Department of Primary Industries Student Conservation Award

2019 John Holliday Award Applicant Summaries

Picture: Left to right Dr Natalie Moltschaniwskyj (Director Fisheries Research), Giulia Ferretto awarded the 2019 John Holliday Student Conservation Award, Sue Holliday (wife of late John Holliday).

More information

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NSW Department of Primary Industries (DPI) Fisheries is aware of the diverse range of research undertaken each year by university research students in NSW, and encourages communication of this research to assist the management of fisheries resources and aquatic habitats in NSW.

The John Holliday Student Conservation Award is offered by DPI to encourage research students to share their research findings on topics of interest to the Department. The winning entrant for the 2019 John Holliday Award received a cash award of $3,000. The Award is named in honour of the late Dr John Holliday, a former Senior Conservation Manager, who pioneered the Department's involvement in aquatic habitat and fish conservation issues.

The 2019 John Holliday Award was open to research students who were enrolled at an Australian University during 2019 and who undertook research of relevance to DPI Fisheries in NSW. The applicant's summaries are listed below.

2019 Winning Project Summary

Restoring the threatened seagrass *Posidonia australis* in old boat mooring scars

Giulia Ferretto, University of New South Wales, Email: g.ferretto@unsw.edu.au

The seagrass *Posidonia australis* (hereafter Posidonia) inhabits sheltered estuaries along the southeast coast of Australia. This seagrass is particularly sensitive to disturbances because of its slow recovery rates. Posidonia declines can have vast impacts on ecosystem functions and services, including losses to fisheries, reduced blue carbon sequestration or increased erosion, with cascading impacts to local economies. Traditional block-and-chain boat moorings are a major threat for Posidonia as they scour the seafloor, removing shoots and creating unvegetated sandy patches where natural recolonization is inhibited. Environmentally friendly moorings are now available that avoid damaging seagrasses. However, the natural recolonization by Posidonia can be very slow.

In this study, we develop a novel restoration approach to revegetate old mooring scars through planting naturally-detached rhizome fragments collected by citizen-scientists, thereby avoiding damaging remaining Posidonia meadows. We have tested three techniques to optimize restoration success: restoring on bare sediment with, and without, stabilising jute mats and on scars colonised by faster-growing seagrasses. Naturally-detached fragments were individually tagged and their morphological traits were recorded prior to replanting into four mooring scars. Early results show that overall survival after one month was 94% for the fragments anchored in bare sand irrespective of whether they were planted with or without jute mats and 80% in scars colonised by faster-growing seagrasses. After four months there was no evidence that the presence of faster-growing seagrasses and the use of jute mats facilitate survival of Posidonia, and important differences emerged between different mooring scars. Encouraging results from this restoration suggest that naturally-detached Posidonia shoots can survive and produce new shoots when replanted in boat mooring scars previously vegetated by the seagrass. Seagrass restoration is still a developing science and our initial results show promising enhancement in conservation of such a critical species.

Other Project Summaries

Remnant Oyster Reefs as Fish Habitat in New South Wales

Francisco Martinez-Baena, Macquarie University, Email: francisco.martinez-baena@hdr.mq.edu.au

Oyster reefs were once an important component of New South Wales estuarine seascapes, but historic overharvest for food and lime has rendered them functionally extinct across much of their former range. As interest in oyster reef restoration grows, there is need to describe and understand the communities of fish associated with oyster habitats across a range of habitat contexts, and how these communities compare to those of other estuarine habitats. Remote underwater video sampling at four sites distributed across two NSW estuaries compared fish communities between remnant oyster reefs and adjacent mangroves, seagrasses and bare sediment. Oyster reefs generally supported greater richness and abundances of fish than adjacent habitats. Remnant oyster reefs not only provided food, shelter, and nursery habitat to species of commercial and recreational value, but supported cryptic species not present in any other habitat. This research suggests that oyster reef historically played an important role in supporting fish communities along the east Australian coast, and that oyster reef restoration, particularly where coupled with restoration of other biogenic habitats, may lead to significant fisheries benefits.

Cold water pollution affects growth of larval silver perch, trout cod and golden perch

Laura Michie, University of Technology Sydney, Email: Laura.Michie@student.uts.edu.au

Temperature is an important determinant for fish survival, reproduction, growth and metabolism. Changes in river thermal regimes may cause reduced fitness, reproductive health and population declines in fish. Cold water pollution (CWP) occurs downstream of large thermally stratified dams when cold water is released from the bottom of the dam. Water temperatures can be reduced by as much as 12-16°C below natural river temperatures. CWP affects approximately 2,000 km of rivers in NSW and has been linked to population reductions in threatened fish species including Murray cod, trout cod and silver perch. We assessed growth in larval silver perch, trout cod and golden perch when exposed to a range of temperatures between 13°C and 24°C for a period of 30 days. Growth of all species was affected by water temperature, with colder temperatures resulting in reduced growth. Silver perch and trout cod (threatened species) were the most sensitive to CWP. No growth was observed in silver perch and golden perch when held at 13°C. By highlighting the sub-lethal impacts of cold water pollution this study has identified a key threat to native Australian fish populations which can ultimately affect individual fitness, recruitment success and population health.

Length at maturity of largehead hairtail (Trichiurus lepturus) in south-eastern Australia

Chantelle Clain, Western Sydney University, Email: 17501864@student.westernsydney.edu.au

Knowledge of reproductive biology is critical for sustainable exploitation of fished populations. Regional differences in exploitation histories, environmental productivity and genetics can drive considerable variation in reproductive traits among populations,

influencing relative productivity and resilience to exploitation. I investigated the length at maturity, a major component of stock productivity, of *Trichiurus lepturus* (largehead hairtail) in south-eastern Australia; a region of minimal exploitation for this otherwise heavily fished circumglobal predator. I found that *T. lepturus* in south-eastern Australia matured at a larger size (L50: 107.8 and 108.9 cm TL for females and males, respectively) than stocks in other regions. A larger length at maturity suggest the stock may be less productive and therefore potentially less resilient to fishing pressure. The difference in south-eastern Australia may relate to limited fishing pressure, genetic variation, or differences in environmental factors that influence reproductive development, including temperature, trophic resources and habitat.

Expanding the artificial reef attraction-production paradigm to benthic predators

Aaron Puckeridge, University of New South Wales, Email: z5075575@ad.unsw.edu.au

Designed artificial reefs are deployed with the goal of increasing local fish production by enhancing habitat complexity, therefore allowing more fish to inhabit and forage in an area. Since artificial reefs are usually subject to high fishing pressure, the fisheries benefit of an artificial reef depends upon a balance between foraging benefit and fishing pressure. It is therefore crucial to quantify fish movements and activity around an artificial reef, to infer whether fish populations benefit or not from an artificial reef. This study used a VEMCO Positioning System (VPS) to monitor the fine scale movements of 48 bluespotted flathead (*Platycephalus caeruleopunctatus*) around the South Sydney Artificial Reef. The flathead were surgically tagged with acoustic transmitters, 22 of which contained accelerometers. Standardised detection counts indicated that the flathead were highly associated with the artificial reef modules with 44% of flathead detections within 10 m of a module and tagged flathead spent on average 84 days of a year at the artificial reef. Furthermore, activity data indicated that the artificial reef acts as a foraging ground. This is the first study to define the functional role of an artificial reef for a benthic predator.

Can the impacts of cold water pollution on fish be mitigated by thermal plasticity?

Monique Parisi, University of Queensland, Email: monique.parisi@uq.net.au

Cold-water pollution (CWP) has been recognised as a significant threat to aquatic communities downstream of large, bottom-release dams. CWP typically occurs during summer when storage dams release unseasonably cold waters, which can decrease the temperature of downstream waters by up to 16°C. Depending on the release duration, these hypothermic conditions can persist for many months. The capacity of fish species to tolerate or rapidly adjust to acute temperature changes may determine the nature and magnitude of the impact of CWP. This study assessed the impacts of an acute reduction in water temperature on swimming performance of juvenile Silver Perch (*Bidyanus bidyanus*) and examined their capacity to compensate for the depressive effects of low temperature. Swimming performance was measured at multiple points over a ten week period following an abrupt 10°C drop in water temperature. Cold exposure had significant depressive effects on swimming performance. Sustained swimming performance showed the capacity to partially compensate for the depressive effects of low temperatures, however this occurred late in the exposure period. The results of this study have substantial implications for the management

of cold water releases form large scale dams and the conservation of native freshwater fish species.

Blessing in disguise: Breakwater upgrade helped improve the conservation of a critically endangered seaweed

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Coastal protection structures such as breakwaters alter natural ecosystems, subsequently affecting biodiversity and ecosystem service provision. Critically, such structures will become more prevalent to protect coastlines from climate-related changes to sea levels and storms. One of these structures is the Coffs Harbour northern breakwater, which recently underwent a major upgrade. Notably, this upgrade is a unique example of an infrastructure alteration that posed a serious extinction risk to a species, the critically endangered macroalga *Nereia lophocladia*. The breakwater and adjacent reefs are the species' only known location, hence, the breakwater upgrade needed a tailored management process, including recovery plans. Such plans require information about a species' biology and ecology, however, little information was available for Nereia. This triggered conservation actions, including targeted scientific surveys. These surveys revealed that Nereia has a less strict seasonality than thought and that Coffs Harbour did not support the last remaining population. These results suggests that Nereia might be not as rare as believed and that its listing might need re-evaluation. Ongoing monitoring of the species will not only improve understanding of Nereia, but also provide stakeholders and industry with information that can be incorporated both into future coastal upgrades and threatened species management plans.

'Dine out or get delivery? Planktivorous fish schooling responses to current at natural and artificial reefs'

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High spatial-resolution distribution of planktivorous reef fish can reveal behavioural adaptations to optimise the balance between feeding success and predator avoidance. We used a multi-beam echosounder to record bathymetry and the three-dimensional distribution of fish schools associated with natural and artificial reefs. We utilised generalised linear models to assess the distribution, orientation and aggregation of fish schools relative to structure, vertical relief and currents. At artificial reefs fish schooled more closely to structure and demonstrated a preference for the windward side, particularly when exposed to strong currents. Similarly, at natural reefs fish demonstrated a preference for windward aspects of bathymetry, particularly when associated with high vertical relief. Our findings suggest that under conditions with stronger current velocity, fish can exercise their preference to remain close to structure for predator avoidance, while still receiving an adequate supply of zooplankton delivered by the current. Similarly, when current velocity is low, fish tend to disperse for better access to zooplankton. As artificial reefs are generally deployed with the goal of creating productivity rather than simply attracting fish from elsewhere, we advise that future artificial reefs be designed as semi-linear arrays perpendicular to the prevailing current, with multiple tall towers. This will facilitate the conversion of dispersed zooplankton into energy for higher trophic levels, enhancing reef productivity and fisheries.

NSW tailor spawning highly important for southern NSW recruitment

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Transport of larvae by ocean currents to appropriate juvenile habitat is an important mechanism for many marine species. Changes in spawning timing or location can have large implications for the final destinations of ocean-transported larvae. A previously unrecognised NSW summer spawning event was recently reported for the east Australian population of tailor (*Pomatomus saltatrix*; Schilling et al. 2019). While fishing restrictions are in place to protect the traditionally recognised QLD spring spawning event, the importance of NSW spawning is uncertain. Here I conduct a particle tracking simulation of tailor spawning and resulting larval dispersal via the East Australian Current to highlight the differing contributions of spawning events to potential settlement along the east Australian coast. This study showed that the newly recognised NSW summer spawning event contributes the highest proportion of larvae to south-eastern Australia. This finding highlights the importance of NSW spawning events while demonstrating that species which use ocean currents for larval transport can substantially alter the final settlement locations of larvae by spawning in different locations or at different times of the year.

Double whammy: simultaneous exposure to elevated nitrate and low pH reduces the swimming performance and growth of the Australian native, Spangled perch

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Human activities present aquatic species with an increasing number of environmental challenges, including excessive nutrient pollution (nitrate) and altered pH regimes (freshwater acidification). Despite the numerous, simultaneous challenges being faced, data on species responses to multiple environmental stressors are scarce. Here, using an experimental approach, we examined the combined effects of low pH and nitrate pollution on the freshwater fish, spangled perch (*Leiopotherapon unicolor*). Fish were exposed to a combination of nitrate (0, 50 or 100 mg L-1) and pH (pH 7.0 or 4.0) treatments in a factorial experimental design. After four weeks of exposure, we measured a series of physiological tests including growth, swimming performance and oxygen consumption rate of fish to understand how fish are affected by the interaction between nitrate pollution and low pH. Oxygen consumption of fish was impeded by nitrate and low pH exposures, which reduced growth and swimming performance. These results highlight the impacts on aquatic organisms living in environments threatened by excessive nitrate and acidic pH conditions.