



# Ningaloo Research Day for Students



Monday, 30 March 2009 • CSIRO Auditorium Underwood Ave, Floreat

*The Ningaloo Research Program - supporting students undertaking research in the Ningaloo region*



Department of  
**Environment and Conservation**  
*Our environment, our future* 

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For further information on the Ningaloo Research Program or to download a copy of the Ningaloo Student Research Day proceedings, visit the Ningaloo Research website:

[www.ningaloo.org.au](http://www.ningaloo.org.au)

# Introduction

**The iconic Ningaloo Marine Park is the focus of substantial research activity, with scientists from many organisations investigating its biodiversity, ecological and physical processes and interaction with human use. This research falls mainly within the Ningaloo Research Program (NRP), a multi-million-dollar research effort funded by government, research institutions, universities and industry. It is jointly led by the Department of Environment and Conservation, WA, the CSIRO Wealth from Oceans Flagship's Ningaloo Collaboration Cluster and the Western Australian Marine Science Institution (WAMSI).**



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**Environment and Conservation**

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The NRP originated in 2005 with the support of the Western Australian Government. Its task was to address critical information gaps needed to better understand and manage Ningaloo Marine Park in the wake of changes made to its management plan, including extending and re-zoning the marine park. The research program developed in consultation with the research community and resource managers aims to provide a better understanding of the natural values within the marine park and how best to manage them effectively. The NRP seeks to integrate research findings and information from the various projects and organisations involved through the Ningaloo Research Coordinating Committee (NRCC).

Each year, since July 2007, the NRCC has sought to bring together scientists working in Ningaloo to discuss their research and learn more about the big picture of work at Ningaloo and more broadly in the region. There is a clear focus at these symposia on addressing management issues for the Ningaloo Marine Park and on working together to make the biggest difference through collaboration and integration of our shared knowledge.

As the number of research projects grows, we decided this year to hold a separate science day for postgraduate students, to recognise the contribution they make to the bigger picture of Ningaloo and to the advancement of marine science in Western Australia. We hope you take the opportunity today to meet other scientists engaged in similar paths, to share your ideas and experiences and to open the way for further collaboration and integration between projects.

The NRP is committed to making a difference at Ningaloo Marine Park. We rely on the scientists to assist by providing information that will improve our understanding and long term management of the marine park.

We wish you all an enjoyable and productive symposium.

Neil Loneragan, Irene McKissock (Murdoch University, Ningaloo Cluster)

Bill de la Mare (CSIRO Wealth from Oceans Flagship)

Chris Simpson, Kelly Waples (Department of Environment and Conservation, WAMSI, Node 3 research)

# Ningaloo Research Day for Students

**Monday 30th March 2009 – CSIRO, Underwood Avenue, Floreat  
Commencing 9:15am**

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10:10 - 10:30	Cecile Rousseaux – UWA	Production and transport of particulate matter in a regional current system	6
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12:50 - 1:00	Steve Blake – WAMSI	Summary	
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# Abstracts:

Presented at the Ningaloo Research Student Day

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## **The role of oceanographic processes in the trophic ecology of Ningaloo Reef**

**Alex Wyatt**

PhD Student; University of Western Australia; [awyatt@graduate.uwa.edu.au](mailto:awyatt@graduate.uwa.edu.au)

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While recycling of nutrients plays a key role in coral reef food webs, it is increasingly apparent that reefs may be highly dependent on the production, supply and incorporation of particulate nutrients from the ocean (plankton), which is controlled by processes over a variety of spatial scales.

At the regional scale, plankton production available to reef consumers may be controlled by oceanographic processes. For instance, seasonal upwelling at Ningaloo Reef, Western Australia leads to 10-fold increases in nitrate concentrations and over doubling of primary production in adjacent waters. We explore the implications of upwelling for temporal and spatial patterns in reef benthos using synoptic stable isotope data. Scaling phytoplankton uptake we show that Ningaloo may be linked to an area of ocean on the order of 1000 – 10,000 km<sup>2</sup> during upwelling and non-upwelling periods, respectively.

At the reef scale, wave-pumping over the reef flat drives plankton supply, with our data suggesting that uptake of phytoplankton alone represents a nitrogen flux to the reef up to an order of magnitude higher than typically reported for dissolved nitrogen.

At the organism scale, there is increasing interest in the role that plankton feeding plays in energy budgets, calcification and resilience to stressors. Stable isotope and fatty acid biomarkers are used to examine species-level plankton uptake, which we suggest may have implications for maintenance of reef biodiversity.

The process level understanding of reef-ocean linkages presented has significant implications for understanding reef function, as well as the response of reefs to global changes that will alter not only reefs themselves but also the oceanographic systems to which they are intrinsically linked.

## **Geomorphology, Sediments and Habitats of Ningaloo Reef, Western Australia**

**Emily Twiggs**

PhD Student; Curtin University; [emily.twiggs@postgrad.curtin.edu.au](mailto:emily.twiggs@postgrad.curtin.edu.au)

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My PhD research aims to identify evolutionary characteristics significant to the conservation of marine biodiversity of the reef and continental shelf at Ningaloo. It forms WAMSI Ningaloo Research Program Node 3.4 and part of 3.1.1 and covers five research areas:

- Late Quaternary reef growth and development.
- Influence of reef evolution on contemporary geomorphology and broadscale habitat zonation.
- Geomorphic controls on habitats and coral community structure of the northern Ningaloo backreef.
- Influence of geomorphology and sedimentary environments on the habitats across the northern continental shelf.
- Carbonate sedimentology and broadscale geomorphology of the entire Ningaloo Marine Park.

Reef coring and high precision U-series dating provide the data on reef growth and evolution. GIS seabed mapping using remote sensing techniques alongside video transects, sediment grabs and benthic sampling, have been used to characterise geomorphology, sedimentary environments and benthic habitats.

Pleistocene foundations and fluctuating sea-levels played a major role in the establishment of the Holocene reef and are the primary physical controls on contemporary geomorphology and associated habitats of the reef and shelf. Distinct coral reef assemblages occur within backreef geomorphic zones. On the shallow forereef slope there is a veneer of coralgall growth on multiple backstepping 'spur and groove' systems. Hard corals are rapidly replaced by rubble and rhodolith beds at the lower slope to inner shelf, providing the hard substrate for diverse filter-feeding communities. On the open mid-outer shelf, gravelly sediment veneers over limestone pavements and 'large to very large' dunes are interrupted by extensive ridge and pinnacle systems. Exposed surfaces are colonised by prolific sponge, gorgonian and bryozoan "gardens". These are prevalent near continental slope canyons, which are sites of cold water, nutrient-rich upwelling; ideal conditions for cooler-water carbonate production. Distinct carbonate sediment assemblages occur across the shelf and latitudinally, and have become a proxy for the habitats that produced them.

## **Production and transport of particulate matter in a regional current system**

**Cecile Rousseaux**

PhD student; University of Western Australia; rousseau@sese.uwa.edu.au

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Recent studies have suggested that reefs may rely on importation of particulate matter from the adjacent ocean to sustain their high productivity. Here we examine cross-shelf gradients and transport of particulate organic matter in the Leeuwin Current system adjacent to Ningaloo Reef, Western Australia. Particulate matter, nutrient uptake rates and phytoplankton abundance and diversity (based on HPLC) were sampled in May and November 2008 along an 18km-transect running from the Ningaloo reef slope to the 500 m isobath. Phytoplankton concentration was much higher in May (~1 µg/L) than in November 2008 (~0.2 µg/L). In May 08 the phytoplankton community was dominated by diatoms with 10X greater concentration offshore (0.182 µg fucoxanthin/l) than close to the reef (0.02 µg fucoxanthin/l). This onshore-offshore gradient was still observed in November 2008 but the chlorophyll maximum was moved to ~2km off the reef. We also observed f-ratios of ~0.5 which is the highest values that have been observed in this region. This would suggest that new production peaks in autumn due to Leeuwin Current acceleration and not in summer during the upwelling season as expected.

## **The Policy Relevance of Choice Modelling: an application to Ningaloo & Capes Marine Parks**

**Abbie McCartney**

PhD Student, University of Western Australia; mccara01@student.uwa.edu.au

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This study applies the economic Choice Modelling (CM) technique to the Ningaloo Marine Park and proposed Ngari Capes Marine Park in Western Australia. The study aims to investigate the suitability of CM as tool for valuing marine parks and provide estimates of specific ecological values in each park that can be considered in future marine policy and planning. Potential management processes and conservation outcomes are also considered within the study to obtain information on general public and expert scientist preferences for input in to future management decisions. The public and expert preferences will be compared to determine if they diverge, and if information and publicity effects play a role in preference formation regarding management of the marine parks.

## **Spatial and temporal patterns of recreational use by visitors to the Ningaloo Marine Park**

**Claire Smallwood**

PhD Student; Murdoch university; [claire.smallwood@gmail.com](mailto:claire.smallwood@gmail.com)

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Understanding the patterns of recreational usage which occur in multiple-use marine parks are essential for conservation and management. However, the collection of such spatial and temporal information at fine-scale resolution is rarely undertaken. A project to map the human usage within the Ningaloo Marine Park (NMP) is currently underway with geo-referenced aerial and land-based coastal surveys as well as face-to-face interviews with recreational participants conducted throughout 2007. These surveys were undertaken along the entire 300 km length of the NMP and showed that snorkelling, fishing, diving, surfing as well as charter tours for coral viewing and manta rays were some of the most popular activities undertaken by visitors. Mapping of the spatial and temporal patterns of the recreational activities has quantified the clear seasonality in usage with greater abundance and dispersion of people using the NMP during the peak winter months. As this study has comprehensively mapped the location of recreational activities along both the shoreline and in the lagoon environment of the NMP, factors that contribute to distribution patterns (coastal access points, infrastructure, demographics of visitors etc.) can be examined. In addition, travel networks used by visitors throughout the NMP to undertake shore and boat-based recreation have been identified and demonstrate the highly clustered and node-focused nature of visitor use. A clear understanding of both the distribution and connectivity patterns of visitors using the NMP should allow managers to focus their attention and resources in appropriate locations which may be exposed to increased pressure from recreational activities.

## **Spatial and temporal variation in fish assemblages within and adjacent two coral reef marine protected areas.**

**Ben Fitzpatrick**

PhD Student; University of Western Australia;

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We describe patterns in the abundance of fish assemblages in relation to finescale biophysical habitat and summer and winter seasons over two years at two protected and adjacent fished locations at Ningaloo Reef in North Western Australia. We used benthic video transects combined with stereo-Diver Operated Video and stereo Baited Remote Underwater Video to take random replicated measures of finescale habitat and fish assemblages stratified by six distinct lagoon zones at each location. Statistical analysis revealed distinct fish assemblages and biophysical habitats within each of the lagoon zones sampled. Finescale biophysical habitat as represented by percent cover of habitat forming benthos described on average 47% of the variation in fish assemblages within the sanctuary zone habitats. When compared to variation in fish assemblages at fished locations target species including *Lethrinus atkinsoni*, *Lethrinus nebulosus*, *Epinephelus rivulatus*, *Lutjanus fulviflamma* and *Carangoides fulvoguttatus* were variously more abundant and larger. Non target species including invertivores such as *Thalassoma lunare* and herbivores such as *Acanthurus triostegus* were also more abundant while planktivores particularly *Chromis viridis* were found to be less abundant. Overall species richness and diversity was also higher at protected sites. The strength of this response varied between the six lagoon zones depending upon the species and their habitat affinities. The strength of this response was also moderated by seasonal and inter-annually variable processes affecting trophic groups and species differently. Fishing impacts had very different implications for overall fish assemblage structure depending on the spatial and temporal distribution and particular habits of target and non-target species.

### **Additional Authors:**

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## **Loggerhead turtle nest predator dynamics on a mainland nesting beach in Cape Range National Park**

**Sabrina Trocini**

PhD Student; Murdoch University; S.Trocini@murdoch.edu.au

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Nest predation by introduced European red foxes (*Vulpes vulpes*) has been identified as a key threatening process for endangered sea turtle populations in Australia. In fact, it has been suggested that ongoing nest predation by feral foxes may have contributed to the decline of Western Australian mainland nesting populations (Baldwin et al. 2003), as indicated also by anecdotal evidence of fox predation on turtle nests and hatchlings in Coral Bay in the early 1990's.

This study aims to improve the understanding of factors affecting hatching success and in particular, assess levels of predation and predator dynamics at the mainland Loggerhead turtle (*Caretta caretta*) nesting beach in Cape Range National Park, to enable informed decisions to be made with regards to prioritising management actions. The research was conducted for two nesting seasons (2006/07 and 2007/08) and results show that predation by ghost crabs (*Ocypode* spp), varanid lizards (*Varanus giganteus*) and feral European red foxes considerably reduce survivorship from egg to hatchling. In fact, in the first and second years of this study, 78.2% and 83.3% of the monitored nests respectively, showed signs of partial or complete nest predation.

Surprisingly, ghost crabs were responsible for the majority of recorded predations. Besides, ghost crabs showed to predate on turtle nests at any stage of incubation. In general, ghost crabs tend to burrow into nests earlier during the incubation period compared to foxes and varanid lizards. Ghost crabs are natural predators; however numbers of ghost crabs could have increased above normal levels due to tourism activities.

Further investigations will be necessary in future to assess fox control strategies at nesting beaches and to investigate if ghost crab numbers are increased due to anthropogenic factors.

## **Herbivorous fish of Ningaloo**

**Peter Michael**

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Herbivory is an important ecological factor that can control primary productivity and producer structure in a wide range of natural ecosystems, both terrestrial and marine. Herbivory is particularly high in coral reef ecosystems, where herbivorous fishes play a major role in shaping the overall benthic community structure. This relationship between herbivorous fishes and algae represents one of the key natural processes responsible for the persistence of coral reefs against potential 'phase-shifts' by mediating the competition for space between corals and benthic macro-algae, essentially maintaining the system in an animal dominated state.

Current literature describes a number of functional groups which have been ascribed to herbivorous fish on coral reefs based on their shared ecological roles and functions. However, the mechanical removal of benthic algae in coral reef systems by these groups is only partially understood, and little published data exists quantifying the impact of particular species or functional groups (predominantly those from F: Acanthuridae, Scaridae, Kyphosidae and Siganidae) in maintaining the standing algal biomass at low levels amongst coral reefs.

The core of my research is driven by the need understand the species-specific rates of fish herbivory along the Ningaloo Reef in order to correctly identify the key species which maintain natural ecosystem processes, and ultimately underpin effective coral reef management. Ningaloo Reef provides a unique opportunity to investigate algal-herbivore interactions without the potentially confounding affects of overfishing and poor water quality.

In this study, I will use a combination of descriptive and experimental approaches to quantitatively characterise species-specific algal-herbivore interactions. In particular, remote video techniques coupled with in-situ algal bioassays (*Sargassum myriocystum*) will be used to quantify spatial variation in macroalgal herbivory across reef habitats (lagoon, reef flat and outer reef) and along the different regions of the reef (Bundegi, Mangrove Bay, Mandu, Osprey, Pt. Cloates, Maud and Gnaraloo). This study will be the first of its kind to be applied over such a large spatial scale in order to characterise fish herbivory within an entire coral reef system.

## **Ecology of Indo-Pacific humpback dolphins (*S. chinensis*) and bottlenose dolphins (*Tursiops* sp.) in Ningaloo Marine Park**

**Kristel Wenziker**

PhD Student; Murdoch University; k.wenziker@murdoch.edu.au

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Delphinids are high level predators that rely on a healthy and intact ecosystem. Two species of coastal dolphins are the focus of this study, Indo-Pacific humpback dolphins, *Sousa chinensis*, (henceforth humpback dolphins) and bottlenose dolphins (*Tursiops* sp.). The Ningaloo reef region has in recent years experienced significant development due to the iconic nature of the area and anthropogenic impacts on cetaceans such as boating harassment, noise and commercial wildlife interaction tours are likely to continue to increase (CALM & MPRA, 2005). In Shark Bay, in direct proportion to an increasing number of tour operators, there was a significant average decline in dolphin abundance over 13.5 years (Bejder et al., 2006). Other threats include decreases in prey abundance, ecosystem degradation and entanglement in fishing gear. The IUCN status of humpback dolphins is data deficient (Jefferson et al., 2008) and the long-term performance target for cetaceans in Ningaloo Marine Park is “No loss of whale and dolphin diversity and abundance as a result of human activity in the reserves” (CALM & MPRA, 2005, p57). However, to-date no studies have been undertaken on delphinids, and there is an urgent need for initial assessment of these populations and their ecological needs.

Two study sites are proposed, Coral Bay and Tantabiddi lagoon. Boat-based surveys will be undertaken and standard photo-identification and mark-recapture methods will be used to obtain population estimates. Observations of dolphin distribution, behaviour and habitat usage will be combined with biodiversity and benthic habitat maps. This will clarify their habitat preferences and determine drivers of distribution, such as prey distribution and predator avoidance; predictive modelling of critical areas will be undertaken. Recommendations for their conservation and management, and a contribution to the assessment of the conservation status of the humpback dolphin at a national level will be made. This study should shed new light on the importance of the region to humpback dolphins and bottlenose dolphins.

# Additional abstracts:

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## **Reef Encounters: how repeat visitors to the Ningaloo region may be impacted by tourist management changes**

**Pippa Chandler**

PhD student; Curtin University; pippagirl@hotmail.com

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This research will examine the experiences and attitudes of people who holiday regularly in the Ningaloo Reef area, a rapidly changing part of Australia's North West.

The area is popular with West Australian visitors who value the area's beauty and isolation, and often have strong attachments to specific campsites or caravan parks. Impending changes to the way land is managed at Ningaloo, notably changes from pastoralist to government control, may disrupt or restrict the ways in which these individuals experience the region.

Using semi-structured interviews with repeat visitors (RVs) to the region, this research explores how management changes to the area may effect these individuals' interactions with their physical and cultural surroundings.

It asks what motivates a visitor to return to any destination repeatedly, and whether RVs' interact with their environments differently from other types of visitors. It will analyse these people's travel experiences in relation to academic literatures on place and place-attachment, social impacts of tourism, rural change and repeat-visitation.

In doing so, it will evaluate the potential influence of RVs' attitudes and values on future tourism/planning in the region and elsewhere in coastal Australia.

## **Tourism research to tourism practice: potential barriers to building adaptive institutions in Ningaloo**

**Kelly Chapman**

PhD Student; Edith Cowan University; [kelly.chapman@gmail.com](mailto:kelly.chapman@gmail.com)

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Despite careful research, modelling and planning, resource management recommendations in complex social and ecological systems, such as those being proposed for tourism in Ningaloo, often fail to deliver on the ground. Since the 1970s, many writers have challenged the notion that managerial decision-making is rational or logical. Rather, decisions are based on complex political pressures and contextual dynamics, often using incomplete information. A new action research project is underway in the Ningaloo area, aiming to engage researchers, policy makers, resource managers, and other stakeholders in a bid to establish adaptive institutional arrangements for synthesizing and acting on data generated by research/modelling efforts in the region. This study hypothesizes that engaging stakeholders in a deliberative and transformative co-learning approach will increase the likelihood that adaptive institutional arrangements are developed. The approach will specifically involve a combination of transformative participatory decision-making processes, organizational change management strategies, and the eight elements of Learning Tourism Destinations.

# **Sustainable Camping at Ningaloo: Impact assessment, Environmental Load and User Preference**

**Anna Lewis**

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While coastal areas are prime destinations for outdoor recreation activities, they are also dynamic and highly sensitive to impacts. Despite its isolated location, the Ningaloo coastline is emerging as one of the more prominent remote camping locations in Western Australia. Visitors have a choice to camp at either regulated or unregulated campsites, which differ in management structure, restrictions, cost and facilities. Potential negative environmental impacts of camping tourism in the Ningaloo Marine Park, can be attributed to incremental growth, the absence of appropriate plans and lack of management. It has been argued by David Wood (2003) that the future of tourism in the Ningaloo Marine Park depends on its sustainability, largely through maintenance of the natural environment.

Given government plans to develop multiple camping 'nodes' along the Ningaloo coast by 2015, the focus of this study is to provide baseline data to aid in sustainable planning of both unregulated and regulated campsites within the Ningaloo Marine Park. This study will have three aspects: Initial environmental impact assessment of campsites; environmental load of campers; and user preferences of campers concerning facilities and restrictions. Both qualitative and quantitative methods will be utilised. Literature surrounding campsite impact assessments in the coastal environment is limited. However, much research has been done in forested environments, from which methods will be drawn. The environmental load and preferences of campers will be determined through 'choice model' questionnaires and 'semi-structured' interviews. Unregulated camping areas to be assessed include Ningaloo, Warroora, and Cardabia Stations, Turtles at Gnaraloo station, and the Defence land. Regulated campsites include Red Bluff, Three Mile Camp, and campsites within Cape Range National Park.

Data will be analysed using the Ecological Footprint model to help determine carrying capacity of campers with regard to the local resources available. Carrying capacity, indicators (created through the campsite impact assessments), and user preferences may then be used to inform future management.

This research will undertake an initial environmental assessment of sample campsites within different locations along the Ningaloo coast. Campers' daily activities, resource (water, energy) use and waste production will also be determined. This research is highly significant from a local and regional perspective, given government plans to develop multiple camping 'nodes' along the Ningaloo coast by 2015. The data will therefore contribute to a stronger understanding of campsite sustainability, with regard to campsite placement and facilities. This research will also address international information gaps within the field of recreation ecology.

Unregulated camping areas will likely include Ningaloo, Warroora, and Cardabia stations, Turtles at Gnaraloo station, and the Defence land. Regulated campsites will likely include Red Bluff, 3 mile camp, and campsites within Cape Range National Park.

## **The influence of place attachment on the management of marine parks and their hinterlands**

**Joanna Tonge**

PhD Student; Murdoch University; [j.tonge@murdoch.edu.au](mailto:j.tonge@murdoch.edu.au)

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Recently completed fieldwork by Murdoch University (Beckley, Smallwood and others) indicates that 55% of visitors to the Ningaloo Marine Park have been there before, and 82% intend to visit again. Interestingly, 44% of these visitors have always stayed at the same place, which is extraordinarily high site fidelity. Such fidelity suggests that place attachment is likely to be a strong influence on how visitors behave, what their expectations are and how they respond to policy and management changes. Extensive research in North America has described the different forms of place attachment expressed by visitors to national parks and forests and its effects on visitors' responses to management. Similar research has not been undertaken in Australia and additionally place attachment in marine environments has received little attention in Australia or elsewhere.

Planning, developing and managing protected areas requires an understanding of the attributes and values of these areas. However, how can managers consider place attachment when making management decisions? Understanding the connections between quality of life, sense of place, place attachment and satisfaction is likely to assist managers in providing protected areas where both biodiversity and the quality of visitors' experiences are assured.

This project will focus on measuring and gaining an understanding of visitors' attachment to the Ningaloo Marine Park as well as gaining an insight into the attachment of locals and managers. Such an understanding will better inform management and development decisions. Potential outcomes include: identifying methods for determining place attachment in marine environments; determining associated measures of place attachment; and providing information on how different forms of place attachment might contribute to different responses to proposed changes in management.

## **Coral associated microbes of Ningaloo Reef**

**Janja Ceh**

PhD student; Murdoch University; j.ceh@murdoch.edu.au

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Over the past several decades, coral reefs worldwide have been subjected to unprecedented degradation. Recently the importance of microbial-coral interactions has been recognised with studies demonstrating a conserved microbiota associated with some species potentially active in maintaining coral health. However the specificity of these associations is still not well understood and little is known about the dynamics of coral-microbial associations over time and space.

This study investigates the dynamics of coral-associated microbial communities over a one years period, in the Ningaloo reef system of Western Australia. The study specifically looks at the seasonal changes in diversity and community structure of microbes harboured by corals and presents the findings of data acquired from the first nine months of study.

Samples were collected every three months, with additional sampling before and after coral spawning, to determine how microbial communities changed through this event. Three different coral species were examined and comparisons made between brooders versus spawners and massive versus branching corals. Mucus samples of corals were taken in situ and the diversity and community structure of the associated microbes were analysed by molecular techniques including phylogenetic analysis of 16S rRNA gene clone libraries.

The dynamics of coral-microbial associations over space and time is discussed. Considering the uniqueness of Ningaloo Reef in terms of its location on the western side of a continent and the associated unusual oceanographic regime, this data provides interesting and novel insights

**The trophic ecology of the grazing sea urchin *Echinometra mathaei* within Ningaloo Marine Park, Western Australia: Comparing the effects of different closure regimes on urchin distribution and trophodynamics.**

**Mark Langdon**

PhD Student, Murdoch University; M.Langdon@murdoch.edu.au

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Sea urchins can have a significant influence upon the ecological structure of coral reefs through bioerosion of substrata and also by affecting competition for space. However, the relative importance of the role of sea urchins in influencing the composition and structure of coral reef habitats has rarely been explored.

Ningaloo Marine Park provides an opportunity to study a near-pristine tropical coral reef environment that has not been affected by the over-exploitation of natural resources that has occurred in most other tropical reef systems of the World. Furthermore, this allows for comparisons in reef community structure between Ningaloo and other degraded systems.

The overall objective of this research project is to add to the general understanding of coral reef ecology and more specifically, advance the existing knowledge of the role of sea urchins in coral reef ecology at Ningaloo Marine Park. This study will examine marine grazers (particularly sea urchins), investigating their habitats, distribution, and trophic relationships at Ningaloo Marine Park. The indirect effects of different closure regimes (e.g. Marine Protected Areas such as sanctuary zones) on urchin ecology within Ningaloo Marine Park will be examined at length, both temporally and spatially over the next two to three years and will provide important new information which will aid in the formulation of future management strategies for the conservation and stewardship of Ningaloo Marine Park.

## **Movement patterns of Serranids as they relate to marine park planning at Ningaloo Marine Park**

Jason How

PhD, student; Edith Cowan University; j.how@ecu.edu.au

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Serranids (groupers) are often targeted by fishers resulting in significant fishing pressure on their populations. Due to their general sedentary nature, they often benefit from protection of marine protected areas. This study is examining the movement patterns of twenty individual fish representing five species of Serranid with acoustic tags and an array of receivers. This project forms part of a larger CSIRO project, which is tracking numerous fish and shark species through the Mangrove Bay sanctuary zone and adjacent fished areas. The project on serranids aims to examine the general movement patterns of these fish as well as identify any potential natural barriers to movement to possible spawning aggregation sites. Data collected on these highly exploited species will provide valuable information on their scales and patterns of movement that will benefit planning MPAs.

To date, the twenty tagged fish have been tracked over a six month period, and analysis is underway.

## **Assessment of coastal groundwater and linkages with Ningaloo Reef**

**Deanna Wilson**

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Little is known about the groundwater system and its connectivity with Ningaloo reef but there is sufficient information to indicate that groundwater discharge from the hinterland to the reef system is a significant process which probably has linkages to issues such as stygofauna habitat, water chemistry and biodiversity patterns within the reef lagoon. Groundwater influx is expected to be responsive to recharge and runoff events, tidal oscillations, seasonal variations and storm events. Groundwater discharge has been shown to be significant within the lagoon of the Great Barrier Reef, for example by delivering nutrients to the reef system, and analogies are to be expected with Ningaloo Reef due to the presence of a karst hinterland and distinctive palaeochannel systems encroaching into the reef lagoon.

Some of the project objectives will be utilisation of shared field time, including shared seabed bathymetric and swath data relevant to project objectives and also shared access to remote sensing data through projects within WAMSI node 3 and the CSIRO Ningaloo Collaboration Cluster projects. The latter are particularly important with respect to remote sensing data sharing.

Project findings thus far have been that spatial patterns do exist in the groundwater data for the Ningaloo Reef Marine Park and it is possible to predict areas where groundwater discharge is likely using a combination of fresh groundwater indicators such as well locations, karst, Ficus and stream discharge. Predictive analysis has highlighted a number of 'likely areas' for groundwater discharge and will reduce the duration of groundtruth studies and area to be covered by these studies which are planned for 2009. A preliminary map of the groundwater system has also been composed based on the predictive analysis. Further, preliminary work has been undertaken on hyperspectral data analysis in the predicted areas to determine if a particular spectral signature exists for groundwater discharge in a marine setting and to further refine the study sites. A more detailed investigation will be undertaken in the second year of the project.

# Student contact list

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