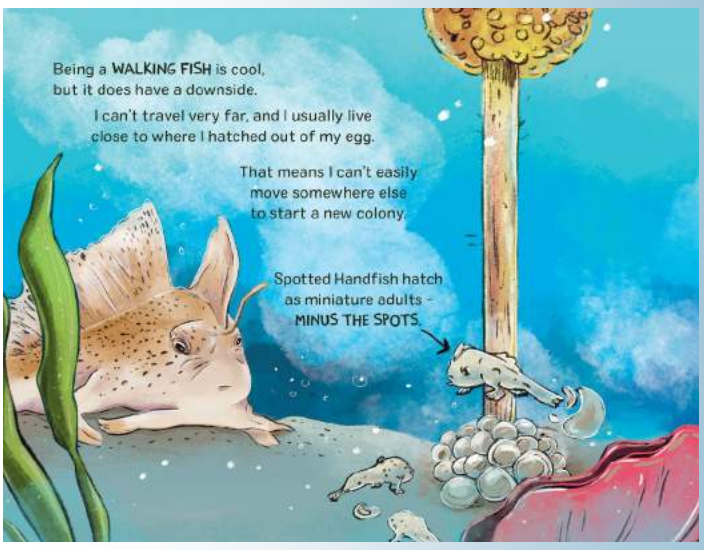
This is the one that the publishers really like, as many schools and libraries will order the CBCA Shortlist each year. Of course, the creators like it too. The winner and two highly commended books for each category are finally announced in August.



Above. *An excerpt from the book.*

The content of this picture book is suitable for mid to upper Primary/early High school aged kids (age 6 – 13 years) and comprehensive Teacher Notes are also available (on my or the publisher's website). This 'true' story is based on a quirky, primitive little fish that is famous for two reasons: walking on its 'hands' (pectoral fins) and being one of the first marine fish species in the world (and Australia) to be listed as Critically Endangered (via IUCN Red List and EPBC Act) – the Spotted Handfish. On another note, sad to say that another of its relatives was declared extinct by the Red List last year (the Smooth Handfish).

Above. *Handstand giving out some helpful facts in the book.*



Above. *Handstand explaining what life is like for a handfish.*

I wanted kids and people outside of Tasmania to know about this fish and its conservation plight, which is a story that also showcases the amazing work of scientists and citizen scientists. The information I used to develop the story and its associated facts, were all thoroughly researched, and any concerns were followed up with experts for further advice. Although this is a children's book, it is vital that it is developed with scientific credibility and rigour - as should any good science communication piece.

Right. *A beautiful real life handfish. Photo credit: Rick Stuart Smith.*

To follow, is a brief list of some of the devices I used to hook in and encourage the reader (kids and adult), keep them engaged, increase suspense, and convey scientific information in a way that feel's entertaining, accessible and satisfying:

- The story is narrated by a cartoon-style Spotted Handfish called Handstand, with speech bubbles used to complement the 'normal' text – that makes it less formal, more fun and more engaging.
- Right up front there's a 'hook' - a link to dinosaurs, and kids love dinosaurs.
- Also, near the front, providing comparison to deep-sea angler fish provides some scary intrigue.
- Using imaginative illustrations to help convey information – e.g., diver with a ruler to show the small size of the fish and at the same time labelling the body parts; using the Vulnerability Checklist; invasive seastars shown as mean and hungry.
- Using a change in font size and boldness now and then in the text to highlight certain words or phrases.
- Explaining complex concepts with simple text and sentences, but link to harder words.
- Listing and defining the harder words (jargon) in a Glossary at the back of the book.
- Weaving concepts into the narrative of the story – keeping the progression logical, linked, and moving toward a climax and conclusion (i.e., have a story-arc).
- Changing up the scenery and perspective to provide visual variety for the reader (e.g., under the sea, on a desktop, in the laboratory, gallery of pegged photos, etc.).
- Use iconic, more widely known aspects to help convey information – e.g., many kids know the Tasmanian Tiger is 'extinct' and what that may mean.
- Inject some humour where possible to add some 'lightness' – Handstand is good for that.
- End the story on a bright and hopeful note.
- Using the End Papers at back to provide more detailed information in a 'Conservation Timeline' from the 1960s to 2020.

And finally, a picture book is not a picture book without the illustrations. I was fortunate to have such a talented artist as is Rachel Tribout as my co-creator. Her imaginative and vivid artwork really brought the story to life and greatly added to the visual appeal and visual literacy of the book. Please wish Handstand good luck for August; it would be so good if the story of the Spotted Handfish was better known around the nation.

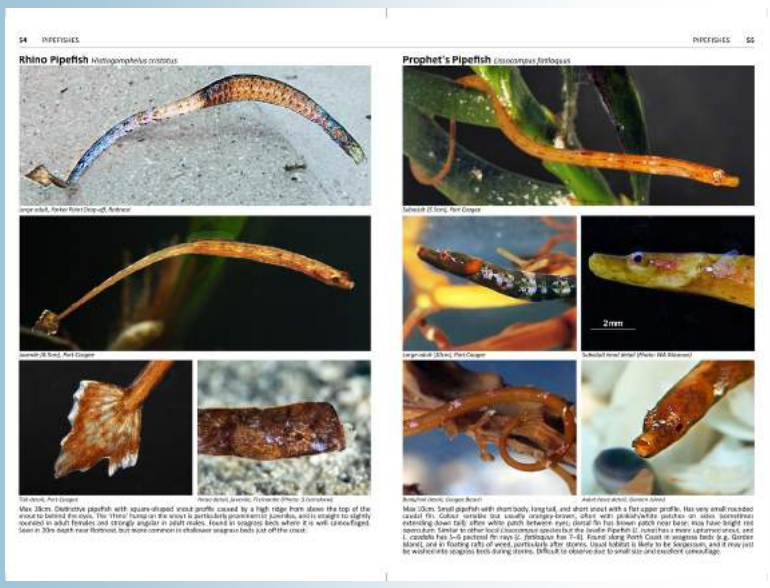
Right. *Some of Rachel Tribout's amazing artistry on display in the award winning book.*

Arts and Science

The Perth Coast Fish Book

By Glen Whisson and Alexandra Hoschke

The Perth Coast Fish Book is the most comprehensive fish identification guide ever produced for the coastal waters surrounding Western Australia's capital city—featuring over 1,000 colour photographs, and descriptions of more than 500 species found along the Perth Coast between Mandurah and Two Rocks.



Recently published in May 2021, the book represents years of research, diving and photography by authors Dr Glen Whisson and Alexandra Hoschke, and is a key resource for fishers wishing to identify their catch; divers and snorkellers working out what fish they observed; marine researchers and the general public needing a detailed reference guide; and anyone interested in the wonderfully diverse marine environment that exists on Perth's doorstep.

Part of the appeal of *The Perth Coast Fish Book* is the large input from Citizen Scientists, with over 100 contributors supplying beautiful images of the local fish fauna, from incredible images of seahorses releasing young to rarely observed species like the Goblinfish (*Glyptauchen panduratus*) and the Australian Tilefish (*Branchiostegus australiensis*).

Of particularly importance to scientists and researchers is the inclusion of a verified list of all fish species ever recorded along the Perth Coast to a depth of 30m, highlighting species endemic to Western Australia, introduced species, those considered outside their normal historic ranges, and species thought to have recently expanded their ranges to the Perth Coast. This list was produced in collaboration with Dr Glenn Moore from the Western Australian Museum, and is a comprehensive reference for researchers, management authorities, and fish enthusiasts.

Copies are available direct from the authors at: https://www.aquamonitoring.com.au/arms-shop/

ASFB Committee Reports

Fisheries Management Committee Update

Over the past six months the Fisheries Management Committee (FMC) has been kicking goals and progressing with projects and workshops. In January 2021, New Zealand was welcomed to the Committee Executive.

Three workshops were hosted by the Committee with the theme of Electronic Reporting. The workshops were held in September and December 2020, and March 2021. The aim of the workshops were to provide an opportunity for fisheries managers to share information and learn from the experiences of others. One of the common goals found was to implement some form of electronic reporting in each jurisdiction. The Committee will be holding more workshops in the future.

The Committee has been successfully trialling the use of 'Trello' as a centralised communication platform for storing and sharing information across jurisdictions for over two years. In May 2021, the Committee submitted a paper to the Australian Fisheries Management Forum (AFMF) seeking support on the adoption of Trello to fisheries managers in Australia and New Zealand as an information sharing and communication platform. Subject to the support from the AFMF, the Committee hopes to be able to make Trello available to all members in the near future.

A desktop project is underway looking at social and economic objectives for Australian and New Zealand fisheries. This project will pull together information on how these objectives are currently being used across Australian and New Zealand and help fisheries managers gain a better understanding on how to apply measurable social and economic objectives to harvest strategies.

The FMC intends to have a general meeting at the World Fisheries Congress on 20 September 2021.

ASFB Committee Reports

Alien fishes committee

Queensland

Invasive cichlids across the Pioneer River Catchment update –
Michael Mottley, MSc Candidate, QUT.

The study is focused on detecting the invasive jaguar cichlid within the Pioneer River Catchment utilising eDNA techniques. The species is currently assumed to be limited to the lower regions of the catchment, with a fishway prohibiting spread upstream. Detection of the species upstream has the potential to drastically alter the management of the Pioneer, highlighting the need to expand monitoring methods to include molecular techniques such as eDNA, which boasts increased sensitivity and is capable of the detection of species despite low abundance. Michael is currently optimizing a qPCR protocol with the use of a Taqman probe to further increase the techniques detection probability and sensitivity. Following this, the project will expand to detect other invasive cichlids in the catchment, including tilapia and peacock bass.

Biosecurity Queensland leads National Risk Assessment Process for ornamental fish – Dr Bonnie Holmes, USC

In 2006 a working group of Natural Resource Management Ministerial Council (NRMMC) released a document called the *Strategic Approach to the Management of Ornamental Fish in Australia*. This report included two lists; a national noxious fish list, and a 'grey' list. The grey list of species originally consisted of 778 non-native fish species, many believed to be in the Australian ornamental aquarium trade, but not actually permitted for importation, trade and/or possession under the Federal government's current Live Import List. In 2018, a new risk assessment framework was developed by SARDI Aquatic Sciences, which incorporates a scoring system that provides more robust tool to assess grey list species for invasiveness risk to Australia. The Freshwater Vertebrate and Invertebrate Working Group (FVIWG) is leading both a Technical Working Group, and a series of risk assessment workshops (with industry involvement) to roll out the risk assessment. There will soon be two 'assessors' appointed to complete the risk assessment process for 500+ identified grey list species. Follow up policy decisions at both the State/Territory and Federal levels are also in development, including possible increases in permitted species importation for low risk species, and other strategies for those deemed medium or high risk. Work on a collaborative nation-wide communications plan is also in the pipeline, to ensure consistent messaging across all jurisdictions.

ASFB Committee Reports

Alien fishes committee

Australian Capital Territory

eDNA surveys detected the presence of Carp for the first time in Googong Dam (just across the border from the ACT), but convention sampling had failed to detect any individuals in 2019. A fisherman returned two fish to authorities, with one being a confirmed common carp. A program is underway to try and characterise the incursion.

Other alien fishy news:

- It's Invasive Species Week in the UK and USA this week, which times in well with the Virtual Australasian Vertebrate Pest Conference on now
- The ornamental documentary Dark Hobby was finally released- it looks at fish exploitation in the Hawaiian ornamental industry: https://thedarkhobby.com/
- An interesting ornamental paper came out on the potential exploitation of ornamental zebra loach in India: https://www.scopus.com/record/display.uri?eid=2-s2.0-85105304137&origin=SingleRecordEmailAlert&dgcid=raven_sc_search_en_us_email&txGid=48b5b4c8fb88cdd13a44aa4bddffd4fa&featureToggles=FEATURE_NEW_MAIN_SECTION:1,FEATURE_NEW_SOURCE_INFO:1,FEATURE_NEW_REAXYS_SECTION:1,FEATURE_NEW_SCIVAL_TOPICS:1,FEATURE_VIEWS_COUNT:1

ASFB Membership

Applications for membership are invited from any person interested in the aims of the Society (as set out in the constitution) or any institution wishing to receive the Society's newsletter and other publications. The membership application is through the website (https://members.asnevents.com.au/login/) with credit card online payment options. Membership of the Society entitles all members to discounts for conference registrations and access to download the newsletter and conference proceedings from the website. Members who are non-financial for more than 12 months will forfeit the benefits of membership and be removed from the membership database. There are three membership categories:

Student Member:

- One Year $30.00
- Three Years — Not available.

Ordinary Member:

- One Year $60.00
- Three Years $150.00

Retired Member:

- One Year $30.00

Institutional Memberships are also available by contacting the Membership Secretariat at: http//www.asfb.org.au/contact-us/ Office bearers and half of the Executive Council are elected from the membership at the Annual General Meeting, held during the Annual Conference.

Pay Your Membership & Update your Membership details

The Society requires your details to be registered online. We must have your current contact details and e-mail address in order to send out ASFB communications. Please make sure you pay your subscriptions promptly and contact the Membership Secretariat at: http://www.asfb.org.au/contact-us/.