

Centre for Marine Ecosystems Research
RESEARCH HIGHLIGHTS
2014





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DIRECTORS' REPORT

The Centre for Marine Ecosystems Research had a highly productive year in 2014. It was a year which saw the blossoming of our research programs within the Collaborative Research Network, working with our partners at The University of Western Australia, Otago University in New Zealand and CEAB in Spain. The CRN has resulted in a dramatic expansion of the scope of research CMER is involved in as our collaborations lead to new projects and new areas of research. These include our involvement in the \$3 mill. CSIRO Coastal Carbon Biogeochemistry Cluster, looking at blue carbon stocks in Australia, and a key role in deciphering the genetic connectivity among plant populations in the Kimberley and Pilbara. At the same time, we continued our significant involvement with the WA Marine Science Institution's research programs in the Kimberly and on Dredging Science. Exciting times!

Centre members produced 16 research publications during the year and it was pleasing to see the continued increase in the quality of journals being targeted; the average impact factor of journals we published in increased from 2.49 in 2008-12 to 3.67 in 2014, a 50% increase. Center members obtain four new research grants to continue work on trophic connectivity and coastal disturbance, and maintained 14 funded research projects, raising over \$1.5 million during 2014. A highlight of the year was a series of workshops run by CMER. Among these was a workshop on the tropicalisation of the marine environment in Western Australia, and another on the application of dimensionless numbers to characterize marine systems. Both attracted collaborators from around the country and overseas.

Glenn Hyndes and Paul Lavery
Co-Directors, Centre for Marine Ecosystems Research

CMER has maintained a healthy postgraduate cohort of 17 students, two of whom completed and graduated during the year, and a third submitted his thesis for examination. The Centre hosted three international visitors during the year: Prof Ken Heck Jr from Dauphin Island Sea Lab and the University of South Alabama; Prof. Pere Masqué from the Universitat Autònoma de Barcelona; and Prof. Mats Björk from Stockholm University. Prof Masqué was appointed as an adjunct professor at ECU in recognition of the opportunities he has, and continues to, provide to expand our research. Staff and students continue to be involved in a wide range of professional engagement activities, including conference, workshops and collaborative research with government and NGOs.

This report acknowledges the continued high quality and quantity of research and research training activity within the Centre, and we look forward to the continued growth of CMER, and our collaborations with research partners in WA, Australia and the rest of the world.



HIGHLIGHTS IN HABITAT CONNECTIVITY AND TROPHIC INTERACTIONS

Habitat connectivity and trophic interactions form one of the main focal topics of research in CMER. The two projects outlined here convey the broad research undertaken by CMER's postgraduate students. A PhD student investigated kelp distribution effects on the trophic dynamics of surrounding habitat, and the iconic Black Swan was the focus of a Masters student looking at grazing pressure of seagrass.

GENETIC CONNECTIVITY OF THE SEAGRASS *THALASSIA HEMPRICHII* IN THE KIMBERLEY AND PILBARA, WESTERN AUSTRALIA

Post-graduate student Udhi Hernawan has been working with Kathryn McMahon and Paul Lavery and collaborators from UWA (Gary Kendrick), University of Adelaide (Korjent van Dijk), CSIRO (Oliver Berry), Department of Fisheries (Mike Travers) and Australian Institute of Marine Science (Jim Underwood) to examine the genetic connectivity of the tropical seagrass *Thalassia hemprichii* in the Kimberley and Pilbara region of WA. This project is funded through the WAMSI Kimberley Research program, and is led by Kathryn McMahon (pictured below).

Dr Kathryn McMahon undertaking field work in the Kimberley.



T. hemprichii is a foundation species, widely distributed in the Indo-Pacific and is a key food source for green turtles. Due to its buoyant fruits, it has the potential to disperse over 100's of km. The population connectivity is being investigated to provide insight into the resilience of seagrass populations and to contribute to the design and spatial management of seagrass in the region. Seagrass samples were collected from 13 meadows in the Kimberley and 3 meadows in the Pilbara (Figure 1) and the genetic variability, population structure and gene flow analysed based on 16 polymorphic microsatellite loci. There was little evidence of gene flow between the Pilbara and Kimberley populations; suggesting that the Pilbara and the Kimberley are discrete management units (Figure 2). Within the Kimberley three distinct clusters were identified. A barrier was identified which separated two of the Kimberley sites from others only 8 km away, but others sites showed connectivity over distances of 70 km. This asymmetry in the gene flow and connectivity may be due to the complex hydrodynamics in the region where 10 m tides are common and strong currents and tidal eddies form. Work is continuing to understand the relationship between genetic and hydrodynamic connectivity. Overall, connectivity within the Kimberley was characterized by a predominantly north-to-south direction of gene flow, which contrasted with the south-to-north direction of gene flow among meadows within the Pilbara.

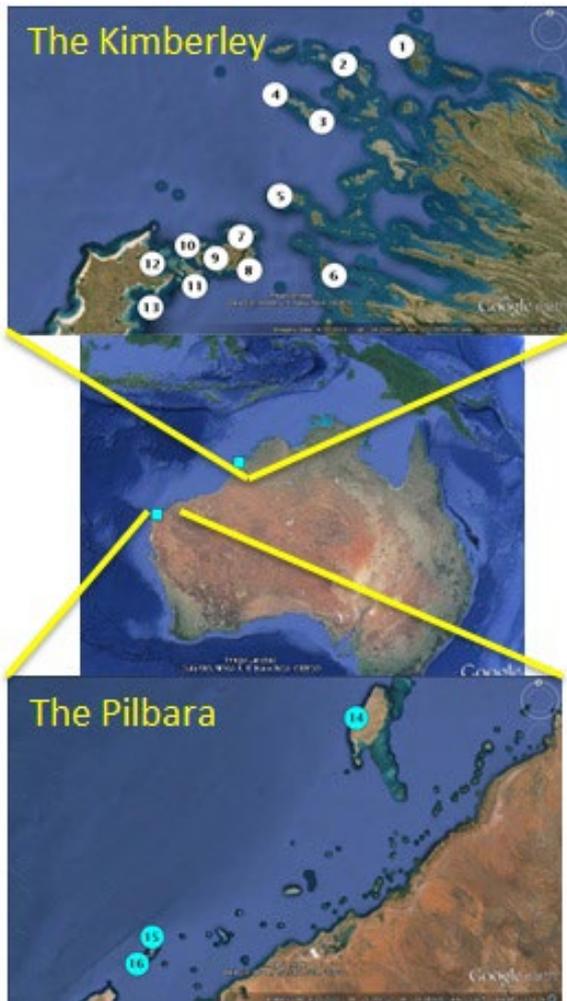


Figure 1: Sites (top) 13 meadows at the Kimberley, (bottom) 3 meadows at the Pilbara

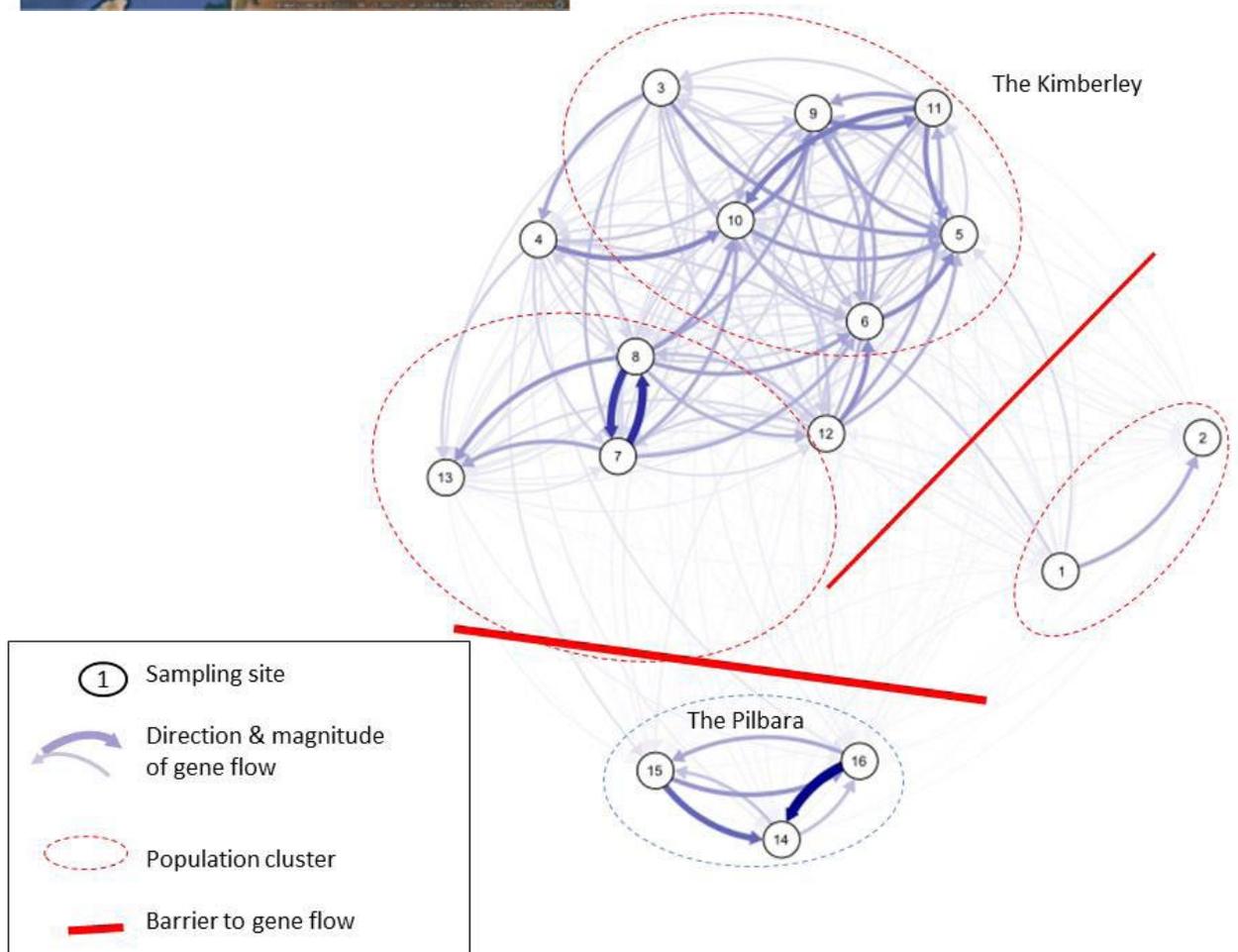


Figure 2: Gene flow between sampling



COASTAL MICROBIAL CONNECTIVITY – THE MICROBIAL-MEDIATED EXCHANGE AND TRANSFER OF MATTER WITHIN AND ACROSS COASTAL SEASCAPES

Ammonia-oxidising prokaryotes associated with seagrass meadows (*Posidonia sinuosa*) in Western Australia

Ammonia-oxidizing prokaryotes (AOPs) perform the first and rate-limiting step of nitrification: the conversion of ammonium (NH_3^+) to nitrate (NO_3^-) through ammonia monooxygenase (encoded by the gene *amoA*). AOPs have been detected in a wide range of marine ecosystems: as part of picoplankton or associated to corals, sponges and macroalgae, however, nothing is known about AOPs associated with seagrasses but they are likely to play an essential part in nitrogen cycling within seagrass meadows (Figure 3). We sampled seagrass meadows (*Posidonia sinuosa*) in the oligotrophic waters of the Marmion Marine Park in Western Australia to determine the spatial and temporal variability in abundance and community composition of AOPs.

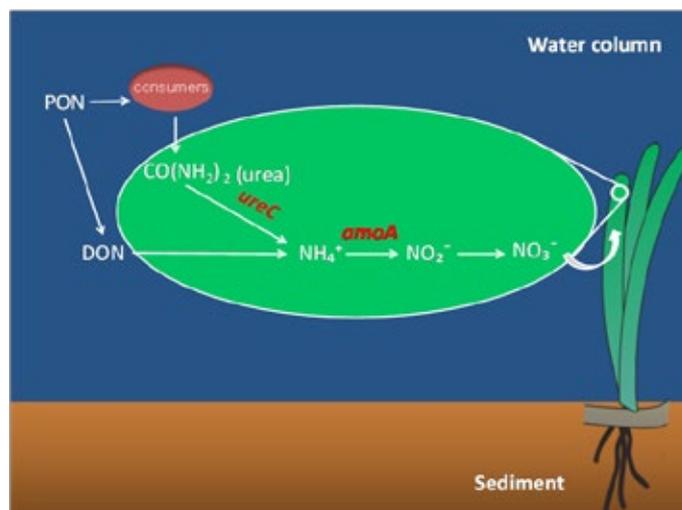


Figure 3: Hypothesised reactions performed by seagrass leaf-associated prokaryotes. Particulate organic nitrogen (PON) can (I) release DON reworked by epiphytic prokaryotes and/or (II) be taken up by consumers with release of urea. The reworking of organic nitrogen implies the formation of nitrate as final that can be taken up by the seagrasses.

Preliminary findings

There was spatial and temporal variability in the total abundance of AOPs. Epiphytes had higher abundance of AOPs than water and sediment, and in spring compared to summer. AOB were consistently more abundant than AOA in the seagrass meadows and community structure changed according to substrate. Our results indicate that

AOPs may play an important role in recycling nitrogen in seagrass meadows and are likely to be important facilitators of nitrogen uptake in these oligotrophic marine ecosystems.

Researchers: Flavia Tarquinio | Dr Christin Sävström | Associate Professor Glenn Hyndes | Dr Annette Koenders | Dr Bonnie Laverock (UTS)

Diurnal changes in bacterial activities and DOC fluxes in near shore wrack accumulations

Near shore oligotrophic coastal waters are greatly influenced by autochthonous organic matter (OM) input, both land-derived and offshore marine-derived (OM). During the winter period in Western Australia, autochthonous OM in nearshore waters are largely derived from wrack accumulations, which readily leaches out in the water.



Benthic chambers with wrack inside to simulate nearshore wrack accumulations

This input of OM can potentially act as a “priming effect” i.e. the input of labile OM substrates can stimulate bacterial production and enhance the degradation of more refractory substrates already present in the waters. Furthermore, the wrack may also introduce new bacterial species and alter the community composition in the waters. To test this concept we performed *in situ* wrack incubations in near shore coastal waters off Penguin Island in Western Australia.



Field “laboratory” on Penguin Island, Western Australia

Preliminary findings

The wrack accumulations within the chambers leached a substantial amount of DOC into the water and these increases in DOC encouraged the bacterial community. Bacterial response to leached DOC was rapid (within 2hrs) with increases in bacterial production and respiration rates, possibly causing temporary net heterotrophy (system respiring more C than it takes up). The wrack leachate caused compositional changes in the DOC pool as the carbon isotope signature of the dissolved organic and inorganic carbon (DOC and DIC) changed within the chambers. Our results indicate that near shore wrack accumulations can cause compositional changes in the DOC pool which can alter microbial substrate usage and increase bacterial growth efficiency thus acting as a positive priming effect on bacterial activity in near shore oligotrophic coastal waters.

Researchers: Dr Christin Sävström | Associate Professor Glenn Hyndes | Dr Damien Maher (SCU) | James McLaughlin (CSIRO) | Dr Bonnie Laverock (UTS)



HIGHLIGHTS IN CONSERVATION AND FISHERIES BIOLOGY

This wide-ranging research theme covers a diversity of projects in CMER with a focus on integrating marine ecology with coastal planning and management through improved understanding of ecosystem processes. This Research Highlights looks at studies on the reproductive biology of coral trout at the Abrolhos Islands in relation to effects of fishing pressure, and the impact of rock lobster fishing on benthic ecosystems.

THE DISTRIBUTION OF PERTH HERRING EGGS AND LARVAE WITH AN ESTUARY

Globally, estuarine conditions have altered due to human impacts, resulting in nutrient enrichment, increased phytoplankton blooms and anoxic/hypoxic zones. In addition, drying climate in some regions is leading to reduced water flow and changes to normal salinity conditions. This is likely to have consequences on the spawning and recruitment strength for fish species that reproduce in the upper regions of estuaries. This formed the basis of the Masters by Research study by Peter Malanczak, who aimed to link the distribution of eggs and larvae of Perth herring (*Nematalosa vlaminghi*) with location and environmental conditions in the Upper Swan estuary, where this species spawns. The abundances of eggs and larvae (pictured below) were determined from 180 plankton samples collected throughout the upper region of the estuary during January - February 2013, correlated to distance from the estuary mouth, salinity levels and the level of stratification of salinity. The distribution of Perth herring eggs and larvae occurred from 36 to 46.3 km and peaked

41.8/40.3 km upstream from the estuary mouth, corresponding to salinity levels of 8-19 ppt (Figure 4). Abundances were negatively correlated with salinity stratification, suggesting that salinity influences the distribution of Perth herring eggs and larvae in the Swan estuary.



Eggs and Larvae of Perth herring (*Nematalosa vlaminghi*)

The downstream limit of their distribution has encroached upstream by 12 km since the late 1980s, suggesting the optimal environmental conditions for eggs and larvae has shifted upstream during a period when freshwater flow has been decreasing.

In addition, the late stage eggs and early stage larvae occur at the bottom of the water column, indicating that these stages are susceptible to mortality resulting from the hypoxic and anoxic conditions that can occur in the upper Swan Estuary. This study, which has been co-supervised by Dr Kim Smith from the Western Australian Department of Fisheries provides further insights into the possible impacts that changing estuarine conditions will have on sustainability of Perth herring, which is endemic to south-western Australia.

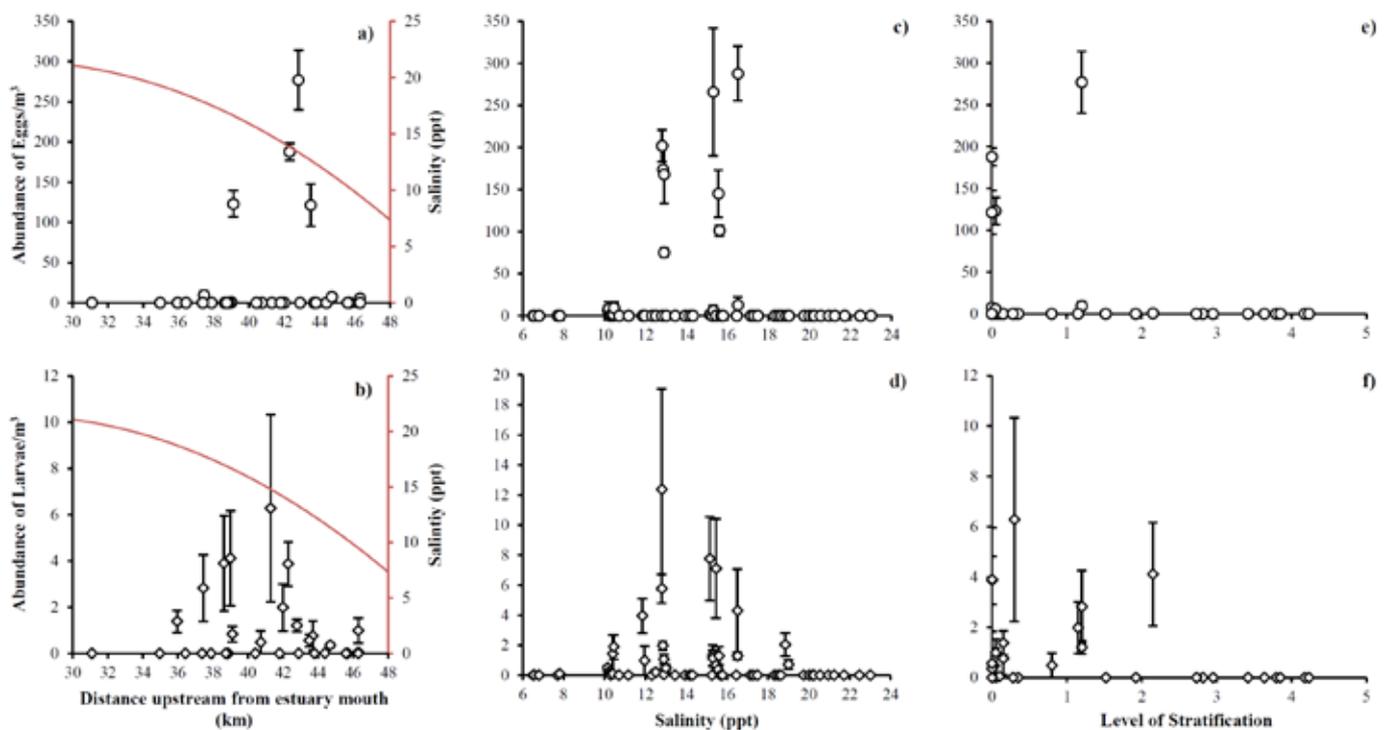


Figure 4: Mean (\pm SE) abundance of Perth herring eggs (top) and larvae (bottom) per m³ against a-b) distance upstream from estuary mouth (km) (with trend-line of salinity levels experienced during sampling); c-d) salinity conditions of sampling sites (ppt); e-f) level of stratification of the water column during sampling.



HIGHLIGHTS IN HUMAN IMPACTS OF ECOSYSTEMS PROCESSES

Western Australia's growing population and the massive development of infrastructure to support mineral exports are putting significant pressure onto the coastal environment. CMER has continued to lead research into the increasing range of human impacts in coastal marine systems. Research in this theme stress the importance of not only understanding coastal ecosystems' responses to human impacts, but also drawing on the immense value these systems offer to mitigate those impacts. Research into previously unexamined impacts of dredging on seagrasses and the role for human disturbance in reducing the capacity of coastal ecosystems to store atmospheric carbon are highlighted in this year's report.

COASTAL CARBON CLUSTER: AUSTRALIA'S LARGEST EVER COASTAL BLUE CARBON ACCOUNTING, MAPPING AND MEASUREMENT STUDY

CSIRO's Coastal Carbon Cluster is fostering vital scientific research to strengthen our low carbon economy and prevent future excessive greenhouse gas emissions. Over the last few months, the Coastal Carbon Cluster has progressed further towards it's goals, with the delivery of Milestone 3 and a corresponding report. Additionally, UWA members Prof Carlos Duarte and Dr Oscar Serrano have represented the Cluster and run Symposiums at the Australian Marine Sciences Association conference and the Association for the Sciences of Limnology and Oceanography conference in Granada, Spain, a very exciting prospect for all involved and a wonderful way to promote the Cluster and UWA globally. The Cluster is now past the halfway point in its lifespan, so most of our members are knee-deep in sampling, datasets, models and experiments. From now until June 2016, all workpackages and

members will be focusing on the delivery of information and goals in order to meet our Milestone deadlines.

In November 2014, we held a 2 day workshop with Coastal Carbon Cluster participants to discuss CO₂ emissions associated with degradation of blue carbon habitats and possible enhanced CO₂ sequestration associated with restoration of these habitats (Figure 5). The workshop focussed on an analysis of the uncertainties around CO₂ emissions with degradation of blue carbon habitat. We looked at the emerging evidence for sediment carbon losses, examining a range of case studies.

We identified where the greatest risks for CO₂ emission might occur and developed a risk analysis framework.

We also identified that the final fate of lost sediment carbon, whether redeposited or remineralized to CO₂ was dependent on a wide range of environmental factors which we worked to summarize in order to reduce uncertainties and to focus future work. The outputs of the workshop will be manuscript that is currently in preparation.

The research is on-going with current efforts directed at understanding what factors are important in making one type of seagrass meadow better at capturing and storing carbon than others. CMER researchers Paul Lavery, Oscar Serrano, Mohammad Jamaludin and Miguel Angel Mateo have demonstrated the critical function of water depth, which is limiting plant productivity and ultimately the amount of CO₂ being sequestered. The research examined two species of seagrass in two locations: *Posidonia sinuosa* in Western Australia's Cockburn Sound, and *P. oceanica* in the Spanish Balearic Islands. The differences in CO₂ storage between the species, and at different water depths, were striking. The *P. sinuosa* beds showed a fourfold decrease in organic carbon stocks at water depths of 6-8 metres, compared with beds at 2-4 metres. The shallower beds contained 7kg of organic carbon per cubic metre, while the deeper beds averaged 2kg. The pattern was similar for *P. oceanica* beds, although the volumes were much greater. In 2 metres of water the top 2.7m of sediment averaged 200kg of organic carbon per square meter, while beds at 32m of water contained 19kg. We think that *P. oceanica* meadows contain the highest organic carbon stocks of all seagrasses, with estimated volumes of up to 770kg of organic carbon in soil deposits up to 13 metres thick. This research sustains the importance of preserving these blue carbon sinks.

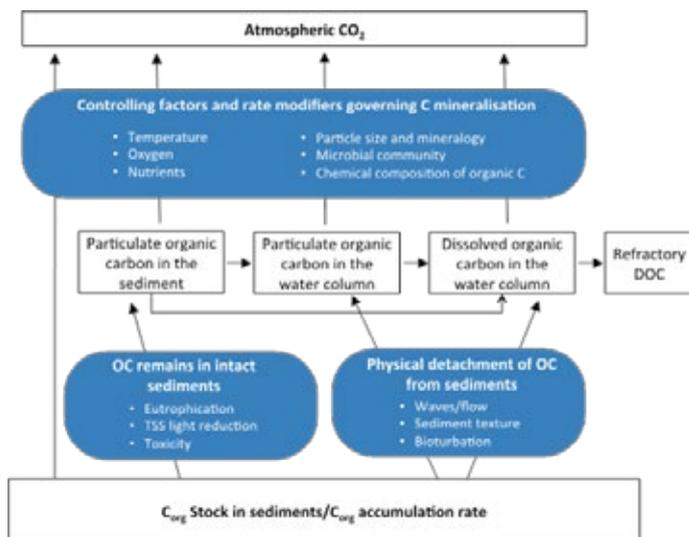


Figure 5. Conceptual framework for the potential remineralisation of organic carbon following disturbance of blue carbon habitats.

LIGHT SPECTRA INFLUENCES ON SEAGRASS GROWTH AND DEVELOPMENT

Seagrass meadows provide crucial benefits to coastal ecosystems but are globally threatened due to activities such as dredging. Dredging alters both the amount and colour of light reaching seagrasses, resulting in plants receiving mainly yellow and green light, which are the least useful for plant growth. PhD student, Simone Strydom (pictured below) hopes to increase our understanding of the consequences of these shifts in light colour for

the growth and reproduction of seagrasses through her research. Experiments conducted in this investigation have shown that seagrass production was significantly lower in seagrass grown under yellow lights compared to those grown under full spectrum lights as shown in Figure 6.

Therefore, even if dredging activities do not reduce the amount of light in the water column, yellow shifts in light can still potentially impact seagrass tolerance to dredging. Seed germination and seedling survival experiments are also underway and the preliminary results indicate that spectral quality of light significantly affects *Halophila ovalis* seed germination rates. These results will help dredging operators identify critical times to avoid dredging and will assist coastal developers to better predict the effects of dredging on our valuable seagrass meadows.

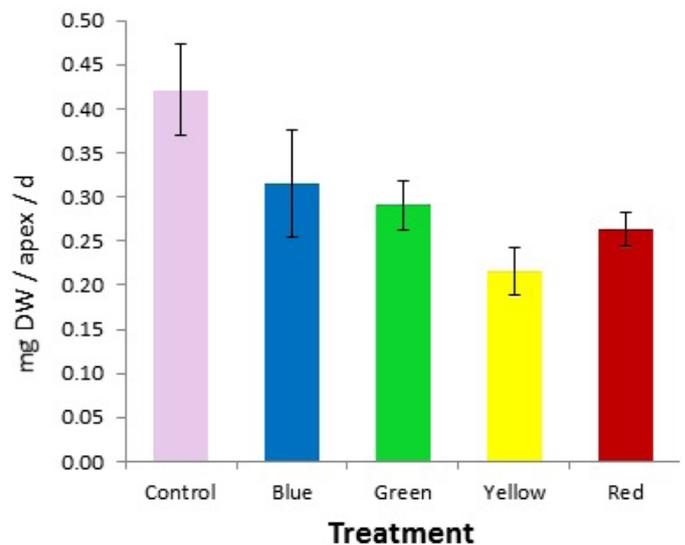
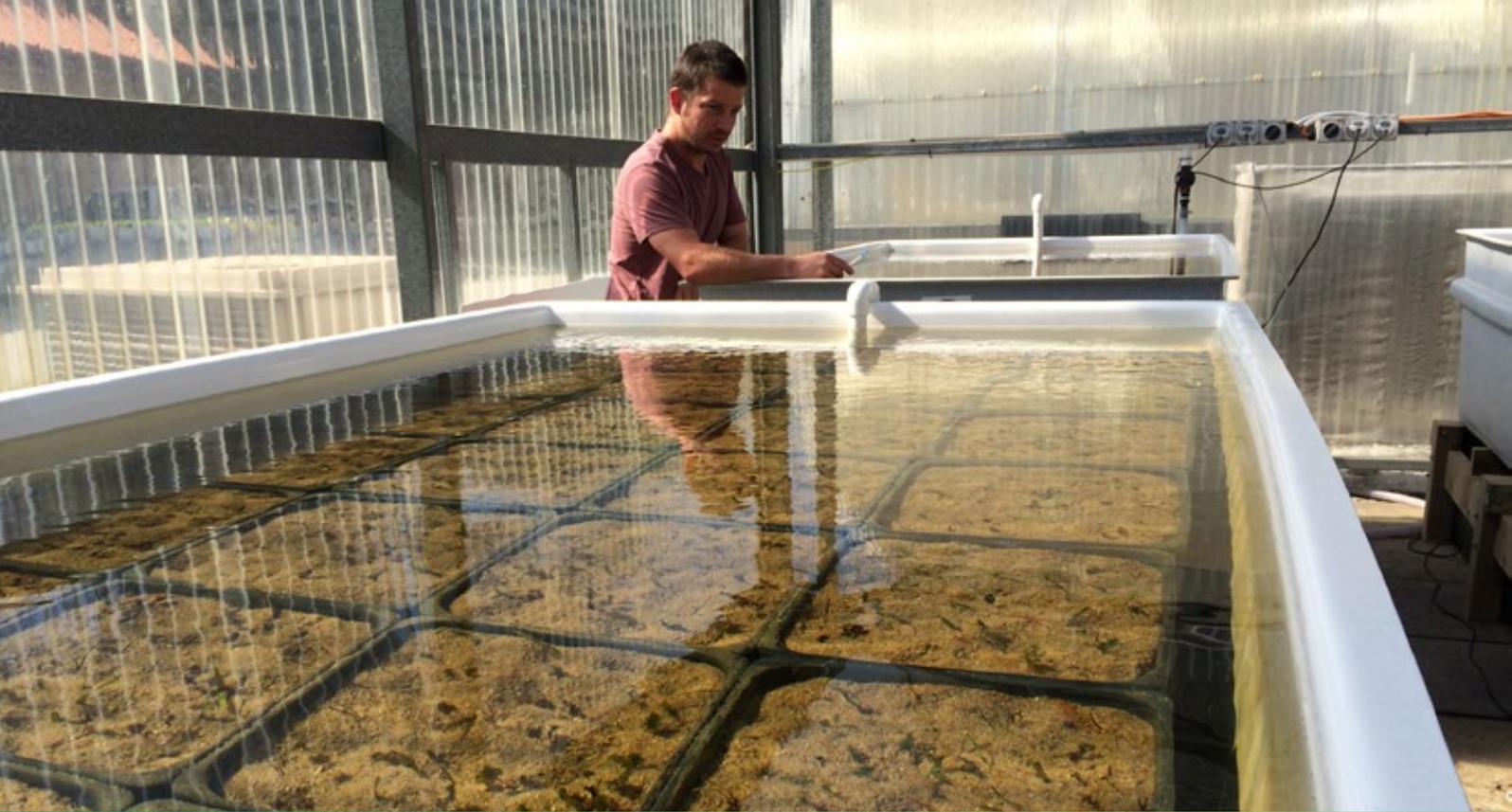


Figure 6. The mean (±SE) productivity of *Halophila ovalis* is significantly lower when grown under yellow light treatments compared to full-spectrum control lights.



PhD student Simone Strydom monitoring seagrass growth in the aquarium at ECU



HIGHLIGHTS IN COLLABORATIVE RESEARCH NETWORK

Since 2012, CMER has been fortunate enough to lead a research program within ECU's Collaborative Research Network (CRN). The CRN is a program established by the Commonwealth Government to facilitate collaboration among newer universities and established research-intensive universities. ECU was granted \$6 mill. of funding under the scheme to establish a network of sub-projects covering environment, health and engineering. The environment project, led by Professor Paul Lavery, at the CMER, has focused on the development of capability in two interconnected themes; eco-hydraulics and coastal connectivity (genetics and nutrients) among marine ecosystems.

Eco-hydraulics examines the ecological role of water motion, for example how waves affect the movement of nutrients into and out of marine plant canopies or the biodiversity of reef and seagrass ecosystems. Coastal connectivity relates to the ways in which marine ecosystems are connected through the movement of water, particles and genes as depicted in Figure 7. Much of CMER's research examines the transfer of nutrients and energy from one marine ecosystem, say a reef, to another ecosystem, such as a beach. Often this exchange of material, be it dead plants or seeds, is crucial to sustain our coastal resources.

Key collaborators in the CRN include the University of Western Australia (Oceans Institute and School of Environmental Systems (now Civil Engineering)), the Spanish Research Council's CEAB laboratory and The University of Dunedin. In 2014 one of the major collaboration focused on eco-hydraulics in seagrass canopies.



Figure 7: Water movement in coastal ecology affects trophic and genetic connectivity via exchange of material from one ecosystem to another essential to biodiversity and sustainability.



HIGHLIGHTS IN RESEARCH TRAINING

Dynamics of Isotope baselines and the Biogeochemical Environment - Andrew Mackey (PhD)

Stable isotopes have become an important tool for many ecological studies, including estimating energy flow and trophic positions in aquatic food webs, comparing food webs, and aiding in the tracking of wide-ranging consumers. However, each of these applications requires accurate measurements of isotopic signatures in organisms at or near the base of the food web (e.g. autotrophs and their consumers), which act as basal reference points from which to calibrate inferences. Therefore, understanding variations in isotopic baselines, and the mechanisms leading to their variability, is crucial for food web ecology. Using the shallow temperate reefs along the lower west coast of Australia as a test case, Andrew Mackey's broad aim for his PhD thesis was to determine isotopic variations in a coastal food web and their relationship with surrounding environmental factors or food sources.

Spatial patterns for $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ in the kelp *Ecklonia radiata* and $\delta^{15}\text{N}$ in the calcareous red alga *Amphiroa anceps* were influenced by variation at replicates (10s of m) and sites (1s of km) over regions (10s of km), whereas the reverse was true for $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ in the foliose red alga *Plocamium preissianum*. Of the environmental parameters examined, water temperature was the best single explanatory variable, accounting for ~50-60% of variation in the $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ of *P. preissianum*, and the $\delta^{15}\text{N}$ of *E. radiata* and *A. anceps*. From the above relationships, spatial predictions of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values in macroalgae showed clear latitudinal patterns (Figure 8),



Andrew Mackey sampling algae to examine spatial and temporal variation in $\delta^{13}\text{C}$

which covered a far wider range of values than temporal predictions, over a 12-month period. This illustrates the potential scale in the shift of isotopic baseline food sources over broad scales, and its implications for food web studies.

Primary consumers, particularly the bivalve *Septifer bilocularis* and the gastropod *Turbo torquatus*, generally mitigated a large proportion of the $\delta^{15}\text{N}$ variation in algae and displayed relatively stable $\delta^{15}\text{N}$ over time. Further, by conducting a controlled feeding study, Andrew showed that *S. bilocularis* exhibited slow $\delta^{15}\text{N}$ turnover estimates (e.g. half-life of 56 days), which from simulations, negated and "dampened" the effect of fluctuating $\delta^{15}\text{N}$ values of food sources. This suggests that, owing to their high abundances and wide distributions, these species can be

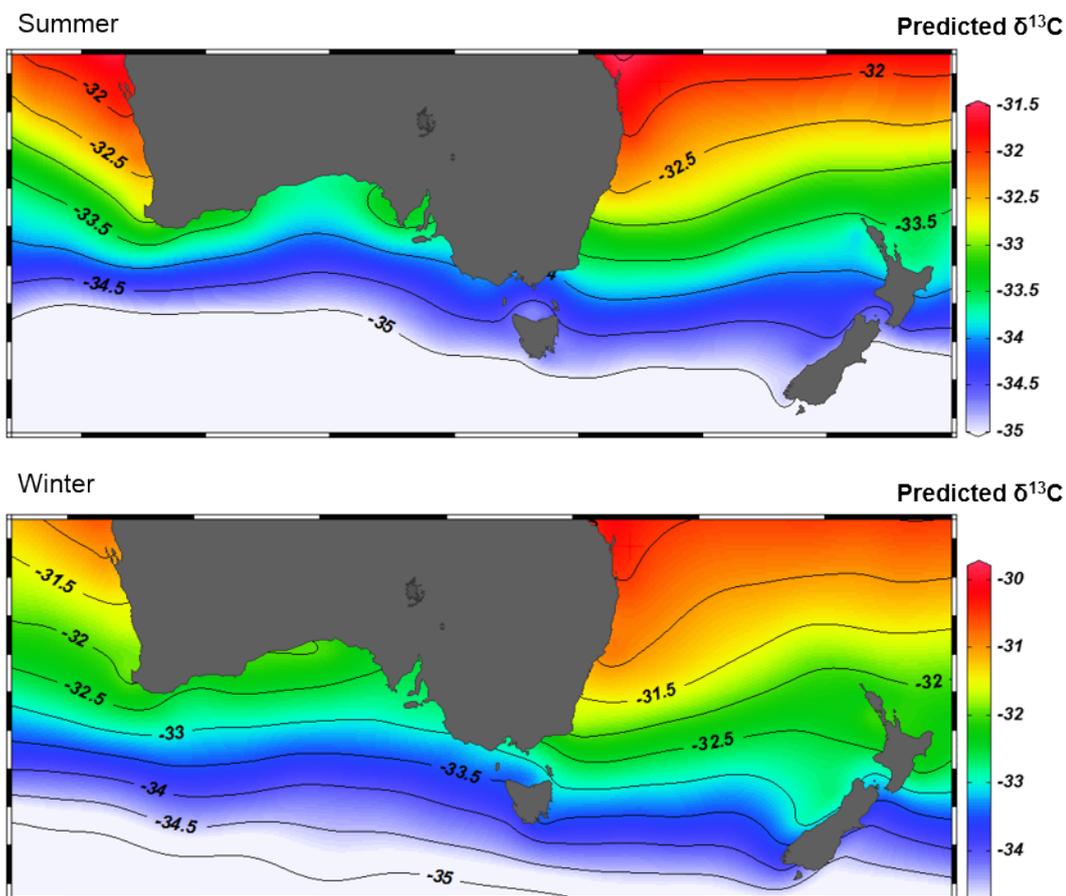


Figure 8: Predicted variation in the $\delta^{13}\text{C}$ of the red alga *Plocamium preissianum* across temperate Australasia for (A) winter; and (B) summer

used to compare $\delta^{15}\text{N}$ baselines over large spatial scales. However, this was not the case for $\delta^{13}\text{C}$, where primary consumers were as variable as those autotroph(s) they are assumed to proxy. Therefore, consistency in consumer $\delta^{15}\text{N}$ does not necessarily equate to consistency in $\delta^{13}\text{C}$.

Andrew's results provide a reference from which to determine the appropriate sampling design to capture variation in ecologically important taxa, to help inform future studies. Further, the models he developed to predict isotopic values for important autotrophic sources, and the identification of reference taxa of baseline $\delta^{15}\text{N}$ (bivalves and gastropods), could be used by ecologists to remove a large proportion of unexplained variation, thus facilitate the interpretation of variation in stable isotopes of consumers in food webs, to help answer important questions in food web ecology.



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PAUL ARMSTRONG

With several years' experience in marine and aquaculture research, Paul joined CMER in 2013 as a Research Technician. He completed a Master of Applied Sciences in Aquaculture in 2010, and has been involved in aquaculture research projects with the University of Tasmania (Australian Antarctic Division), and CSIRO. His technical ability has been pivotal in developing laboratory experimental design in projects CMER is currently undertaking such as dredging impacts on seagrass beds in northwest Australia.



ROB CZARNIK

After completion of a Post Graduate Diploma of Science (Biological Sciences) Rob was employed as a research assistant in CMER. Rob has since taken on the role of Field Safety and Support Officer where he provides expert advice and assistance to postgraduate students and staff on the preparation of Risk Analysis and Management Plans and ensures CMER operates under legislative, training and competency requirements. In addition, Rob is actively involved in the field operations of many of CMER's research projects.



DR MEGAN HUGGET

With more than a billion microorganisms per litre of seawater, the biodiversity of microbial communities and the functional roles that they play in the marine environment are enormously significant. Megan's research focuses on the function and diversity of marine microbes, and falls into two themes: prokaryote-eukaryote interactions in the marine environment and the function and diversity of bacterioplankton communities. She has been involved in studies of the genome content and architecture of bacterioplankton via whole genome sequencing projects, as well as investigating bacterioplankton diversity in response to a large storm event, and across coral atolls in the North-western Hawaiian Islands.



ASSOCIATE PROFESSOR GLENN HYNDES

Coastal marine and estuarine environments are highly complex systems prone to high levels of human disturbance resulting from the concentration of Australia's population along the coastal regions. It is, therefore, crucial to develop a high level of understanding of the complex ecological processes in these coastal environments. The movement of animal and plant material from one habitat to another forms

CMER MEMBERS

an important process of habitat connectivity in the coastal, marine landscape. This forms the focus of Glenn's research activities. His studies have examined the trophic links among habitats using a combination of experimental and biomarker (stable isotopes and fatty acids) approaches to trace key food sources through the food web. Glenn's work has also examined the importance of different coastal habitats, particularly seagrasses, to fish communities, the ecosystem effects of consumers on shallow coastal biodiversity.



PROFESSOR PAUL LAVERY

Paul's research focuses on benthic marine ecosystems and how they respond to human-induced pressures, particularly seagrass ecosystems.. Currently, he has three major areas of research interest: (1) The impact

of dredging on seagrasses and other primary producer ecosystems, currently with a focus on tropical species; (2) Connectivity and trophic subsidies among coastal marine ecosystems, using stable isotope and other biomarker techniques to understand how materials transported from one habitat support productivity in adjacent habitats; and (3) the use of seagrass sediments as environmental archives to reveal past environment conditions and their ability to capture and store atmospheric carbon, thereby offsetting some of the impacts of global CO₂ emissions.



ROSIN MCCALLUM

Roisin's role at CMER is part of a collaborative project between ECU, UWA and CSIRO, investigating the impacts of dredging on seagrasses in the north-west of Australia. Roisin joined CMER in 2013 after completing a Master's

degree at Southern Cross University in Marine Science and Management. Her interest in marine ecology research encompasses the interactions between biogeochemistry of sediments and water, in particular seagrasses and macro algae. Roisin is also a representative for Work, Health and Safety at the centre and manages CMER's laboratory.



DR KATHRYN MCMAHON

Kathryn's main research area is coastal marine ecology, specifically focusing on seagrasses in both tropical and temperate environments following three main themes: human impacts in seagrass ecosystems; seagrass-

grazing interactions; and phylogenetics. Her research into human impacts (e.g. nutrient enrichment, light reduction associated with dredging) has focused on

developing ecophysiological tools to assess health or measure impacts. Secondly, with plant-grazing interactions Kathryn is interested in understanding the strategies plants use to cope with grazing, especially related to sexual reproduction. Thirdly, Kathryn's uses molecular tools to investigate the relationship of seagrass taxa.



DR OSCAR SERRANO GRAS

Oscar joined CMER in 2012 with over 7 years research expertise in marine ecology, palaeo-ecology and marine biogeochemical cycles. With a focus on carbon sequestration and paleo-ecological reconstruction

from sedimentary deposits, Oscar's research includes investigating the capacity of seagrass ecosystems as a globally significant carbon sink, and the variability in carbon storage of seagrass habitats and between seagrass species. His research is largely centred on marine ecosystem response to climate change.



DR CHRISTIN SÄVSTRÖM

Christin's is a marine microbiologist and has undertaken postdoctoral research positions in Sweden and Australia since gaining her PhD in 2006. Joining CMER in 2012, her primary focus is in aquatic microbial ecology exploring whole community

processes and energy flow in this relatively new area of marine ecosystem research. Christin has investigated the complexities of these communities including characterizing marine microbial diversity and function in marine habitats of Western Australia, exploring virus aquatic ecology, and environmental influences on virus and host interactions particular to sub-tropical systems.



ASSOCIATE PROFESSOR UTE MUELLER

Geostatistical techniques were developed for the estimation and simulation of the spatial distribution of mineral reserves, but are equally applicable to other natural resources.

Ute's research interests include the development and application of simulation and estimation of fisheries data.

CMER MEMBERS

ADJUNCT STAFF



DR RAY MASINI

Ray is based at the Office of the Environmental Protection Authority. His research has focused on Western Australian marine ecosystems, with particular emphasis on the tropical arid ecosystems of the central- and north-west coasts. More recently this focus has moved north to the tropical Kimberley coast. His research interests include nutrient-effects, ecological modelling and environmental management strategy and policy formulation. Ray has been centrally involved in the planning and management of a range of multidisciplinary marine environmental studies around the State's 13,000 km coastline. Ray's interests also include knowledge transfer and application, particularly related to the interaction between research, environmental policy formulation and environmental management.



DR BRITTA MUNKES

Britta is a benthic ecologist, interested in community processes. Her research focuses on the impact of human-induced stressors (nutrient pollution and altered food webs) as well as interacting physical factors on benthic communities. Britta is particularly interested in the effects of these stressors on the resilience and biodiversity in seagrass communities, and on processes leading to changes in competition strength between seagrasses and algae, between top-down (grazers) and bottom-up (nutrient enrichment) effects.



DR FERNANDO TUYA

Fernando's research is driven by the need to develop rules and models to explain the patterns of organization of marine populations and communities from local to macroecological (biogeographical) scales. From this general interest, Fernando is particularly interested in ecological processes shaping temperate reefs from small to large geographical scales, trophic linkages between reefs and adjacent seagrass meadows, effects of human perturbations on natural communities and the role of Marine Protected Areas in preserving marine biodiversity and fishery resources. As a tool to improve the public perception and awareness of marine biodiversity, he has contributed to the dissemination of the marine flora and fauna of the Atlantic Ocean through books and open-access monographs.



DR RUSS BABCOCK

Russ is based at CSIRO Marine and Atmospheric Research, and leads research to better understand how human activities influence coastal ecosystems such as kelp forests and coral reefs. Research programs focus on issues such as fishing impacts and the effectiveness of marine reserves as conservation tools. Other projects have focused on the impacts of sedimentation on both temperate and coral reef ecosystems.



DR MAT VANDERKLIFT

Mat is a marine ecologist based at CSIRO Marine & Atmospheric Research. His research interests include ecological linkages between habitats, the use of stable isotopes to study trophic ecology, factors influencing the abundance of flora and fauna, the ecological importance of consumers (herbivores and carnivores) and the effects of human use of marine ecosystems.



PROFESSOR PERE MASQUÉ

Currently a Professor at the Department of Physics and the Institute of Environmental Science and Technology at the Universitat Autònoma de Barcelona (Spain), Pere leads the Environmental Radioactivity Laboratory. Pere's work is centred on using radioactive isotopes as tracers of environmental processes, mostly in oceans. With an emphasis on climate change, his interests include the role of oceans as a source/sink of CO₂; the importance of the decline of sea-ice in the carbon cycle; and impacts of the releases of artificial radioactivity in the oceans, for example the nuclear reprocessing plant Chernobyl disaster and more recently Fukushima).



POSTGRADUATE RESEARCH STUDENTS



ANDREW MACKEY (PhD)

Dynamics of isotopic baselines within a temperate coastal ecosystem in relation to the surrounding biogeochemical environment.



MOHAMMED ROZAIMI JAMALUDIN (PhD)

Carbon preservation in seagrass meadow ecosystems.



MARYAM ADOLAHPOUR (PhD)

Flow dynamics through seagrass meadows.



PIERRE BOUVAIS (PhD)

Impact of dredging activities in north-western Australia on filter feeders assemblages.



FLAVIA TARQUINIO (PhD)

Ecological role of prokaryotes associated to seagrass leaves and their contribution to the plant's nutrient requirement.



ERIC AIDOO (PhD)

Spatial Modelling of Recreational Boat-Based Fishing in Western Australia.



MR ALDO TURCO (PhD)

Investigating the strength of herbivory pressure on seaweeds along a latitudinal gradient.



CHARU LATA SINGH (PhD)

Role of microbial assemblages in affecting the nutrient cycling associated with wrack and in supporting the food webs of surf zones and sandy beaches.



FEDERICO VITELLI (PhD)

Feeding ecology of *Parma mccullochi* (Pomacentridae) and its impact on temperate algal dominated reefs.



UDHI HERNAWAN (PhD)

Genetic connectivity of the seagrass *Thalassia hemprichii* in the Indo-Australian Archipelago.



SIMONE STRYDOM (PhD)

Influence of light spectra (light quality) on the growth and development of seagrasses through their life history phases.



JASON HOW (PhD)

Assessing the potential benefits of marine protected areas to adjacent fished areas.



PETER MALANCZAK (Masters)

Relationships between spawning and recruitment of *Nematalosa vlaminghi* with hydrological characteristics within an estuary: can this species be used as an indicator of estuarine health?

HANNAH CAMERON-CALUORI (MSc)

A preliminary investigation of the potential effects of the invasive Mozambique tilapia *Oreochromis mossambicus* on the native fish assemblages of Lake MacLeod, Western Australia.

EVA LEI (PhD)

Integrate various sources of data to assess the recreational fishery in Western Australia.

BEN JONES (MSc)

Hydrodynamic influences on the structure of epibenthic fauna communities inhabiting the seagrass species, *Posidonia sinuosa*.



CURRENT RESEARCH PROJECTS

TITLE	RESEARCHERS	FUNDING AGENCY
The role of <i>Kyphosus</i> spp in reef ecosystems	Hyndes, Turco	ANZ Executors and Trustee Co Ltd
Spatial and temporal variability in ¹³ C and ¹⁵ N stable isotope signatures of primary producers and consumers on temperate reefs	Hyndes, Mackey	
Ecological connectivity of Kimberley marine communities - WAMSI Kimberley Research Program	McMahon	Aust. Institute of Marine Science (AIMS)
Coastal Carbon Biogeochemistry Cluster	Lavery, Serrano, Säwström	CSIRO
Effects of suspended sediment on filter feeders	Bouvais, Lavery	
Protection of coastal ecosystems and marine resource management	Lavery, Hyndes, McMahon, Kendrick, Oldham, Säwström, Ghisalberti (UWA)	Dept. of Innovation, Industry, Science and Research (DIISR)
Microbes, the missing link in Coastal Landscape Connectivity	Hyndes, Säwström	Dept. Parks and Wildlife (DpaW)
Sedimentation rates and history in the Vasse-Wonnerup estuaries	Serrano, Lavery	Dept. of Water

Improving the experiential design and statistical rigour for estimating state-wide recreational catch by boat based anglers	Lavery, Hyndes, Mueller, Graham	Dep. of Agriculture and Fisheries Western Australia (DAFWA)
Boat-based recreational boat fishing activity in Western Australia: a long term profile	Hyndes, Graham, Mueller	
Bacterial carbon usage – loss, sink or link of carbon in coastal systems?	Sävström	Edith Cowan University (ECU)
Assessing the capacity of seagrass sediments to sequester carbon dioxide and metal pollution: past, present and future scenarios	Lavery, Serrano	
Insights into carbon preservation in seagrass sediments: the microbial community structure and its role in carbon degradation and remineralisation	Jamaludin	Holsworth Wildlife Research Endowment
Beach Wrack Dynamics in Geraldton	Hyndes	Northern Agricultural Catchments Council (NACC)
Vasse-Wonnerup Investigation Node	Hyndes, McMahon	South West Catchment Council (SWCC)
Ghost crabs on mid-west beaches	Hyndes, Rae	Western Australia Landskills Inc
Defining thresholds and indicators of Primary Producer response to dredging related pressures	Lavery, McMahon, Strydom	Western Australian Marine Science Institution (WAMSI)
Undertaking Geographe Bay Keep Watch Seagrass monitoring program 2014	McMahon	Geocatch
SUMILEN: Advances in sampling techniques, biogeochemical characterization, and quantification of the millenary deposits of seagrasses: critical update of their role and value as biospheric carbon sinks	Mateo, Serrano, Lavery	Spanish Government; Ministry of Economy & Competition
Millenary changes in the ecosystems of insular National Parks: perturbations, resilience, and trends after the seagrass archives (PALEOPARK).	Mateo, Serrano, Lavery	Spanish Government; Ministry of Agriculture and the Natural Environment
Benthic primary productivity: production and herbivory of seagrasses, microalgae and microalgae	Christin Sävström, Glenn Hyndes, Gary Kendrick (UWA Mat Vanderklift (CSIRO) and Bonnie Laverock (UWA)	WAMSI Kimberley Node Project 2.2.4
Characterising marine microbial diversity and function in key benthic habitats of Western Australia	Huggett, Sawstrom, Fromont, Lavery	Early Career Researcher Grant Scheme, ECU
Seagrass meadows as sinks of carbon: towards an improved understanding of their role in sequestering CO ₂ and their economic significance	Oscar Serrano, Paul Lavery, Carlos Duarte, Pere Masque	ECU Faculty Research Grant Scheme



PUBLICATIONS

BOOKS

Waycott, M., McMahon, K., Lavery, P., (2014), A guide to southern temperate seagrasses. 108, Collingwood.

JOURNALS

Abdollahpour M., Roshan R., 2014, "Flow aeration after gate in bottom outlet tunnels", *Arabian Journal of Science and Engineering*, DOI 10.1007/s13369-014-0954-5

Choney, GE., McMahon, K., Lavery, PS., Collier, N. (2014) Swan grazing on seagrass: abundance but not grazing pressure varies over an annual cycle in a temperate estuary *Marine and Freshwater Research*, 65, 738–749. <http://dx.doi.org/10.1071/MF13126>

Dulaquais, G., Boye, M., Middag, R., Owens, S., Puigcorbe, V., Buesseler, K.O., Masqué, P., de Baar, H. and Carton, X. (2014). Contrasting biogeochemical cycles of cobalt in the surface Western Atlantic Ocean. *Global Biogeochemical Cycles*, 138 (12), 1387–1412.

Farina, S., Arthur, R., Pages, JF., Prado, P., Romero, J., Verges, A., Hyndes, G., Heck, KL., Glenos, S., Alcoverro, T., (2014), Differences in predator composition alter the direction of structure-mediated predation risk in macrophyte communities. *OIKOS*, 123(11), 1311–1322,

Gómez-Guzmán, J.M., Cámara-Mor, P., Suzuki, T., López Gutiérrez, J.M., Mas-Balbuena, J.L., Masqué, P., Moran, S.B. and Smith, J.N. (2014). New insights on the role of sea ice in intercepting atmospheric pollutants using 129I. *Marine Pollution Bulletin*, 89, 180–190.

Hedley, JD., McMahon, K., Fearn, P. (2014) Seagrass Canopy Photosynthetic Response Is a Function of Canopy Density and Light Environment: A Model for *Amphibolis griffithii*. *PLoS ONE* 9(10): e111454. doi:10.1371/journal.pone.0111454

McMahon, K., Lavery, PS. (2014) Canopy-scale modifications of the seagrass *Amphibolis griffithii* in response to and recovery from light reduction. *Journal of Experimental Marine Biology and Ecology*, 455, 38–44

McMahon, K., van Dijk, K., Ruiz-Montoya, L., Kendrick, GA., Krauss, SL., Waycott, M., Verduin, J., Lowe, R., Statton, J., Brown, E., Duarte, C. (2014) The movement ecology of seagrasses. *Proc. R. Soc. B* 281: 20140878.

Nieto-Moreno, V. Martínez-Ruiz, F., Gallego-Torres, D., Giral, S., Garcia-Orellana, J., Masqué, P., Sinninghe Damsté, J.S. And Ortega-Huertas, M. (2014). Paleoclimate and paleoceanographic conditions in the westernmost Mediterranean over the last millennium: an integrated organic and inorganic approach. *Journal of the Geological Society*,

Oldham CE, McMahon K, Brown E, Bosserelle C and Lavery P (2014) A preliminary exploration of the physical properties of seagrass wrack that affect its offshore transport, deposition and retention on a beach. *LIMNOLOGY & OCEANOGRAPHY: Fluids and Environment* 4: 120-135

Pergent G., Bazairi, H., Bianchi, C. N. , Boudouresque, C. F., Buia, M. C., Calvo, S., Clabaut, P., Harmelin-Vivien, M., Mateo, M. A., Montefalcone, M., Morri, C., Orfanidis, S., Pergent-Martini, C., Semroud, R., Serrano, O., Thibaut, T., Tomasello, A., Verlaque, M. (2014) Climate change and Mediterranean seagrass meadows: a synopsis for environmental managers. *Mediterranean Marine Science*. Doi: [hdx.doi.org/10.12681/mms.621](https://doi.org/10.12681/mms.621)

Sawstrom, C., Beckley, LE., Saunders, MI., Thompson, PA., Waite, AM., (2014) The zooplankton prey field for rock lobster phyllosoma larvae in relation to oceanographic features of the south-eastern Indian Ocean. *Journal of Plankton Research*, 36(4), 1003-1016.

Serrano, O., Lavery, PS., Rozaimi, M., Mateo, MÁ. (2014), Influence of water depth on the carbon sequestration capacity of seagrasses, *Global Biogeochem. Cycles*, 28, 950–961

Steenhauer, LM., Pollard, PC., Brussaard, CP., Sawstrom, C., (2014), Lysogenic infection in sub-tropical freshwater cyanobacteria cultures and natural blooms. *Marine and Freshwater Research*, 65(n/a), 624-632, Australia.

Tovar-Sánchez, A., Basterretxea, G., Rodellas, V., Sánchez-Quiles, D., García-Orellana, J., Masqué, P., Jordi, A., López, J.M. and Garcia-Solsona, E. (2014). Contribution of groundwater discharge to the coastal dissolved nutrients and trace metal concentrations in Majorca Island: karstic vs detrital systems. *Environmental Science and Technology*, 48(20), 11819-11827.



CONFERENCE ATTENDANCE & PRESENTATIONS

10th International Temperate Reefs Symposium.
University of Western Australia, January 12-17.

Presenting: Kathryn McMahon and Aldo Turco
How water motion, canopy density and shading interact to effect canopy saturation state

International Indian Ocean Expedition 2 (IIOE-2).
Planning of the proposed International Indian Ocean Expedition 2 (IIOE-2) 2015-2020. Perth, Australia. 16th of April 2014.

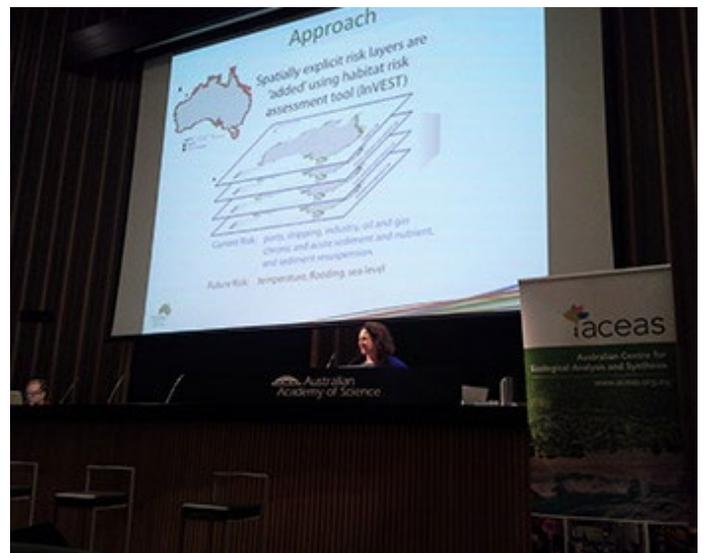
Attended: Christin Sävström.

Centre for Ecological Analysis and Synthesis (ACEAS)
Science Making Sense: the role of transdisciplinary synthesis. Australian Academy of Science, Canberra, | May 7-9.

Presenting: Kathryn McMahon

3rd International Marine Conservation Congress,
Glasgow, Scotland UK. 14-18 August 2014

Presenting: Roisin McCallum



Kathryn McMahon presenting on the challenges of identifying and sourcing data - ACEAS

SEMINARS

Professor Carlos Duarte | Spanish National Research Council (CSIC) at the Mediterranean Institute for Advanced Studies (IMEDEA) in Mallorca, Spain | The Evolving World of Scientific Publication

Dr Dolors Pujol | University of Western Australia | Study of the turbulence in different canopy models under progressive waves: Laboratory experiments, ecological implications

Dr Kathryn McMahon | Centre for Marine Ecosystems Research | The movement ecology of seagrasses

Dr Christin S awstr om | Centre for Marine Ecosystems Research | Coastal connectivity and spatial subsidy from a microbial perspective

Professor Pere Masque | Universitat Aut noma de Barcelona | Radionuclides in the Oceans: tracers of processes and impacts

Professor Kenneth L Heck Jr | Dauphin Island Sea Lab and University of South Alabama | Shifting species interaction and the tropicalization of the northern Gulf of Mexico

Ms Simone Strydom | Centre for Marine Ecosystems Research | The influence of light quality on different life history phases of seagrasses

Ms Aurora Martinez | University of Barcelona | Seascape dynamics and wrack movement in seagrass ecosystems

WORKSHOPS

Tropicalisation of Western Australia's Temperate Seagrasses – 2 day workshop Dec 2014
Coordinators: Glenn Hyndes and Ken Heck

Ecological windows associated with dredging – 2 day workshop July 2014 WA Marine Sciences institution.
Participants: Kathryn McMahon, Paul Lavery

Dimensionless numbers in marine processes: Workshop funded by the Collaborative Research Network 19-24 August 2014. Coordinators: Paul Lavery, Carolyn Oldham, Dolors Pujol. Participants: Udhi Hernawan, Glenn Hyndes, Kathryn McMahon, Flavia Tarquinio and CRN partners

WAMSI Estuaries workshop. October 2014.



Tropicalisation Workshop:
Associate Professor Glenn Hyndes and Professor Ken Heck together with workshop attendees.

RESEARCH LINKS

GOVERNMENT

Australian Institute of Marine Sciences (AIMS)
Department of Parks and Wildlife (WA) Department of Fisheries (WA)
Department of Primary Industries, Victoria
Great Barrier Reef Marine Park Authority
Queensland Environmental Protection Authority
Swan River Trust (WA)
Northern Agricultural Catchment Council
Environmental Protection Authority (South Australia)
WA Marine Science Institute
South Australia Water

AUSTRALIAN RESEARCH

ARC-NZ Vegetation Function Network
Fisheries Research and Development Corporation
Tasmanian Aquaculture and Fisheries Institute
Western Australian Marine Sciences Institute (WAMSI)
CSIRO Marine and Atmospheric Research

- ✦ Wealth from Oceans Flagship (Coastal Carbon Biogeochemistry Cluster)
- ✦ Strategic Research Fund for the Marine Environment (SRFME)

INTERNATIONAL

Université de Nice, France
Université P Sabatier – Toulouse III, France
Otago University, New Zealand
CIIMAR, University of Porto, Portugal
Spanish Council for Scientific Research (CISC), Spain

- ✦ Centre for Advanced Studies of Blanes (CEAB)

University of Barcelona, Spain
University of Las Palmas de GC, Spain
Stockholm University, Sweden

- ✦ Stockholm Marine Research Centre

Dauphin Island Sea Lab, USA
University of Florida, USA
University of South Alabama, USA
University of Virginia, USA
Autonomous University of Barcelona, Spain
University of Satiago, Spain

INDUSTRY

Chevron
Oceanica Consulting Pty Ltd
Woodside Oil and Gas

AUSTRALIAN UNIVERSITIES AND SCHOOLS

Albany Senior High School
Griffith University
James Cook University
Murdoch University
The University of New South Wales
The University of Queensland
The University of Western Australia
University of Technology, Sydney
Southern Cross University, NSW
University of Queensland

COMMUNITY AND GOVERNMENT ENGAGEMENT

BODY/EVENT	ROLE	NAME
Seagrass dynamics and management approaches for tropical WA species. Department of Parks and Wildlife Seminar Series.	Guest Speaker	McMahon
Bivalve Monitoring of the Walpole Nornalup Inlets Marine Park Department of Parks and Wildlife	Collaborative practitioners	Lavery, Hyndes and students of Marine & Freshwater biology course
Investigation of the Cranford Avenue Local Drain Swan River trust	Collaborative practitioners	Lavery, Hyndes and students of Marine & Freshwater biology course
Albany High School - Marine Research Program	Co-coordinator	Hyndes
Live Science	Interview	Hugget
Sydney Institute of Marine Science Marine Microbial Ecology summer short course	Invited Lecturer	Hugget

ALUMNI – WHERE ARE THEY NOW?

Helen Barwick (Honours)
MWH Global, Nelson, NZ.

Ms Rebecca Ince (Honours)
Department of Planning, WA

Dr Muriel Bresseur (PhD)
Oxfordshire Animal Behaviour Centre, United Kingdom

Dr Alan Kendrick (Research Associate)
Department of Parks and Wildlife, WA

Dr Catherine Collier (PhD)
James Cook University, Qld (Post Doctoral Fellow)

Dr Lachlan MacArthur (PhD)
Sinclair Knight Merz Engineering Consultant

Dr Karen Crawley (PhD)
BMT Oceanica Consulting Pty Ltd

Mr Peter Michael (Honours)
Sinclair Knight Merz Engineering Consultant

Mr Chris Doropoulos (Honours and Research Assistant)
University of Queensland (PhD)

Dr Rory McAuley (PhD)
Department of Fisheries, WA

Mr John Eyres (Masters)
Department of Fisheries, WA

Ms Nadia Tapp (Masters)
Department of Fisheries, WA

Dr Adam Gartner (PhD)
Oceanica Consulting Pty Ltd

Mr Andrew Tennyson (Research Assistant)
Sinclair Knight Merz Engineering Consultants

Ms Emily Gates (Honours and Research Assistant)
Australian Institute of Marine Science

Dr Mark Westera (PhD)
BMT Oceanica Pty Ltd

Ms Sophie Harrison (Masters)
Sinclair Knight Merz Engineering Consultant

Mr Nick Wood (Honours)
Scitech

Ms Karina Inostroza (Honours and Research Assistant)
BMT Oceanica Pty Ltd

Dr Pippa Moore (Research Associate)
Aberystwyth University, UK.

Dr Adriana Verges (Research Associate)
University of NSW, NSW

Thomas Wernberg (Research Associate Professor)
University of Western Australia, WA

Mr Dave Holley
Department of Parks and Wildlife, WA

Dr Richard Campbell
Department of Parks and Wildlife –
Marine Science Program, WA

Michael Mulligan (Masters)
Qube Ports and Bulk, WA

Thibaut de Bettignies (PhD)
Oceans Institute, University of Western Australia

Candace Willison (Masters)
Pilbara Ports Authority

Mr Gary Choney (MSc)
Department of Fire & Emergency Services

Jason How (PhD)
Department of Fisheries

Dr Britta Munkes (Research Fellow)
Helmholtz Centre for Ocean Research
(Geomar) and Silversea Marine Cruises

Mohammad Rozaimi (PhD)
UKM (National University of Malaysia)



FURTHER INFORMATION

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