EDITH COWAN UNIVERSITY
School of Natural Sciences
Faculty of Computing, Health and Science

Centre for Marine Ecosystems Research

2009 ANNUAL REPORT

CONTENTS

PRINCIPALS' REPORT

Research activities in the Centre for Marine Ecosystems Research (CMER) continued to be productive in 2009. The centre had the benefit of continuity of many research staff and students, particularly with the continuation of Kathryn McMahon, Pippa Moore, Britta Munkes, Adriana Vergés and Thomas Wernberg as Postdoctoral Fellows. Christine Hanson was also with us in the early months of 2009, but sadly left us to take up a position at the University of Western Australia. We wish Christine the best in her ongoing career. We also congratulate Lachlan MacArthur and Chongdee Srinoparatwatana for the successful completion of their PhDs, and wish them the best in their budding careers.

CMER folk have maintained a strong track record, obtaining external research income from a wide range of industry sources. Income exceeded $0.5M, which reflects the level of engagement with industry, government agencies and research institutes. The quantity and quality of research papers remained high, with 26 papers being published in peer-reviewed journals. Of these, 42% were in high-ranked journals (A* and A category journals under the new Excellence in Research Australis system), and a further 23% were published in B category journals. In addition, seven reports were produced for various funding bodies.

Links and engagement with the scientific and broader communities, as well as industry and government, are high priorities to CMER. We hosted visits from Prof. Marianne Holmer from the University of Southern Denmark, Dr Miguel-Angel Mateo from the Centre for Advanced Studies of Blane (CEAB), Spain, Dr Rebecca McLeod from the University of Otago, New Zealand, and Dr Chris Read (SAHFOS), United Kingdom, which highlights our international linkages. CMER members were involved in a range of conferences, symposia and working groups at local, national and international levels. Members were involved in 15 committees or working groups, and reviewed 38 manuscripts for peer-reviewed journals in 2009.

All members are commended for their high levels of productivity and participation in centre activities during 2009. We will see some more changes to the centre next year, but we look forward to meeting new challenges and maintaining or growing our research activities in 2010.

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

HIGHLIGHTS

IN HABITAT CONNECTIVITY AND TROPHIC INTERACTIONS

TROPHIC INTERACTIONS IN JURIEN BAY

A large three-year programme investigating ecological interactions in coastal reef-seagrass communities in Jurien Bay Marine Park in the mid-west region of Western Australia was finalised in 2009 with the submission of the final report (Hyndes and Hanson 2009). The broad aim of the programme was to gain an understanding of key processes and scales of connections in marine landscapes, which is fundamental to effective management, through Marine Protected Areas (MPA's). Large elements of this programme, which was funded by the Strategic Research Funds for the Marine Environment (SRFME), were lead by Christine Hanson, Glenn Hyndes and Mat Vanderklift, and the success of the programme was significantly influenced by the involvement of a range of researchers within CMER.

A major outcome of the project was the collection of an extensive baseline data set of $\delta^{13}C$ and $\delta^{15}N$ stable isotopes for a range of marine primary producers (seagrass and algae) and consumers (invertebrates). However, we showed a high degree of variability in the stable isotopes at different spatial scales, with significant implications on interpreting stable isotope data and the sampling designs for studies. A dual biomarker approach, using both stable isotopes ($\delta^{13}C$ and $\delta^{15}N$) and fatty acids, was shown to be far superior to using stable isotopes alone for tracing the source(s) of production in marine food webs. Using this approach, we have provided further evidence that macroalgae and periphyton are the dominant contributors to the food web on reefs and in seagrass meadows, rather than seagrass. However, seagrass is likely to provide an important nutrient source as it decomposes, in addition to providing an important habitat for a high diversity of epiphytic algae, invertebrates and fish. We have shown that a combination of brown and red algae and periphtyon contribute to the diet of grazers in reefs and seagrass meadows, but the kelp *Ecklonia radiata*, appears to be particularly important for grazers, even in seagrass meadows through which it drifts once detached from reefs. In addition, using a ^{15}N-labelling approach, we showed that nutrients from reef-derived kelp are incorporated directly into seagrass and its epiphytes, as well as either directly or indirectly into mesograzers such as gastropods. Kelp can, therefore, is likely to have a duel role in subsidising productivity in seagrass meadows.

Our programme has provided clear insights into the flow of nutrients through the food web of a reef-seagrass landscape, and highlights the need to understand the scales of physical connectivity of reef-derived material to other ecosystems. Incorporating corridors of flow of material among ecosystems into spatial management of marine parks are fundamental in maintaining biodiversity and ecological function. A more detailed account of the results can be downloaded from our web site.

SEAGRASS WRACK DYNAMICS IN GEOGRAPHE BAY

Paul and Kathryn have continued with their research into seagrass wrack dynamics in Geographe Bay with colleagues from UWA (Carolyn Oldham, Chari Pattiaratchi and Julia Weyer) and DHI consulting (Tony Chiffings). In 2009, master's student Candace Willison and researcher Adam Gartner also joined the research team at ECU.

Wrack is detached seagrass and macroalgae that is transported from the habitat in which it was growing to other habitats such as sand patches, reefs or beaches. Wrack is an important feature of coastlines as it can play a major role in subsidising terrestrial production and supporting marine food webs. However, it can also create management issues when the coastline is altered and structures such as groynes disrupt the transport processes causing large accumulations to occur.

In the second year of this study our research focused on four main questions: 1) How much wrack is produced and where is it? 2) How quickly does it break down in different habitats and what drives this degradation? 3) How is it transported in the water and on and off beaches? and 4) What conditions drive hydrogen sulphide production in wrack accumulations on beaches? This information was integrated into a hydrodynamic and particle tracking model to provide recommendations for managing wrack at Port Geographe, particularly in relation to modifying the arrangement of groynes. These findings will be released in early 2010.

SOURCE AND SUPPLY OF WRACK: QUANTIFYING VECTORS OF HABITAT CONNECTIVITY

Thibaut de Bettignies came from France to join CMER for his PhD in 2009. His project is supported both financially and in-kind by ECU, WAMSI and CSIRO. He began an intensive field-based research project aiming to quantify the rates and processes that supply seaweed wrack from reefs to adjacent habitats. His thesis title is 'Source and supply of seaweed wrack from reefs to adjacent habitats', supervised by Thomas Wernberg (ECU/ UWA), Paul Lavery (ECU) and Mat Vanderklift (CSIRO). His project is part of a research focus within CMER on trophic connectivity. Movement of plant detritus (e.g. kelps torn off reefs) is a key mechanism of connectivity among marine habitats. Kelp is a dominant primary producer in temperate reefs. It's high productivity and susceptibility to dislodgment and/or erosion (pruning) by waves and currents provides a strong opportunity for kelp to subsidise productivity in adjacent low-productivity habitats (e.g. beaches, surf zone).

The overall objective of Thibaut's research is to improve our understanding of the mechanisms that lead to the dislodgment of kelp from reefs, and which, therefore, influence the delivery of kelp detritus to recipient habitats. These findings will be incorporated into a hydrodynamic model developed for Marmion Lagoon (collaboration with CSIRO - Marine and Atmospheric Research) to allow system scale predictions of the timing, magnitude and most important sources of kelp export. This will allow him to identify delivery hot-spots (i.e. those parts of reef ecosystems most likely to export kelp under certain conditions).

Thibaut has tested how morphological variation affects the hydrodynamic drag and whether it minimizes the dislodgment by adopting a drag-reducing form. He is currently investigating the role of productivity, erosion (partial kelp loss) and dislodgment (complete kelp loss) to export kelp biomass from reefs representing different hydrodynamic disturbance regimes. Erosion and dislodgment were positively correlated to hydrodynamic forces, and up to 700g wet weight.m^{-2}.$month^{-1}$ of kelp biomass was exported from some reefs even during a relatively calm period (austral summer), demonstrating the significant export of biomass from these reefs. Winter sampling is currently ongoing, but so far is showing even higher rates of biomass export.

HIGHLIGHTS

IN CONSERVATION AND FISHERIES BIOLOGY

QUANTIFYING LOBSTER FORAGING BEHAVIOUR USING ACOUSTIC TELEMETRY

Understanding the foraging behaviour and habitat preferences of organisms can provide valuable information on how communities are structured as well as providing managers with information to protect threatened species or habitats. Traditionally quantifying such behaviour in subtidal environments has been difficult, however, recent advances in acoustic tracking technology has enabled the movement behaviour of a wide range of organisms to be determined.

CMER and the Department of Environment and Conservation (DEC) recently invested in a radio acoustic positioning system (VRAP). VRAP is a powerful tool that uses triangulation to provide fine-scale temporal and spatial (accurate within 1-2m) information on an organism's movement in real time.

Initial work by Pippa Moore has focused on determining the movement behaviour of the western rock lobster (*Panulirus cygnus*). Six lobsters had acoustic transmitters attached to their carapaces and were tracked for up to one month at Kingston Reef, Rottnest Island. Initial analysis indicates that lobsters on average forage no further than 30-60m away from reef refugia and spend on average less than two hours foraging each night. Detailed analysis of this data is ongoing using quantitative movement techniques to investigate relationships between lobster foraging behaviour and lobster sex/size, habitat, lunar cycle, wind strength and direction. In addition to tracking lobsters, the VRAP system will be used by CMER researchers and DEC to track a variety of organisms including fish, detached kelp and rays over the coming years.

HIGHLIGHTS

IN MANAGEMENT OF HUMAN IMPACTS

TROPHIC IMPLICATIONS OF SEAGRASS HABITAT DISTURBANCE FROM REDUCED LIGHT

At the end of 2009, Adam Gartner, supervised by Paul Lavery and Kathryn McMahon in CMER, and Anne Brearley at UWA was finalizing his PhD study on the trophic consequences of disturbance in seagrass meadows. Disturbance and loss of seagrass from human-induced impacts such as reduced light is well documented, yet the consequences of these losses for higher trophic levels, including important fisheries resources, is poorly studied, though these are often of profound interest to ecologists and managers.

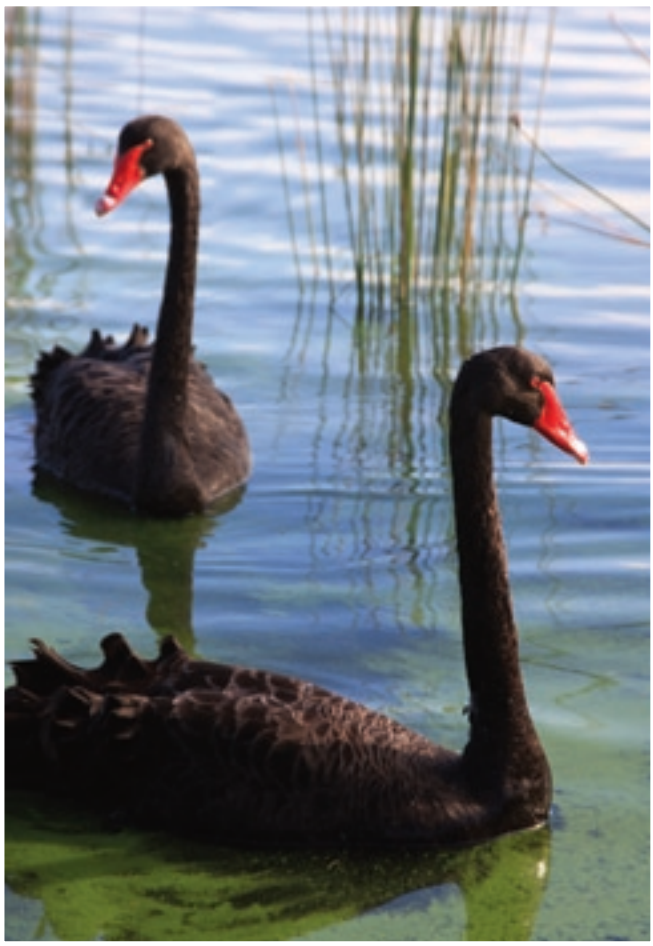
Adam found that the time, duration and intensity of disturbance in a seagrass meadow, where the disturbance simulated light reduction from typical dredging operations, all significantly interacted to reduce the density (by 38%-89%) and biomass of macroinvertebrate fauna. The diversity also declined, with 11%-53% fewer families in disturbed meadows, however, the responses varied between different taxa. Gastropods were the most sensitive and bivalves the least. Macroinvertebrate fauna had the capacity to recover if the seagrass meadow recovered. This occurred within 10 months of the moderate disturbance ceasing.

Changes in the macroinvertebrate assemblage were largely associated with declines in algal biomass, leaf variables and stem biomass, indicating food and habitat limitations. Additional experimental studies confirmed that the highly complex structural components of the seagrass canopy (e.g. that provided by algal epiphytes) were more important than overall seagrass form in supporting macroinvertebrates.

Predicting the flow-on effects on this change in macroinvertebrates to higher trophic levels is difficult using experimental studies. Therefore, Loop analysis and Ecopath with Ecosim modelling approaches were used to estimate the flow-on effects to macrograzers, omnivores, invertivores and piscivorous fish. The modelling predicted lower overall net biomass in these fish with increasing duration and intensity of disturbance. Effects on piscivores may lag for about two years, but once the population biomass declines, it is unlikely to recover.

HIGHLIGHTS

IN STRESS AND DISTURBANCE ECOLOGY



BLACK SWAN GRAZING IN THE LOWER SWAN RIVER ESTUARY

Grazing is an important process in the marine environment and can be responsible for driving the structure of habitats and communities, as well as rates of ecosystem processes. Grazing is often considered a stress for plants, however many plants have evolved strategies to cope with grazing. Previous research at CMER has shown that the iconic black swans are a key grazer of seagrasses in the Swan River estuary, which lies in the heart of Perth City. However, very little is understood about how this grazing pressure varies over the year, and how seagrasses respond at different times of the year.

This study is being undertaken by Gary Choney and aims to improve our understanding of plant-grazer interactions by quantifying the grazing pressure over an annual cycle and investigating strategies that seagrass use to cope with grazing. We will develop an understanding of where and when swans are present in the estuary and what their habitat requirements are, and this will contribute to the management needs of the Swan River Trust. This study will also provide insight into whether future changes in swan abundance will impact on the ability of this seagrass to tolerate grazing, especially in light of other potential stressors in the estuary such as periodic light reductions from algal blooms.

HIGHLIGHTS

IN RESEARCH TRAINING

After working at Department of Fisheries for a few years, Lachlan MacArthur returned to university to undertake his PhD at ECU in 2004. Lachlan became an integral member of the team working on a project funded by the Strategic Research Funds for the Marine Environment (SRFME) on interactions in the marine environment in Jurien Bay to the north of Perth. Lachlan was supervised by Glenn Hyndes, Mat Vanderklift and Russ Babcock, and his project aligned closely with another SRFME funded project examining trophic interactions in Jurien Bay.

Like much of the lower west coast of Australia the shallow (<20 m) coastal waters of Jurien Bay comprise a mosaic of limestone patch-reefs and other benthic habitats such as seagrass meadows, pavement reef and bare sand which stretches 1-10 km from shore. Lachlan's study investigated whether the spatial arrangement of these habitats influences the density, size structure and trophic linkages of a major benthic consumer, the western rock lobster (*Panulirus cygnus*). He also examined the spatial extent of movements linking patches within this landscape (foraging movements) and the level of movement from this landscape to more offshore waters (migratory movements).

Lachlan showed that the spatial arrangement of patch-reefs within shallow water landscapes clearly plays a role in the ecology of western rock lobsters. The arrangement of habitat patches was a strong predictor of long-term diet and nutrition, highlighting the trophic linkage between patch reefs and surrounding habitat, although the extent of movement into these habitats is limited. In comparison, the influence of surrounding habitat on density and size structure was not as great as that of the physical position of patch-reefs. Life-cycle processes that vary over a depth and cross-shelf gradient appear to be more important. The observed patterns suggest that settlement/survival of *puerulus* larvae and movements by large juveniles are likely to be key processes that influence density and size structure of lobsters. These results suggest that spatially explicit models of the distribution, size structure, trophic-linkages, and perhaps growth of *Panulirus cygnus*, should incorporate landscape measures, including depth and distance from shore, and configuration of benthic habitats. Results here provide evidence that the density of legal-sized *P. cygnus* in shallow coastal waters are likely to have been altered through fishing.

Acoustic telemetry confirmed that lobsters use all of these habitats to forage, albeit within close proximity of reef edge (90% of foraging movements were within 60 m). In addition, Lachlan's study questioned some of the paradigms of rock lobster movement. Past research has suggested that a large proportion of pale-shelled 4-5 year old *Panulirus cygnus* in shallow waters, termed 'whites', undergo offshore migratory movements during November-January. Acoustic tracking suggested that, in the absence of fishing, many legal-sized whites can remain within shallow coastal landscapes, at least throughout the migration season. Indeed, the proportion of large-scale movements made by whites was no greater than that made by dark-shelled 'reds', which are commonly believed to display more resident behaviour.

Lachlan's hard work culminated in a thesis entitled "Habitat use, movements and trophic linkages of the western rock lobster, *Panulirus cygnus*, within shallow coastal waters".

Congratulations to Lachlan and best wishes for his career.

CMER MEMBERS

ECU STAFF

Mr Rob Czarnik

After completion of a Post Graduate Diploma of Science (Biological Sciences) Rob was employed as a research assistant for Dr Britta Munkes, Dr Pippa Moore, Dr Adriana Vergès and Dr Christine Hanson. Most of his work has concentrated on grazing in both tropical and temperate seagrass meadows. Rob has also provided support for aquaria feeding experiments and aquaria Ocean Acidification experiments. Outside his research duties Rob is also a first year demonstrator and the School of Natural Sciences' Boating Officer.

Mr Adam Gartner

Adam worked as a research fellow in the last half of 2009, replacing Dr Kathryn McMahon while she was on maternity leave. At this time Adam's research focused on seagrass wrack dynamics, in particular the generation, accumulation and transport of wrack in coastal environments. In conjunction with this work, Adam was also finalising his PhD thesis 'Trophic implications of seagrass habitat disturbance from reduced light'.

Dr Christine Hanson

Christine has broad interests in marine ecological research, especially interdisciplinary studies that seek to provide a holistic understanding of marine community dynamics in relation to their environment and/or habitat. Her work in pelagic ecology has examined oceanographic (physical and chemical) forcing of phytoplankton biomass, production and species composition in the coastal eastern Indian Ocean, on both spatial and temporal scales. More recently, her research has focused on ecological interactions in shallow coastal waters, and more specifically on energy and nutrient flow within and between different habitats (reef, seagrass and sand-dominated regions) using new biomarker techniques (primarily stable isotopes and fatty acids).

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 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.

Ms Karina Inostroza

Karina was working as a part-time research assistant for Dr Pippa Moore on the rock lobster project, examining the impact of *Panulirus cygnus* removal through fishing on the benthic assemblage. Having completed her undergraduate studies at ECU in Marine and Freshwater Biology, she is now completing her part-time Honours in marine ecology. Her research focuses on the impact of spatial management on higher-order consumers and its effect on community assemblage and ecological interactions in seagrass meadows in Western Australia.

Professor Paul Lavery

Paul's research is aimed at improving our understanding of how coastal marine ecosystems respond to pressures and how the functions and ecosystem services they provide might be affected. Much of his research has focused on seagrass ecosystems and is applied to developing appropriate means of assessing impacts and the development appropriate monitoring and management approaches. A second major research theme is the mechanisms and magnitude of connectivity and trophic subsidies among coastal marine ecosystems. Much of this work has relied on stable isotope and other biomarker techniques to understand the role of materials transported from one habitat in supporting productivity in adjacent habitats.

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. In 2009 Kathryn spent the second half of the year on maternity leave with her first child.

Mrs Wendy Mills

Wendy provided administrative support to the group, but sadly moved to Victoria in late 2009 with her family.

Dr Pippa Moore

Pippa's research focuses on the effects of anthropogenic impacts on shallow water marine community dynamics and ecosystem functioning. In particular she is interested in the role of fisheries in altering key ecosystem processes (e.g. predation) and how this affects benthic assemblages. She is also interested in the effects of climate change on marine biodiversity and more particularly how changes in biotic interactions may affect the structure and functioning of marine systems.

Dr Britta Munkes

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

Ms Michelle Newport

Michelle's research activities focus on understanding anthropogenic impacts on marine systems and the ability of marine systems to respond to disturbances.

Michelle is currently examining the lifecycle and transport of seagrass wrack and its ecological importance in coastal marine environments. The outcomes of this research aim to assist in providing informative strategies for wrack management in Geographe Bay.

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.

Dr Adriana Vergés

Adriana's research focuses on the ecology and evolution of marine trophic interactions, i.e. who eats who in the sea, and why. The main bulk of her current research focuses on the topic of fish herbivory in the Ningaloo Reef Marine Park. Other particular topics of interest are seagrass ecology and physiology and the effectiveness of marine protection areas to protect biodiversity and ecosystem functions.

Dr Thomas Wernberg

Thomas has a range of research interests including: the effects of climate change on temperate reef communities; the influence of scale, extent and environmental stressors on trajectories of recovery following physical disturbances to algal habitats; the morphological variation and architecture in canopy-forming algae and its consequences for the ecology of the understorey; the trophic linkages between kelp beds and adjacent habitats in the form of detached reef algae; the biomechanical properties of macroalgae and the prediction of physical disturbances; and the ecology of invasive macroalgae and their impacts on native algal assemblages.

Ms Julia Weyer

Although employed by UWA, Julia spent the majority of her time working at ECU in close collaboration with Professor Paul Lavery and Dr Kathryn McMahon on the Geographe Bay Wrack Movement project. Her research strength is in biogeochemistry and her research at CMER was broadly on the biogeochemistry of seagrass wrack degradation, in particular the characterisation of organic carbon leachate from different wrack sources and the bioavailability of this leachate for heterotrophic bacteria. She also researched the lifecycle and transport of seagrass wrack and its ecological importance in coastal marine environments. The outcomes of this research aim to assist in providing informative strategies for wrack management in Geographe Bay. Julia also left in late 2009 with the birth of her first child.

CMER MEMBERS

ADJUNCT STAFF

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 programmes 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.

Mr Dave Holley

Dave's main focus of research is on the foraging ecology and habitat utilisation of marine mammals, in particular species such as the dugong, seals and sea lions. He is interested in understanding the movements of these species and the forcing factors behind them through the use of technology such as satellite and GPS tags and time depth recorders. In Dave's work with dugongs, he also works closely with local Indigenous communities throughout NW WA. Collaborating with these communities is an important component of any dugong related research activity given the importance of dugongs to coastal Aboriginal groups. Working together also provides for a meeting point of traditional knowledge with modern science.

Dr Ray Masini

Ray is based at the Department of Environment and Conservation. His research has focused on Western Australian marine ecosystems generally, with particular emphasis on the tropical arid ecosystems of the central west 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 as they relate to the three-way interaction between research, environmental policy formulation and environmental management.

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.

Dr Mads Solgaard Thomsen

Mads's research focuses on how anthropogenic stressors, in particular bio-invasions, nutrient pollution and climate change, impact the structure, productivity and biodiversity of aquatic communities. Mads combines manipulative experiments, analysis of long-term monitoring data and literature-based meta-analysis to test how patterns in biological communities are generated and maintained. This research provides predictions on how coastal habitats will respond to anthropogenic stressors and recommendations for conservation strategies needed to ameliorate their impacts.

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.

POSTGRADUATE RESEARCH STUDENTS

Gary Choney (Masters)

Impact of swan grazing on the seagrass *Halophila ovalis* in the Swan/Canning Estuary.

Ainslie Denham (PhD)

Geostatistical spatiotemporal modelling of king prawn catch rate in the Shark Bay managed prawn fishery.

Jason How (PhD)

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

Peter Kiss

The role of allochthonous kelp in subsidising Amphipods inhabiting *Amphibolis* seagrass meadows.

Michael Mulligan (Masters)

Indicator of sub-lethal stress following imposed light reduction on the seagrass *Amphibolis griffithii.*

Charu Lata Singh (PhD)

Kelp wrack as a trophic subsidy in seagrass ecosystems.

Candace Willison (Masters)

Rates and processes of *Posidonia sinuosa* degradation in south-west Australia.

Tracey Rodwell

Connectivity in marine landscapes via fish grazing.

Thibaut de Bettignies (PhD)

Source and supply of seaweed wrack to adjacent habitats.

Adam Gartner (PhD)

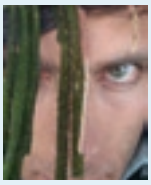
Trophic implications of seagrass habitat disturbance from reduced light.

Karina Inostroza (Hons)

The effects of spatial management on communities and ecological interactions in seagrass meadows in southwest WA.

Peter Michael (Hons)

Regional differences in the piscine drivers of macroalgal herbivory in a coral-reef marine park.



José Plácido Escaño Roepstorff (Masters)

Invasiveness of different *Caulerpa* species and their interactions with seagrasses.

Carli Telfer (Masters)

The Western Australian charter industry: Working towards long-term sustainability.

Justin King (Masters)

Factors affecting *Artemia franciscan* culture and comparison between feeds and strains.

CURRENT RESEARCH PROJECTS

Project	Funding Source	Investigators	2009 Actual External & Internal Income	Total income for grant
Trophic Interaction and Ecosystem Modelling - WAMSI Node 4.3.	WAMSI; ECU	Hyndes, Moore	136,982	421,381
Biodiversity assessment, ecosystem impacts of human usage and management strategy evaluation Node 3.2.	WAMSI; ECU	Hyndes, Vanderklift, Verges	98,888	405,650
Research Study into Seagrass Wrack Movement at Geographe Bay.	UWA	Lavery, McMahon	97,273	372,500
The Role of Herbivory in Ameliorating the Effects of Nutrient Enrichment in Marine Ecosystems.	CSIRO	Lavery, Munkes	50,000	368,000
Impact of Dredging on Coral Communities.	Woodside Energy Ltd	Lavery, McMahon	43,371	276,459
Seagrass TIME - Trophic Cascades in Marine Ecosystems.	European Commission	Lavery, Munkes	36,608	308,175
The Effects of Ocean Acidification on Trophic Interactions in Temperate Seagrass Assemblages.	ECU	Moore, Hyndes, Wernberg	21,458	21,458
Seagrass health survey (Becher Point to Fremantle Region).	Dept of Environment WA	Lavery	8,176	153,682
Do Different Levels of Fishing Pressure, Through Spatial Management, Influence Communities and Ecological Interactions in Seagrass Meadows in South Western Australia.	Rottnest Island Authority	Inostroza, Moore, Hyndes	3,517	3,517
Rates and processes of *Posidonia sinuosa* degradation in south-west Australia.	Karrakatta Club, ECU	Willison, Lavery, McMahon	3,327	3,327
Attributes of a Sustainable Reef: Seagrass and Associated Megafauna.	Great Barrier Reef Foundation	McMahon	3,000	3,000
Interactions Between *Halophila ovalis* and *Caulerpa racemosa* in the Swan River.	Ernest Hodgkin Trust	Wernberg	2,400	2,400

PUBLICATIONS

JOURNALS

Arthur K., **McMahon K.**, Limpus C.J., Dennison W.C (2009) Feeding ecology of green turtles (Chelonia mydas) from Shoalwater Bay, Australia. *Marine Turtle Newsletter* 123: 6-12.

Collier C.J., **Lavery P.S.**, Ralph P.J., and Masini R.J (2009). Shade-induced response and recovery of the seagrass Posidonia sinuosa Journal Experimental Marine Biology & Ecology 370:89-103.

Crawley K.R., **Hyndes G.A., Vanderklift M.A.**, Revill A.T., and Nichols P.D (2009). Allochthonous brown algae are the primary food source for consumers in a temperate, coastal environment. *Marine Ecology Progress Series.* 376: 33-44.

Doropoulos C., Hyndes G.A., Lavery P.S., and **Tuya, F** (2009). Dietary preferences of two seagrass inhabiting gastropods: Allochthonous vs autochthonous resources. *Estuarine Coastal and Shelf Science.* 83, 1: 13-18.

Eklof J.S., **McMahon K.**, and **Lavery P.S** (2009). Effects of multiple disturbances in seagrass meadows: shading decreases resilience to grazing. *Marine and Freshwater Research.* 60: 1317-1327.

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Vanderklift M.A., Lavery P.S., and Waddington K.I (2009). Intensity of herbivory on kelp by fish and sea urchins differs between inshore and offshore reefs. *Marine Ecology Progress Series.* 376:203-211.

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Wernberg T., Campbell A., Coleman M.A., Connell S.D., Kendrick G.A., **Moore P.J.**, Russell B.D., Smale D., and Steinberg P.D (2009). Macroalgae and temperate rocky reefs. In: Poloczanska E.S., Hobday A.J., Richardson A.J. (eds) A Marine Climate Change Impacts and Adaptation Report Card for Australia 2009. NCCARF Publication 05/09, p 1-21.

CONFERENCE ATTENDANCE AND PRESENTATIONS

8th International Temperate Reefs Symposium, Adelaide SA, 12-16 January 2009.
Pippa Moore, Adriana Verges and Thomas Wernberg.

8th Indo Pacific Fish Conference and 2009 ASFB Workshop and Conference, Fremantle WA, 31 May-5 June 2009.
Jason How, Glenn Hyndes, Adriana Verges and Mat Vanderklift.

International Marine Conservation Congress Incorporating International Marine Protected Areas Congress II, Washington DC, 20-24 May 2009.
Jason How.

AMSA 2009, Adelaide SA, 5-9 July 2009.
Thibaut de Bettignies, Paul Lavery, Mat Vanderklift, Glenn Hyndes, Kathryn McMahon and Christine Hanson.

WAMSI/AMSA Rottnest Island Student Workshop, Rottnest WA, 16-17 July 2009.
Thibaut de Bettignies, Karina Inostroza, Peter Michael and Candace Willison.

11th Annual Royal Society of Western Australia Postgraduate Symposium, Perth WA, 20 September 2009.
Karina Inostroza, Charu Lata Singh and Candace Willison.

WAMSI symposium: Monitoring for Action: Understanding WA's changing marine and coastal environment, 24 November 2009.
Britta Munkes, Thibaut de Bettignies, Charu Lata Singh, Karina Inostroza, and Pippa Moore.

SEMINAR SERIES

Dr Chris Reid, University of Plymouth (SAHFOS)
'Experimenting with the global ocean: ecological evidence and implications for the future'.

Prof Andrew Boulton, University of New England and Editor of Marine and Freshwater Research
'Getting published (successfully): Part II'.

Dr Pippa Moore, Centre for Marine Ecosystems Research
'Climate change in the NE Atlantic: effects on rocky shore species and assemblages'.

Dr Daniel Smale, School of Natural Sciences
'Of Ice and Them: the influence of ice scouring on benthic community structure in near shore Antarctica habitats'.

Prof Pierre Legendre, Université de Montréal
'Multiscale spatial eigenfunction analysis of community composition data'.

Dr Len McKenzie, Queensland Primary Industries and Fisheries
'Local eyes, global wise: the Seagrass-Watch monitoring program'.

Dr Shaun Wilson, Dept. Of Environment and Conservation
'Herbivory and detrivory by coral reef fish'.

Thibaut de Bettignies, School of Natural Sciences PhD candidate
'Source and supply of wrack from reefs to adjacent habitats'.

Gary Choney, School of Natural Sciences MSc candidate
'The impact of black swan grazing on the seagrass *Halophila ovalis* in the lower Swan River estuary'.

Candace Willison, School of Natural Sciences MSc candidate
'Seagrass wrack degradation: rates and processes of *Posidonia sinuosa* decomposition in southwest Australia'.

RESEARCH LINKS

- Adelaide University, Australia
- Albany Senior High School
- ARC-NZ Vegetation Function Network
- Australian Institute of Marine Sciences (AIMS)
- Australian Research Council Vegetation Workgroup 47/49 (Australasian Seaweed Biogeograhy) and 58 (Marine flora climate impacts)
- Bangor University (UK)
- Centre of Invasive Species (Denmark)
- Chevron
- CIIMAR, University of Porto (Portugal)
- Cockburn Sound Management Council
- Consejo Superior de Investigaciones Cientificas (Spain)
- CSIRO Marine and Atmospheric Research
- Danish Environmental Research Institute
- Dauphin Island Sea Lab, USA
- Department of Defence (Navy)
- Department of Environment and Conservation (WA)
- Department of Fisheries (WA)
- Department of Natural Resources and Environment, Victoria
- Department of Planning and Infrastructure (WA)
- Fisheries Research and Development Corporation
- Geraldton Port Authority
- Great Barrier Reef Marine Park Authority
- Griffith University
- James Cook University
- Marine Biological Association (UK)
- Murdoch University
- National Environmental Research Institute, Denmark
- Network on Aquatic Invaders (Denmark)
- Oceanica Consultancy
- Otago University (NZ)
- QLD EPA
- Stockholm Marine Research Centre
- Stockholm University
- Strategic Research Fund for the Marine Environment (SRFME)
- Swan River Trust (WA)
- Tasmanian Aquaculture and Fisheries Insititute
- University of Alicante (Spain)
- University of Copenhagen, Denmark
- University of Florida, USA
- University of Las Palmas de GC (Spain)
- Université de Nice, France
- University of New South Wales
- University of Plymouth (UK)
- Université P Sabatier – Toulouse III, France
- University of Queensland
- University of South Alabama, USA
- University of Southern Denmark
- University of Virginia
- University of Western Australia, Australia
- Wealth from Oceans Flagship
- Western Australian Marine Sciences Institute (WAMSI)
- Woodside Oil & Gas

COMMUNITY ENGAGEMENT

Body/Event	Role	Name
Perth Region NRM - Marine Reference Group.	Chair	Glenn Hyndes
Perth Region NRM.	Board Member	
Dept. of Fisheries, WA – Scientific Steering Committee (scientific advice to Fisheries).	Member	
Australian Marine Sciences Association Conference	Presenter	
Western Australian Coastal Conference	Presenter	
Western Australian Marine Science Institute: Node 4 workshop	Participant	
Department of Environment & Conservation: research priorities for the Walpole and Nornalup Inlets Marine Park	Participant	
Australian Marine Sciences Association 2009: Conference: workshop on coastal connectivity	Chairs	Glenn Hyndes, Paul Lavery & Mat Vanderklift
Dept. of Environment and Conservation – Monitoring survey for marine park planning.	Coordinators	Glenn Hyndes & Paul Lavery
ARC Working Group on Seagrass Evolution	Member	Paul Lavery
Seminar at UWA School of Plant Biology: Seagrass responses to light reduction and their role in coastal connectivity.	Presenter	
Western Australian Marine Science Institute – scientific review panel.	Reviewer	
The Environment Protection and Heritage Council and the Natural Resource Management Ministerial Council Working Group: revision of the Aust. & NZ Water Quality Guidelines - Biological Assessment and Monitoring and Assessment	Member	
Australian Marine Sciences Association Conference	Presenter	
WAMSI Climate Change Symposium	Participant	
8th International Temperate Reefs Symposium	Presenter	Pippa Moore
Western Australian Marine Science Institute: Node 4 workshop	Participant	
Earth Day: organised a stall to educate local primary school children about the threats to marine systems and the organisms that can be found in our local waters.	Member	
Joondalup Weekender - article regarding seahorses.	Interview	
Rocky reef section of national 'report card for marine environments' in relation to climate change	Participant	
NCEAS Working Group towards understanding marine impacts of climate change	Participant	
ARC Working Group on Climate impacts on marine flora	Convener	Thomas Wernberg
ARC Working Group on biogeography of marine flora	Participant	
ARC working group on impacts of algae in seagrass beds	Co-convener	
Rocky reef section of national 'report card for marine environments' in relation to climate change.	Lead Author & coordinator	
Swan-Canning Research Innovation Program symposium	Presenter	
Australian Marine Science Association Conference	Presenter	Kathryn McMahon
Workshop on seagrass health measurement for Oceanica	Presenter	
Coordinate development of seagrass illustrations and artwork	Coordinator	
Siemans Science Experience and Science Week Presentations to local high schools	Presenter	
Provide advice to DEC and Rottnest Island Authority on seagrass health monitoring	Participant	
WAMSI Climate Change Symposium	Participant	
8th International Temperate Reefs Symposium	Presenter	Adriana Verges
Indo-Pacific Fish Conference	Presenter	
3rd Annual Ningaloo Symposium	Presenter	
Career-building strategies for women in Academia workshop	Presenter	

ALUMNI -
WHERE ARE THEY NOW?

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

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

Dr Karen Crawley (PhD)
Oceanica Consulting Pty Ltd.

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

Mr John Eyres (Masters)
Department of Fisheries, WA.

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

Ms Sophie Harrison (Masters)
Sinclair Knight Merz Engineering Consultant.

Ms Rebecca Ince (Honours)
Department of Planning, WA.

Dr Alan Kendrick (Research Associate)
Department of Environment and Conservation, WA.

Dr Lachlan MacArthur (PhD)
Hydrobiology Pty Ltd.

Dr Rory McAuley (PhD)
Department of Fisheries, WA.

Ms Nadia Tapp (Masters)
Department of Fisheries, WA.

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

Dr Mark Westera (PhD)
Sinclair Knight Merz Engineering Consultants.

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