currentdirections • SRFME
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Strategic Research Fund for the Marine Environment

THIS ISSUE:

Research to boost ecosystem management in Midwest WA

Two significant environmental research projects are underway in the Midwest region following formal approval from SRFME's Joint Venture Management Committee.

A $300,000 project co-funded with the Geraldton Port Authority is examining the light requirements of seagrasses to find ways to help balance environmental protection and the need to maintain and improve coastal infrastructure.

The second project, with a funding commitment of $770,000, will focus on understanding ecological interactions in coastal marine environments – and links between key habitats and species.

Announcing the new studies, Research Director at SRFME, Dr John Keesing, said the work is integral to the accelerated understanding of Western Australia's marine environment being developed by the SRFME research partners.

"Ecological linkages and the factors influencing them are at the core of much of the science which will ultimately underpin resource management in the region and build security for industry and the environment," Dr Keesing says.

The three-year project will provide a multi-dimensional view of the coastal and shelf marine ecosystem, and factors influencing variability in the system, including –

- What are the pathways for the transport of nutrients between habitats and across the shelf
- How do commercial species use coastal shallow water habitats and other ecosystem components
- What impact does a reduction of predators have on other species?

Background

Profiling Midwest coastal and shelf ecosystems, and predator groups, and assessing what elements of the ecosystem these predator groups favour are the goals set out for the Midwest Ecosystem Study now underway in the Jurien area.

The research will extend previous work in the region by CALM and WA Fisheries to generate a multi-dimensional view of the marine ecosystem at the coast and across the shelf.

"With the detailed marine ecosystem studies being developed through this research, we aim to establish how populations of predatory species – in this case western rock lobsters and finfish – will respond to marine park protection," says Project Co-ordinator, Dr Russ Babcock.

"The ability to simulate the system will provide a powerful tool to help manage ecosystems which are faced with an increasing number of competing demands," he said.

Dr Babcock said the project is a significant initiative for SRFME which has been studying the WA marine environment for the past three years in a three-way partnership between the Western Australian Government, WA's four universities and CSIRO.

The project has three components, each of which will be conducted by research staff from WA Universities and Government institutions working in collaboration with CSIRO.

Habitat and benthic community studies

Objectives: To provide a comprehensive assessment of biodiversity in the Jurien area, simulate the interactions, and link models of habitat with historic ecological studies in the Midwest

Outcomes: The project will provide a landscape-scale spatial framework and a baseline for assessment of change in benthic species assemblages resulting from climate change, climate variability or changes in human usage of the system. The work will link with studies of rocky reefs by CALM and seagrasses by the Department of Environmental Protection and Edith Cowan University.

... continued page 2

Changing conditions

14/10/2002

17/12/2002

2/1/2003

Studies of major predator groups (rock lobster, finfish)

Objectives: Measure relative abundance and size structure of major predator groups in different habitats, their movements and use of those habitats; prey abundance and diet of key predator species in different habitats; link observed habitat use patterns to the life stages of predator species.

Outcomes: The project will measure how key species use their environment and provide data that will be vital to the ecologically-sustainable use of key natural resources. It will also provide the basis for assessing whether future and current attempt to manage these resources are effective.

Links: The work will include PhD research on shallow water rock lobster, and PhD and postdoctoral research on conventional and acoustic tracking to gather information on habitat utilization patterns, mobility and home range extent of rock lobster (and key finfish species).

Trophodynamic studies

Objectives: Using stable isotope and/or biomarker techniques, link the food chain relationships of key consumer and predator species with different sources of primary production (seagrass, macroalgae, detritus).

Outcomes: The project will provide a means of understanding the relative importance of different food chain pathways in maintaining key species and key ecosystem functions, independent of inferences made through direct observations of diet and movement.

The project also will measure how key species use their environment and provide data that will be vital to the ecologically-sustainable use of natural resources. A conceptual model of food linkages in Midwest coastal ecosystems will be developed using this data. The project will provide an ecosystem-level basis for assessing the effectiveness of future and current resource management.

Dr Babcock said participating institutions will include CSIRO, Edith Cowan and Murdoch Universities, University of Western Australia, Western Australia Museum; West Australia Fisheries and the Department of Conservation. ■

Project to shed light on jurien benthic productivity

A SRFME project team has begun a study of how light controls coastal benthic primary productivity in the Jurien region in research to help managers strike the correct balance between protecting the environment without unnecessarily constraining development.

The project is led by Edith Cowan University and Dr. Paul Lavery, and is co-funded by the Geraldton Port Authority and SRFME. Dr Russ Babcock who is the principal SRFME collaborator on the project, says a research program has been established to investigate seagrass meadows which are key benthic habitats in the region.

Dr Babcock said the SRFME Joint Venture Management Committee has agreed to scope and develop collaborative projects on the mid-west coast which would address fundamental knowledge gaps relating to natural variability in marine ecosystems across the coast and continental shelf slope.

"To find the balance required, and to predict impacts, we need to know how much light reduction can be sustained without irreversible or long term damage to habitats.

"From there, we are aiming to develop the key indicators of stress in these habitats and establish environmental "triggers" for management," he said.

The first analyses of the field work, which started earlier this year, are expected in November 2004 with the project continuing through until November 2006.

Dr Babcock said light is probably the single most important environmental factor controlling coastal benthic primary productivity.

The availability of light used for photosynthesis can be reduced indirectly through –

- increased phytoplankton biomass in the water column or excessive algal growth on aquatic plants
- an increase in the amount and change in the characteristics of sediment suspended in the water column (turbidity);
- and increased deposits of sediment on benthic organisms themselves (smothering).

He said that in particular, there are gaps in the understanding of the effects of light and sediment stress on two widespread seagrasses in the region – *Amphibolis antarctica* and *A. griffithii* – common on sandy substrata and low-lying reefs in the Jurien area.

The research will be relevant to agencies within Western Australia, such as the Environmental Protection Authority (EPA), the Department of Environment, Department of Conservation and Land Management, the Marine Parks and Reserves Authority, Department of Fisheries, Department for Planning and Infrastructure, Department of the Premier and Cabinet and the Department of Industry and Resources.

Field work

A single experimental design has been developed to address a range of reduced light and various sedimentation scenarios. The research project (essentially a modified version of the Gordon et al.'s 1994 shading experiments on *Posidonia sinuosa*) will involve the establishment of treatment and control sites to determine the effect of reduced light levels, and the timing and duration of light reduction on *Amphibolis* species.

By applying shading treatments and monitoring an appropriate range of variables in both treatments and control plots, the design allows the seasonal growth (response) characteristics of seagrasses and reef communities to be determined, the annual light requirements to be estimated, as well as making it possible to measure the seagrass' responses to varying levels of shading.

The team is drawn from a range of institutions: Assoc. Prof. Paul Lavery, Centre for Ecosystem Management, Edith Cowan University, Principal Investigator; Dr Russ Babcock, CSIRO Marine Research and Dr Cam Sim, Marine Ecosystems Branch, Department of Environment. A Post-doctoral fellow, to be based at Edith Cowan University will also be appointed. ■

OCEAN OPTICS BRINGS COLOUR TO THE WEST

The development of SRFME has helped WA attract an important international ocean observations conference, being held in the Southern Hemisphere for the first time.

Ocean Optics XVII was held at Fremantle from October 25 to 29.

"Ocean colour research has one of its strongest Australian hubs in WA, and SRFME has contributed to its growth and research application," says local member of the conference Organising Committee and SRFME researcher, Dr Peter Fearns.

Dr Fearns said that from its inception, the Ocean Optics Conference series has attracted a diverse audience of professionals and students addressing virtually every facet of optical oceanography including basic research, technological development, environmental management, and policy.

He said Australian researchers and PhD students are making good use of the International conference to present their work.

Subjects included -

- Radiative transfer theory and simulation
- Interdisciplinary topics addressing the ocean surface and interior
- Interaction of light with shallow ocean benthos and substrates
- Development and application of quantitative ocean colour remote sensing
- Coastal ocean monitoring and data management strategies
- Instrument design and validation

Project to deliver WA inshore profile

The deployment of a set of instrumented moorings off as part of the Strategic Research Fund for the Marine Environment (SRFME) will provide a comprehensive regional profile of coastal conditions off the WA coast near Perth.

The state-of-the-art moorings system include the most advanced oceanographic instruments of their kind available today generating a cross-sectional view of the coastal ocean from near shore out to 100m depth.

SRFME Director, Dr John Keesing, says the information obtained will assist Government resource managers in their decision-making across a range of areas including fisheries, environmental protection, coastal development and marine protected areas.

Information obtained during the next 12 months will help identify how the Leeuwin Current and associated ocean eddies offshore influence the inshore marine environment of South West Western Australia.

"In contrast to basic oceanographic measurements undertaken for the past 30 years we will have the opportunity to monitor seven days a week, 24 hours a day," says Dr Keesing.

"The tremendous improvement in instrumentation and especially in battery power technology, significantly expands our capability to collect and store much more accurate and greater quantities of data than ever before..

"These systems allow us to accurately resolve many of the key oceanographic processes and construct models of the coastal marine environment," he says.

Instruments on the mooring system are measuring -

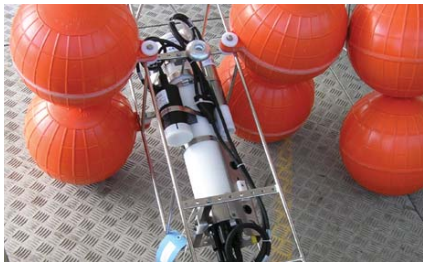
- Depth profiles of ocean currents (Acoustic Doppler Current Profiler)
- Sea Level (tide gauge)
- Surface waves (wave gauge)
- Salinity, temperature, pressure, dissolved oxygen, nutrients, light penetration and turbidity (multi-sensor)
- Salinity, temperature and depth (CTD)

Three moorings have been prepared and will be deployed in early July offshore just north of Perth, at sites 20, 40 and 100 metres deep. This transect has been monitored for each month for the past two years.to improve scientific understanding of the cross shelf biological processes.

"The new measurements will add significantly to this data and will enable for the first time estimates of the biological productivity and its relationship to physical and biogeochemical processes," Dr Keesing says.■

Acoustic release unit, with rope recovery cannister. Used to recover the 40 metre and 100 metre moorings.

Seabird CTD: Measuring temperature, salinity and pressure



Seabird multi-sensor unit: Temperature, salinity, pressure, dissolved oxygen, nutrients, light penetration and turbidity.

At 5,500 kilometres, the *Leeuwin* is our longest ocean current

One of Australia's most influential natural features, the *Leeuwin Current* has been confirmed as the longest continuous coastal current system in the world.

Marine scientists have linked what was originally thought of as three separate coastal currents, with the same oceanographic signature from Western Australia's North West Shelf to South Cape in southern Tasmania.

"Over the last 150 years the system has acquired three different names but we now know for sure it is one long ocean current that shapes marine and coastal biodiversity in western and southern Australia, and the climate of Western Australia," says Ken Ridgway.

"The intriguing aspect is that the current remains connected at all because very different factors must act together with perfect timing.

"The large-scale circulation in the Indian Ocean sets up the flow off WA and delivers it to the south coast just as the seasonal winds change direction and push it further to the east", Mr Ridgway said.

The *Leeuwin* is one of four currents influencing life in the Australian region by regulating rainfall and temperature, fostering coastal recreation and distributing marine species.

Mr Ridgway and fellow CSIRO oceanographer, Dr Scott Condie, documented the complete, 5,500 kilometre path of the *Leeuwin*.

Their work, published in the Journal of Geophysical Research, was funded through SRFME.

He said scientists are still assessing the broader influence of the *Leeuwin* on the marine environment. However, they have established that the current and associated ocean eddies which spin from it govern nutrient distribution to the food chain and distribution of larvae from seafood species such as salmon and the western and south-eastern rock lobsters.

Although segments of the Current were identified in the Bight as early as 1853, it was not until 1980 that the *Leeuwin Current* was formally named by CSIRO scientists George Cresswell and Terry Golding.

The *Leeuwin* originates near North West Cape in Western Australia and flows southward towards Cape *Leeuwin* before turning eastwards into the Great Australian Bight. From south-eastern South Australia it was known as the South Australian Current and flowed to north western Tasmania. It then turned south again down the Tasmanian west coast to become the Zeehan Current, reaching as far as South Cape – and in winter flows north as far as the Freycinet Peninsula.

For researchers, the lack of oceanographic and satellite data across the Great Australian Bight had prevented researchers from linking the flow of water across the Bight with the Zeehan Current because of a lack of observations in the eastern Bight.

Mr Ridgway said the full length of the current was identified using European and US satellites, drifting instruments and measurements in recent years from scientific expeditions and commercial shipping companies which support ocean research.

He said the Current had been shown in earlier research to be vital to a range of ecological mechanisms; it provides a free ride for many marine species and assists their migration and subsequent distribution from the tropical north to the temperate southern waters.

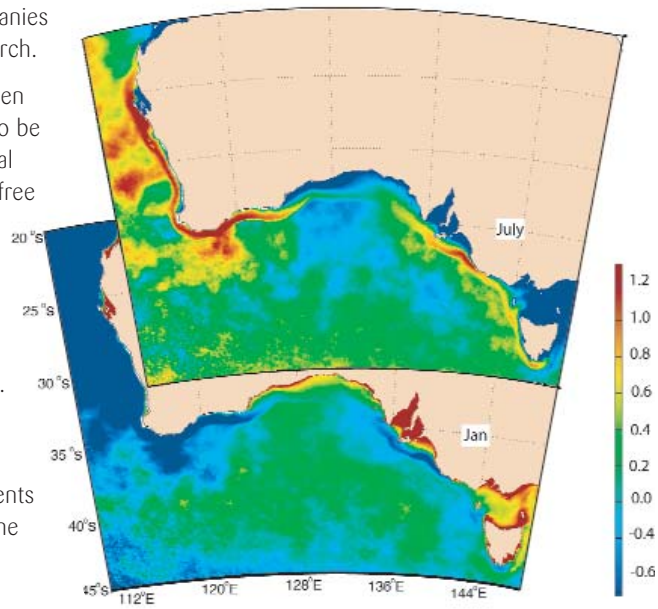
The *Leeuwin Current* takes an opposite course to geographically-similar currents which flow northward up the African (Benguela) and South American (Humboldt) continents.

Partly formed from the system of currents draining the Pacific Ocean into the Indian Ocean through Indonesia, its characteristics are detectable throughout the course of its long winter journey

The journey is governed by seasonal conditions and prevailing winds, with the Current generally following the edge of the continental shelf.

The southward flow of the *Leeuwin* is weakest from November to March when the winds tend to blow strongly northwards and reaches greatest flow is in the autumn and winter when the opposing winds are weakest.

In the Indian Ocean, typical current speeds in the *Leeuwin Current* and its eddies measured are about 1 knot although speeds of 2 knots are common, and the highest speed ever recorded by a drifting satellite-tracked buoy was 3.5 knots. The *Leeuwin Current* is about 300 m deep (quite shallow for a major current system, by global standards), and beneath it is a northwards countercurrent called the *Leeuwin* Undercurrent. ■



Leeuwin Current – Life of the West: **www.marine.csiro.au/LeafletsFolder/44leuwin/44.html**

Rare, tiny ocean creature

A miniscule species of marine life caught during a recent Indian Ocean research voyage is believed to be the first of its kind identified in the Southern Hemisphere.

The six-legged species is an actinopoda phaeodaria coelodendridae. Measuring only 1.4 mllm, it was found during an investigation of ocean eddies by the National Marine Facility, *Southern Surveyor*.

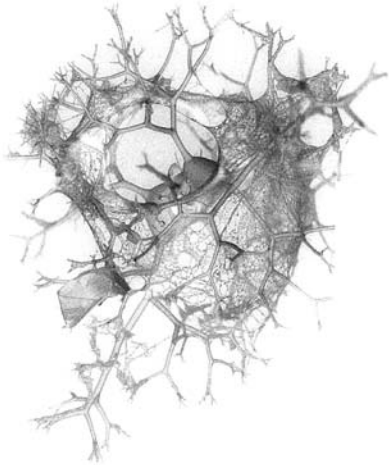
The find has excited scientists researching the microzooplankton world. The theodaria was captured in a sediment trap deployed by Dr Stefan Pessant, from the University of Western Australia,within an 'upwelling' eddy bringing cold and nutrient-rich deep ocean water to the surface.

"It was a case of being in the right place at the right time with the right people," says PhD student Harriet Paterson, who is based at Floreat, Perth.

"Our objective was to collect samples of marine life in ocean eddies and this was a complete surprise to us and I'm sure to other researchers in this field from Northern Hemisphere institutions.

"It is another demonstration of the rich biodiversity found in West Australian waters, especially with the influence of the *Leeuwin Current*," Ms Paterson said.

The microzooplankton species is understood to live from depths of 100 to 5,000 metros. Its food range extends from ocean algae to tiny shellfish which it latches on to and consumes in the same manner as a spider, remnants forming part of the 'ocean snow' that sustains the smallest forms of marine life.



Ms Paterson has searched the scientific literature and believe this is the first sample to be found in the Southern Hemisphere.

The first sample was recorded during the world's first oceanographic voyage by the British ship Challenger in the 1870's, and then more than a century later, US scientist Dr Neil Swanberg collected 18 specimens down to a depth of 500 metres in one voyage from a submersible in 1986. ■

New study continues ocean nutrient research

A$1.7m grant to study the productivity and sustainability of fisheries off the coast of Western Australia has been awarded to several WA scientific organisations led by the University of Western Australia's Dr Anya Waite with collaborators at CSIRO, Fisheries WA, Murdoch University and Curtin University of Technology.

The productivity and sustainability of fisheries off WA may depend on the scale and persistence of physical features importing 'new' nutrients (including upwelling of nitrate and fixation of atmospheric nitrogen,) into surface waters against the influence of the *Leeuwin Current*, a process highly dependent on climatic fluctuations.

The focus of the project is to quantify the nutrient-fisheries link by studying the nutrient-mediated controls of phytoplankton dynamics and ecosystem structure in the coastal waters of WA. Two regions are of interest to Fisheries WA; to the south coast off Esperance, (WA; primary study site); and, to the west, between Fremantle and the Abrolhos Islands. Both regions are seasonally and variably under the influence of the *Leeuwin current*.

The three year project will be funded from the Strategic Research Fund for the Marine Environment (CSIRO and Office of Science and Innovation; ~$500K), with cash and in-kind support from UWA, the National Steering Facility, the Faculty of Engineering and Mathematical Sciences at UWA, Fisheries WA, Murdoch University and Curtin University of Technology. ■

ABOUT US

The Strategic Research Fund for the Marine Environment (SRFME) is a A$20 million, six-year joint venture between the Western Australian State Government and CSIRO.

SRFME was established in 2001 to enhance marine science capability and capacity in Western Australia and to generate strong collaboration among marine researchers from government, universities and the private sector.

Led by its Research Director, Dr John Keesing, SRFME today comprises a multidisciplinary team of 28 research scientists, postdocs and technical and support staff in Perth and 14 PhD students. Another 13 staff in Hobart also contribute to the skills dedicated to SRFME projects proving the ability of CSIRO to deliver on projects from multiple sites across Australia. ■

CONTACTS For more information on SRFME, please contact Dr John Keesing on (08) 9222 8887 at Office of Science and Innovation, Department of the Premier & Cabinet, Level 2, 197 St George's Terrace Perth WA 6000.

www.srfme.org.au

SRFME Strategic Research Fund for the Marine Environment

GOVERNMENT OF WESTERN AUSTRALIA

CSIRO MARINE RESEARCH

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