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SRFME

THIS ISSUE:



# Western Australia's Coastal Ecosystems and Biodiversity

**This edition of *Current Directions* will focus on CSIRO's Coastal Ecosystems and Biodiversity component of the Strategic Research Fund for the Marine Environment (SRFME).**

The project will provide the tools and information to better understand Western Australia's coastal ecosystems and to detect and predict changes in environmental quality.

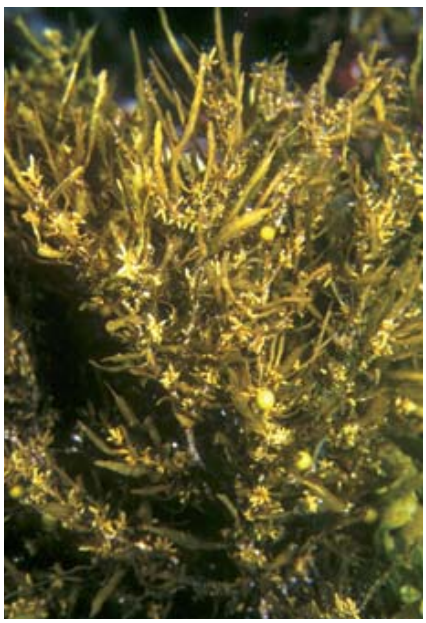
It will help answer fundamental questions such as: What makes a healthy ecosystem? What are the signs that an ecosystem is being degraded? How much environmental variability is natural, and when should we begin to be concerned about it? Answers to such questions will help us predict the impact of human or natural stressors on these ecosystems.

A focus of the work will be the ecosystem's response to environmental factors, including human impacts. These may include the input of nutrients, organic matter, or chemical contaminants into Western Australia's waterways; and habitat alteration or destruction from activities such as dredging, marina or port developments, and fishing or aquaculture enterprises. Such impacts are best understood in the context of ecosystem responses to the natural background of physical factors such as currents, waves, sediments, nutrients, and biological factors such as recruitment variability.

The research will provide the Western Australian government with the scientific basis to assess the suitability of development proposals, and to manage the multiple use of the West Australian marine and coastal environment.

The stakes are high with premium sites for commercial development (ports, marinas, aquaculture operations, fishing, urban growth and shore-based industries) also serving as important nursery sites for numerous fisheries, including commercial species, and sites of high biodiversity. ■

*> Only by understanding Western Australia's unique coastal environment can credible decisions be made about marine and coastal development.*



*> Researchers Julia Phillips and Nicole Murphy are investigating the effect man made structures, such as harbours, have on the gene flow and dispersal of the algae Sargassum along the Western Australian coast.*

## AT THE HELM

**Dr Russ Babcock** began with CSIRO as leader of the Coastal Ecosystems and Biodiversity project in February this year.

"One of the things I'm looking forward to doing is trying to work out what it is about the waters off Western Australia that makes them as productive as they are," he says.

"It seem paradoxical that these waters are low in nutrients, yet on the bottom it seems quite productive in terms of algal growth and the animals we find living there. How can that be?"

Russ Babcock explains that there are several theories: Is there a supply of nutrients that we don't know about? Or are there different kinds of trophic (food web) interactions than we see elsewhere? Or do these waters just seem productive, while in fact they are no more or less productive than other coastal waters?

"The research will help us understand how this ecosystem ticks with regard to the interactions of organisms on the seabed with their physical environment and with each other.

"If we can understand how this system functions, we'll be a long way to understanding what are the consequences of human activities whether fishing, the input of nutrients into the system, or physical disturbances such as marinas.

"That's at the heart of SRFME," says Babcock. And there is potential to use this Western Australian research as a trial area for developing methods for understanding the bigger picture of how Australian coastal waters function, and how they may be impacted by human actions.

Dr Babcock has come to Perth from the University of Auckland where he held the position of Associate Professor at the Leigh Marine Laboratory. He previously worked at the Australian Institute of Marine Science and James Cook University in Townsville. ■

# Western Australia's unique coastal environment

**As indicated in the March edition of *Current Directions* Western Australia's coastal waters differ starkly from other coastal environments around Australia, and from the waters off the West coast of other continents.**

Research leader Russ Babcock explains that the west coasts off Africa and America are characterised by rich fisheries fed by an upwelling of cold, nutrient-rich, deep-ocean water.

In these environments the prevailing currents run from south to north, bringing the cold high-nutrient water up to the coasts, he says.

The waters off the Western Australian coast are by contrast nutrient poor, with prevailing currents flowing north to south and an absence of upwelling.

What drives the productivity of these waters is largely unknown, but theories being explored include the possibility that nutrients trapped in the sediments or from ground water periodically enter the water boosting benthic (seabed) algae and seagrass growth. These nutrients end up in the detrital (dead and decaying marine life) part of the food web, and may be responsible for the increase in productivity of Western Australia's coastal waters in winter.

"This resuspension of detritus and remineralisation of nutrients could be part of the process driving the productivity of coastal waters off Western Australia," he says.

It is important that we find out how the system works if we are to understand how these waters will react to environmental changes, whether natural (as the result of cyclones or changes in oceanic patterns) or human induced (such as increased sediment/nutrient loads from coastal developments including tourism operations or aquaculture enterprises).

It may be something as simple as ensuring that a particular development

> *What drives the productivity of Western Australia's coastal waters is largely unknown.*

doesn't result in increased levels of sediments entering the waterways. Sediments can smother seagrass meadows, which act as vital fish nursery grounds. But without understanding how the system functions we can't predict the impacts of any proposed development.

"We don't yet understand how the physics and ecology interact or why we see the spatial variability (in ecosystems) that we see," says Russ Babcock.

"This research will help us get a better understanding of how pelagic and benthic ecosystems interact."

There are three broad parts to the Coastal Ecosystems and Biodiversity research: ecology (the interactions of animals and plants on the seafloor and in the water column with their physical environment and with each other – why are they where they are?); biogeochemistry (how the sediments, ocean chemistry and life in the sea relate to one another); and remote sensing (using satellites, remote monitoring stations and remote operated vehicles to detect variability in productivity of the coastal waters, oceanographic phenomena, and ecological patterns.) ■

# RETURNED FROM THE FIELD

**CSIRO's Julia Phillips, the ecological team's algal specialist, has just returned from the first field trip to investigate the ecological processes driving the reef systems off Western Australia.**

"We conducted fairly intensive sampling and looked at the canopy forming algae, the understorey algae and the invertebrates associated with these habitats," says Phillips. "The information allows us to unravel the ecological processes – the nutrients, the re-mineralisation and the detritus – of the reefs."

This ecological research will be coupled with remote sensing studies by CSIRO's Peter Fearns who is investigating the productivity of Western Australian coastal waters measured by phytoplankton levels.

Optical instruments were deployed to monitor the spectral variation (colour) of the water column, a feature remote sensing scientists use to infer concentrations of water column constituents.

*> Biologists and biogeochemists collect seabed samples off Western Australia.*

"The aim of the remote sensing work is to improve the accuracy of remotely sensed data and to develop new products of use to marine agencies, scientists, fisheries and coastal managers," says Fearns.

Fearns also investigated the level of nutrients by sampling water from the same locations and at the same time as the ecological team, allowing the data to be usefully combined.

"We took water samples to determine chlorophyll concentrations, pigments present in the water column, nutrient levels and amounts of particulate material."

"We can also monitor the extent and type of benthic habitats," says Fearns. "In-situ sampling carried out by biologists and biogeochemists provides a close view of specific locations along the Western Australian coast." The 'ground truthing' information provided by these divers will be added to the optical models, which will then be used to develop and improve tools for remotely sensing coastal waters in Western Australia.

The research has great potential. Already, remotely sensed data provides views of the complete Western Australian coastline on a near-daily basis, Fearns says.

In coming months Martin Lourey, also of CSIRO's Floreat Laboratories, will begin to study nutrient processes in the sandy coastal sediments.

"In many areas, the sediments are an important nutrient store and sea-floor processes control the amount of nutrient recycling," Lourey explains. "These nutrient processes are generally poorly understood in coastal ecosystems."

*> CSIRO's Julia Phillips with a sample of marine algae collected as part of research aimed at unravelling the ecological processes driving the reef systems off Western Australia.*

A better understanding of the role of the sediments in controlling nutrient supply will support the efforts of the coastal ecosystems project to understand benthic productivity in the region, he says.

The combined research will help tease out the different contributions that phytoplankton, other biomass and sediments make to the levels of nutrients in Western Australia's coastal waters.

In future the team will manipulate the ecological interactions, and the levels of nutrients and sediment to better understand Western Australia's coastal environment. Importantly it will help answer some of the pressing questions about the likely outcomes of disturbances to different parts of the system, whether through natural processes or human development. ■

# TAGGING GREAT WHITES

**In May this year, CSIRO marine scientists successfully attached a hi-tech tag to a 3.5 metre female white shark off the south coast of Western Australia.**

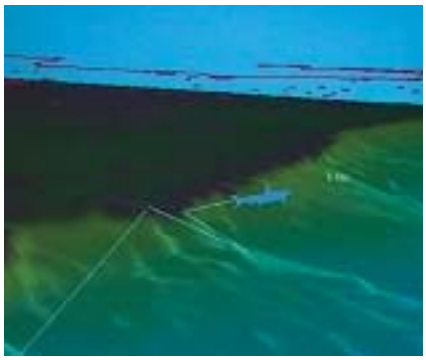
Project leaders Barry Bruce and John Stevens, with funding from the Aquarium of Western Australia's Research Foundation, tagged the shark with a Pop-up Archival Transmitting (PAT) tag that will transmit data on the shark's movements and behaviour once it is released in July this year.

The tagged shark was the only white shark sighted during the five days of berleying in the region.

As part of the same project, the scientists have developed a tagging system and satellite tag pods that,

for the first time, enable large sharks to be tagged without the need for them to be caught or restrained.

The shark tagged in May failed to present an opportunity for the scientists to attach a satellite tag, which transmits whenever the shark's dorsal fin is clear of the water. The tagging team hope to mount a second field trip to deploy the remaining satellite and PAT tags to white sharks in the region. ■



*Acknowledgements:* This project is funded by the Aquarium of Western Australia Research Foundation and CSIRO Marine Research. CSIRO and AQWA acknowledge the support and assistance of Channel Nine (Perth), Geoff Campbell and the crew of the vessel Quadrant, Peter Brown and underwater photographers David Riggs and Jennene Paris. The tagging was carried out under permits granted by WA Fisheries and CALM and conformed to Animal Ethics Committee approvals granted to CSIRO Marine Research.

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