

# Centre for Ecosystem Management

**2006 Annual Report**

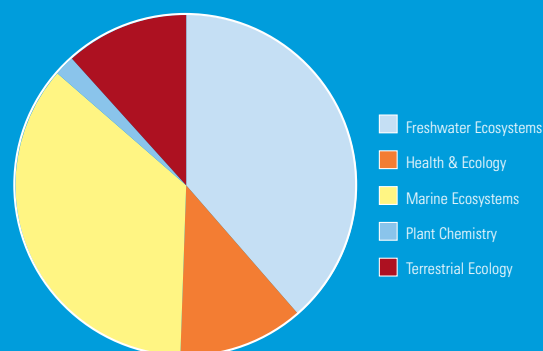


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## Statistics 2006

2006 Research Income - Grants/Consultancies



# Director's Report



The Centre for Ecosystem Management maintained its high research productivity during 2006 and continues to be recognised as one of the outstanding Research Centres at Edith Cowan University. Centre members were successful in raising over \$960 000 in grants and research consultancies which is just below the record \$ 1.2 million obtained last year. The magnitude of the research funding is a consequence of constructive

engagement and research links between the CEM and State, National and International government organizations and research institutions. All specialist research areas of the CEM, including groups in marine and estuarine ecology, freshwater systems, terrestrial ecology, health and ecology, environmental chemistry and forensics and plant chemistry, were successful in obtaining research funding.

Members of the CEM continued to produce high quality outputs in the form of book chapters, refereed papers, reports and conference proceedings. Centre members were responsible for 1 book, 1 book chapter, a record 44 refereed papers, 5 refereed conference proceedings and 10 technical reports to supporting agencies and corporations. The breadth of research interests in the CEM can be seen from the research highlights and published outputs given later in this report. A pleasing feature of the outstanding number and quality of outputs is the significant contribution made by our post doctoral fellows and post graduate students. The CEM is fortunate to have such an array of talent available in pursuing its agenda of growing research activities amongst all staff and members.

Centre members also maintained a strong contribution to professional and community activities outside ECU. Of particular note was the appointment of Dr Andrea Hinwood to the position of Deputy Chair of the Environmental Protection Agency of Western Australia. Congratulations to Andrea on this appointment which is a fitting recognition of her substantial contribution to environmental sustainability across Australia. Associate Professor Pierre Horwitz was invited to deliver the opening keynote address at the 28th Annual Congress of the International

Association for Human Caring while Professor Paul Lavery was an invited speaker at the 7th International Seagrass Workshop in Zanzibar. A number of staff members were invited to take part in Western Australian State of the Environment steering and working groups. Professor Will Stock and Dr Eddie van Etten continued to serve on the Minerals and Energy Research Advisory Committee of Western Australia and Eddie continued to represent WA as the Regional Councillor for the Ecological Society of Australia. During 2006 CEM members were invited to referee over 44 papers for national and international journals, were editors of 3 journals, sat on 5 editorial boards and contributed to 27 professional or advisory boards or committees. The breadth and scope of the contributions made by members of the CEM is remarkable and reflects the growing research culture of the Centre.

A major function of the Centre is to provide support for postgraduate student activities and in 2006 some 63 PhD, MSc and Honours students were members of the CEM. Financial support enabled 6 students to attend international or national conferences. Students performed well at these meetings. The Centre also provided equipment and field work grants to 10 students. Items ranged from custom designed field sampling equipment, local travel grants and funds for specialised analyses undertaken outside ECU.

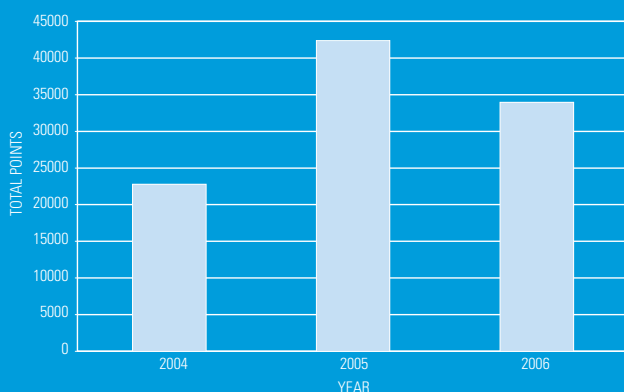
Congratulations to Ray Froend on his promotion to Associate Professor. This is in recognition of his long-term contributions to environmentally sustainable groundwater abstraction. As can be seen in the highlights section his efforts in this area have resulted in a successful ARC linkage grant with a number of partners from the Water Corporation, ECU, UWA and UTS. The project is investigating sympathetic abstraction regimes and their impact on ground-water dependent vegetation.

I would like to congratulate all the CEM members for their contributions and achievements for 2006. With the forthcoming Research Quality Framework (RQF) Assessment I am sure we will continued to be recognised as one of the most productive and busy research centres at ECU.

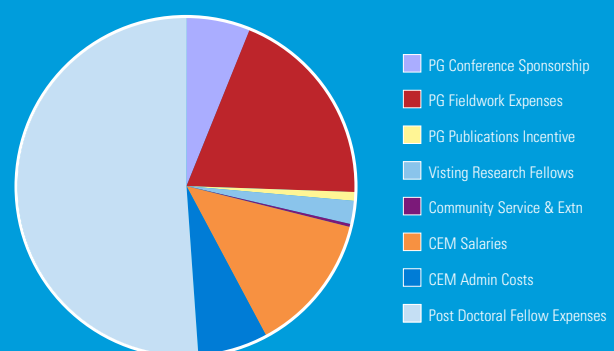
Will Stock

Director, Centre for Ecosystem Management

Total RAI Points Earned 2004-2006



2006 Total Expenditure



# Highlights 2006

## Deputy Chair of the EPA in Western Australia

Dr Andrea Hinwood is a Senior lecturer in Environmental Management in the School of Natural Sciences. She has a Masters in Applied Science from RMIT, Victoria and a PhD in environmental epidemiology from the Department of Epidemiology and Preventive Medicine, Monash Medical School, Victoria. Her research interests include environmental health, forensics and exposure assessment. Andrea has worked in the environmental protection area for over twenty years and has a wide experience in investigation, monitoring and management at the local, national and international levels. She managed the areas of contaminated sites, chemicals management and emergency response for the Victorian EPA prior to managing air quality with the Department of Environmental Protection in Western Australia. Her international experience includes chairing one of the UNEP Technical Options Committees on substances that deplete the ozone layer and membership of the Technology and Economic Assessment Panel under the Montreal Protocol for a period of six years. In May 2003, Dr Andrea Hinwood was appointed as a member of the Environmental Protection Authority in Western Australia and in 2005 was appointed Deputy Chair of the Authority.



*Dr Hinwood*

## Gnangara aquifer winter pumping trial

In Western Australia, the single largest source supplying drinking water to the city of Perth is the Gnangara Groundwater Mound located within and to the north of the metropolitan area on the Swan Coastal Plain. Overlying much of the Mound is native Banksia woodland that is susceptible to prolonged separation from groundwater during Perth's hot, dry Mediterranean summer. During the last 30 years, a drying climate coupled with altered land use and increased abstraction for public and private water supply has contributed to a general decline in groundwater levels across the Gnangara Mound. The consequences of unsympathetic groundwater abstraction on groundwater-dependent vegetation have been observed throughout Australia. With community and industry demand for groundwater highest during the dry period of each year (up to 3 times the winter demand), the risk of impacts on ecosystems dependent on shallow groundwater is high.

Previous research by Associate Professor Ray Froend on groundwater-dependent vegetation has revealed seasonal variability in both the

quantity of groundwater used and the relative importance of groundwater as a water source. Use of groundwater by plants is highest during the driest season of the year which coincides with peak demand for irrigation and drinking water. This collaborative project is designed to assess the response of vegetation to operating borefields during winter which is a period of low environmental and domestic demand. Modifying pumping to be sympathetic to, rather than in competition with, environmental demand offers benefits for sustainable operation of bores especially large bore fields. Low magnitude and rates of change in groundwater levels, as opposed to rapid drawdown, may also allow intra- and inter-generational adaptation and persistence of native vegetation to groundwater abstraction under different management scenarios.

A section of Mirrabooka superficial aquifer borefield in Whiteman Park, Western Australia has been chosen since the majority of production bores are currently turned off due to environmental regulation. In collaboration with the Department of Environment selected bores will be allowed to operate at reduced capacity for the research to take place. A total of 6 study sites, located at various distances from the production bores, have been selected. All sites have a groundwater depth of <5 m and at least 3 individuals of the study species, *Banksia attenuata* and *B. ilicifolia*. A groundwater monitoring well and several neutron access tubes have been installed at each site and climate and soil water are closely monitored.



The Banksia species at the sites are being assessed in terms of how their water relations change in response to the different abstraction regimes. This will be coupled with studies of the ability of the Banksias to change their root functioning in relation to the altered seasonality of groundwater availability. These studies offer PhD opportunities for at least 2 students.

With funding from the Australian Research Council, the Water Corporation of Western Australia and the Western Australian Department of Water and collaboration between Associate Professor Ray Froend and Professor William Stock (Centre for Ecosystem Management, Edith Cowan University), Professor Derek Eamus (University of Technology, Sydney) and Associate Professor Keith Smettem (University of Western Australia), this project represents a significant contribution to Australian and international research on ecosystem dependency on groundwater. It is particularly innovative as it aims to use phreatophyte groundwater requirements and adaptability to formulate sustainable bore field operations. The project represents a long-term commitment by the Chief Investigators and partner organizations to research that leads to sustainable water resource development and management.



## ECU contribution to WAMSI

The Coastal Marine Ecosystems Research group (CMER) is a large and active research group in the Centre for Ecosystem Management, with 4 academic and 6 postdoctoral and research staff and 8 research students. CMER, which is co-directed by Paul Lavery and Glenn Hyndes, focuses its research efforts on examining and understanding ecological processes in coastal systems, with the goal to provide a sound basis for understanding and managing human impacts. The group also has strong links with Marine and Atmospheric Research, CSIRO in Perth and Tasmania, as well as the departments of Fisheries, Environment and Conservation, and Environmental Protection in Western Australia. In terms of research activities, the group has strong collaborations with Drs Russ Babcock and Mat Vanderklift at CSIRO, who hold adjunct positions at ECU.

Extending research outcomes has been a strong emphasis of the group through engaging with government and the general community. Members have been active in the development of the research directions of the newly established Western Australian Marine Science Institute, as well as being involved in a range of advisory committees or reference groups at both local and national levels. The group is also active in disseminating research outcomes at local, national and international conferences and workshops, including the Strategic Research Fund for the Marine Environment Symposia, the Australian Marine Science Association conferences and International Seagrass Biology Workshops.

The majority of the group's activities focus on examining ecological processes in seagrass and reef ecosystems, with particular emphasis on the processes that connect these ecosystems with other marine ecosystems. Understanding the scale of connectivity among different marine habitats is critical for the effective management of our coastal environment. Connectivity among habitats can occur through the movement of animals between habitats for foraging, or the transport of nutrients and plant material that can enhance production in other areas. Knowledge on the scale and type of habitat connectivity is particularly important for determining appropriate zoning schemes and size of management zones in marine parks. This emerging research area provides important information on processes that lead to connectivity in our complex marine system that comprises reefs, seagrass beds, and bare sand areas including surf zones of beaches.

A strong connection among habitats occurs through the transport of algae and seagrass into a range of coastal habitats. Algae and seagrass



become dislodged from reefs and seagrass beds, particularly during winter storms, and are then transported elsewhere. This material, known as wrack, accumulates in other habitats, where it can increase production of consumers. CMER is examining the importance of wrack to the productivity of coastal habitats, such as seagrass meadows and sandy surf-zone regions. Karen Crawley, who graduated in 2006 with her PhD, has shown that kelp from reefs is the main driving force for production of animals in the surf-zone region of our coastline. Current work by Fernando Tuya, a Postdoctoral Fellow funded through the Spanish Bureau of Education and Sciences, is showing that grazers in seagrasses are likely to be influenced by the presence of detached kelp from reefs.

It would appear that wrack not only influences other marine habitats, but also habitats on land. Rebecca Ince showed through her honours study in 2005 that wrack washed up on beaches strongly influences the biodiversity of invertebrates on beaches. Furthermore, biomarker studies indicated that algae and seagrass in the wrack were eaten by grazers. In turn, these animals were eaten by beetles and spiders that could then move back into the sand dunes and thereby increase production further inland.

Marine-derived nutrients can also subsidise production on land through seabirds, as shown by Sofie Harrison who graduated with her Masters in 2006. Sofie found that seabirds, which forage for fish in the ocean, add nutrients via their guano to nesting and roosting sites on islands. Seabirds therefore provide another conduit for marine resources to be transported from ocean to land.

CMER is at the forefront of research examining habitat connectivity in Western Australia. Combined, the various studies are showing strong links among the various coastal habitats in the marine environment and on land. Such information is integral to effective management of our coastal environment.



# Highlights 2006

## Fire, wetlands and acidity: a national first

Traditionally fire managers have tended to overlook the effects of fire in wetlands, assuming that they are too wet to burn. Climate change (a decrease in winter rainfall), and over-extraction of groundwater have caused a rethink of this assumption. Wetland sediments formed under permanently saturated conditions are being exposed to drying and fires are entering these sediments, often burning for months. This problem is one of local, State and national importance: local government becomes involved when local residents complain about the persistent acrid smell from the fires; State government agencies are obliged to manage the fires to prevent them spreading and to manage the environmental values that might be degraded due to the fires.

In the first study of its kind, and with the support of local councils, and funding from the State agencies of the Department of Water (the then Department of Environment), and Fire and Emergency Services Authority, Drs Pierre Horwitz and Bea Sommer, and their colleague Ms Tracy Calvert, set out to examine the effects of an intense arson-lit fire in the Yanchep National Park, Swan Coastal Plain, Western Australia. Their study was conducted to investigate the likelihood that burnt, dried, heated and oxidised pyritic soils might lead to a groundwater acidification event. The following null hypothesis was tested: 'where organic rich pyritic soils are exposed to fire, the oxidation of iron sulphides will not be severe enough to override the buffering effects of the soil itself, the resultant ash or their rehydration' at three wetlands (Wilgarup, Yonderup and Pipidinny). Piezometers were placed "upstream" and "downstream" at each wetland and within unburnt and badly burnt sediments where an ash layer was evident.

For the upstream/downstream piezometers their research was significant for at least one of the wetlands. At Wilgarup, the downstream pH of the shallow groundwater was significantly lower than upstream, and in a range (i.e., 3-4) likely to be due to mineral acids (rather than organic acids which might normally be elevated downstream of a wetland). A groundwater plume at this wetland was characterised by greatly elevated ammonia, aluminium (up to 190 mg/L), iron (up to 290 mg/L), phosphorus (up to 490 ug/L), and higher levels of trace metals than found in other piezometers.

For the within-wetland piezometers, most declined in pH in response to resaturation of the sediments, but they all subsequently recovered over time. Two out of the five piezometers had pH recordings below 4, but for the rest of the sites it seems that the buffering effects from the soil and ash may be sufficient to override a once-off fire-induced



oxidative effect. Of note from this investigation were some high concentrations of arsenic (up to 1.3 mg/L), ammonia, iron, aluminium and phosphorus, and trace metals like zinc in piezometers where pyritic soils had been burnt.

Horwitz and Sommer believe that sufficient evidence exists to regard the oxidative effects of fire as highly relevant for managers of acid sulphate soils. Future studies are therefore critical in areas where acid sulphate soils are becoming exposed due to drying conditions, making them vulnerable to the effects of fire. The work is being continued by PhD student David Blake, with on-going funding support from the Fire and Emergency Services Authority.

## Treating contaminated urban lakes

In 2005, the City of Stirling (CoS) engaged in discussions with Drs. Clint McCullough and Mark Lund, researchers at Edith Cowan University's Centre for Ecosystem Management (ECU, CEM) regarding Acid Sulfate Soil (ASS) issues causing acidity and arsenic contamination of the Spoonbill-Shearwater lakes. The City of Stirling agreed to provide cash and in-kind support for a ECU collaborative grant to finance the establishment, running and analysis of a treatment system based upon Acid Mine Drainage (AMD) treatment technologies used in the mining sector. ECU contributed additional funding and the treatment system was established on the northern side of the southern lake's island over the winter of 2006. The treatment system draws water from the northern lake, neutralises acidity with a computer-controlled dose of sodium hydroxide solution and then settles and removes the flocculent (predominantly iron ochre) in a settling tank. The neutralised water,

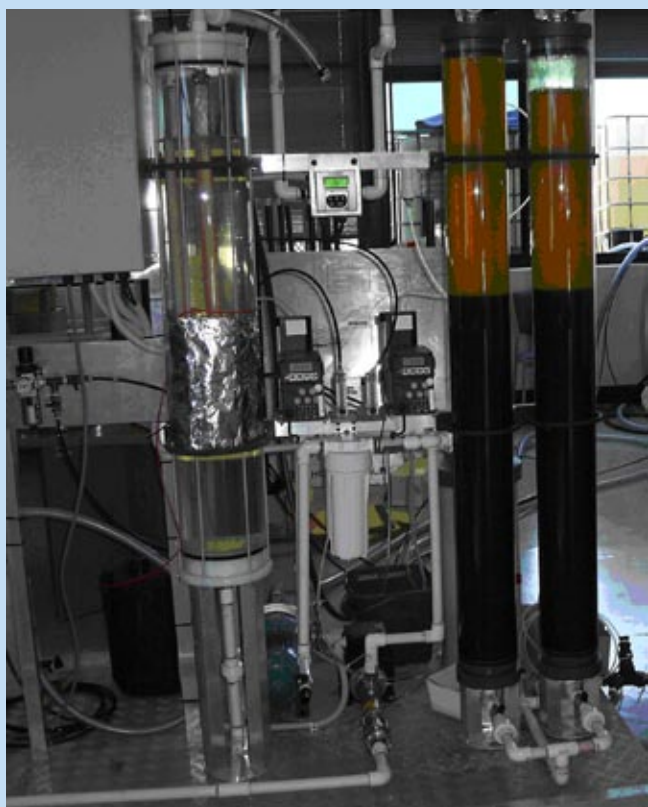




with low iron concentrations, is then passed into the first bioreactor, consisting of 10 t of decomposing potatoes and 18 m<sup>3</sup> of hardwood mulch. Naturally-occurring bacteria undertake sulfate reduction in this reactor. Further sulfate reduction occurs in the second reactor which contains 27 m<sup>3</sup> of hardwood mulch. Sulfate reduction removes excess sulfate in the water and at the same time binds arsenic and heavy metals. Sulfate reduction is essentially a reversal of the arsenopyrite oxidation process that caused the ASS problem following initial wetland disturbance. The treated water is then passed through a final 'polishing' stage in an aerobic wetland which was constructed in the north of the south lake.

## Arsenic removal from drinking water

An Australian company, 'Advanced Water Technologies Pty Ltd' (AWT) approached Dr Wajrak to collaborate on a project, which required the implementation of the ASV arsenic detection method to assist in the



*Catalytic Arsenic Removal Plant – Dewatech Machine*



*Untreated waste water entering the Dewatech Machine (above) and treated water being expelled (below).*



chemical testing of their new patented arsenic removal technology. AWT serves clients globally ranging from governments and non government organisations ("NGO's") such as the World Health Organization, World Bank, public utilities and private companies. The company's main focus for drinking water applications is to provide communities in developing economies with access to safe drinking water.

Mr Gheorghe Duta, Managing Director of AWT, developed 'Catalytic Arsenic Removal – Dewatech Machine' which uses multistage oxidation and co-precipitation by injecting air and sodium hypochlorite to remove arsenic, with the main aim that this technology could be implemented in countries such as Bangladesh and India to eliminate people drinking arsenic contaminated ground water. The company is currently in the process of negotiating with the Bangladesh government to approve this technology.

The process of implementation of this technology in Bangladesh will take some time, however, because the Dewatech machine is also capable of removing other metals, such as iron, copper and manganese. The technology has already been used at a construction site in Nedlands (Steve's Pub) to treat contaminated waste water from the operation of construction activities for disposal into storm water drains.

The research carried out by Dr Wajrak using the ASV technique to detect arsenic and other metals will be used by AWT to monitor the quality of their treated water.

# Highlights 2006

## Black cockatoos in transformed landscapes

Populations of South-Western Australia's three black cockatoos, Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*C. baudinii*) and the Forest Red-tailed Black Cockatoo (*C. banksii naso*) are under threat. Their numbers have declined dramatically due to large-scale destruction of their original habitat of forests, woodlands and heathlands. The birds now live in fragmented and highly modified landscapes. These landscapes include extensive areas of logged forests, forest rehabilitated after mining and significant areas cleared for agriculture. Since little is known about how the different cockatoos use current landscapes researchers from a number of organizations have got together to study the problem. The team is lead by Will Stock from the CEM with partners from ALCOA (Andrew Grigg), DEC (Mark Garkaklis) and Murdoch University (Mike Craig) and is funded through an ECU Industry grant with contributions from the partners. The project will require extensive fieldwork across three study areas: Pickering Brook, Jarrahdale and Myara to the south east of Perth. The project is also being used as the basis of a MSc study by Maree Weerheim. Maree has become an expert at recognising the three species from their distinct calls, tail colour and bill shape. The two white tails, Carnaby's and Baudin's, are notoriously difficult to tell apart in the field. Fieldwork will run through 2007 with 90 km transects undertaken at each site every other month. The study will assist in improving conservation and management of all three species of black cockatoo by providing insights on how the landscape, as an integrated whole, affects their distribution patterns.



## Human impacts in seagrass ecosystems

Seagrass meadows, a dominant habitat in nearshore coastal waters, are regularly impacted by human activities. With the resources boom in Western Australia, several ports are being expanded to cater for larger ships and new ports are planned. Considerable dredging is associated with these activities, which has the potential to harm seagrass meadows, through either smothering or shading associated with the fine sediments suspended during dredging.

Professor Paul Lavery and Dr Kathryn McMahon are working on a number of projects to understand the significance of these potential impacts and help to better manage dredging programmes. A project funded by SRFME (Strategic Research Fund for the Marine Environment) and the Geraldton Port Authority (GPA) is investigating the impacts of dredging on seagrass meadows. Through consultation with Drs Ray Masini and Cam Sim (DEC), Michael Mulligan (GPA) and Dr Russ Babcock (CSIRO) we are developing criteria for dredging operations in the state. These will allow us to better predict impacts and manage projects so that impacts are minimised.

Predicting impacts on seagrass from dredging is an essential component of the management of marine resources by the State Government but understanding the consequences of disturbance in a seagrass ecosystem, such as the impact to fisheries, is also required. Additional research funded by SRFME and DEC is investigating the responses of marine fauna to seagrass disturbance. Helen Barwick completed an Honours on the topic in 2006, and Adam Gartner started his PhD supplemented with a top-up scholarship from WAMSI (Western Australian Marine Science Institution). Dr Anne Brearley (UWA) is also providing expert advice for the project on the identification of faunal species within seagrass meadows.

This large project is due for completion in 2008 but has already influenced decision making in government agencies by increasing our understanding of how seagrass meadows are impacted by human activities. A number of papers have been presented at state (SRFME Symposium), national (Australian Marine Science Association - Cairns) and international (International Seagrass Biology Workshop - Tanzania) conferences.



# Specialist Research Areas: Staff Achievements and Activities

The members of the Centre for Ecosystem Management are conducting research in the following specialist groups. In each group there is a wide variety of research expertise, links and activities as summarized below.

## HEALTH & ECOLOGY



Associate Professor  
Pierre Horwitz

### CURRENT RESEARCH

- The inter-relationship between human health, community well-being and ecological integrity. Developing participatory approaches for the management of aquatic systems and natural resources in general. Sustainability and health; social and ecological resilience; poverty and health inequalities.

- Freshwater, inland saline and estuarine fauna and flora as indicators of environmental change. The effects of fire, forestry, agriculture and urbanisation on inland aquatic systems; acidification and salinisation as aquatic processes.
- Taxonomy, biogeography and conservation status of aquatic invertebrates.
- The contribution of flagships, keystones and other icon species to biodiversity conservation and the well-being of human communities.

### CURRENT PROJECTS

- Biological consequences of acidification of inland waters
- Developing curriculum materials for systems thinking
- Relationships between nature reserves and human well-being
- Relationship between water, drought and mental health
- Long term trends in monitoring data for wetlands on the Swan Coastal Plain

### RESEARCH LINKS

- Department of Water
- Worldwide Fund for Nature (WWF)
- Department of Environment and Conservation
- University of Hawaii
- University of British Columbia
- Consortium for Conservation Medicine
- Centre for Social Research, ECU
- Combined Universities Centre for Rural Health, Geraldton
- University of Sunshine Coast, Queensland
- Murdoch University
- Curtin University
- WA Museum
- The Wilderness Society
- Greening Australia (WA)
- Friends of Fitzgerald River National Park
- University of Tasmania
- Deakin University

## COMMUNITY ENTERPRISE

- Invited Keynote talks:
  - Keynote Speaker, International Association for Human Caring Conference, Fremantle, Australia. 1st June 2006.
  - Keynote Speaker Australian Association Environmental Education, Biannual Congress, Bunbury W A, November 2006
- Invited Papers at Symposia/Workshops/Conferences
  - Invited Paper presented at "Tap the Yarragadee" Public Symposium, 6th May 2006 .
  - Evening Speaker, Denmark Wetland Field Programme, GreenSkills Inc. 25th May 2006.
  - Invited Paper (with Bea Sommer) at the Lake Gwelup Groundwater Forum, 5th September 2006.
- Other Invited Talks
  - Wildflower Society – Northern Branch, 28th February 2006.
  - Talk at Public Meeting at City of Wanneroo Council – Acid Sulphate Soils and East Wanneroo Planning Strategy, 10th January 2006.
  - Seminar at UWA Department of Population Health 3rd October 2006.
  - Speaker at the Land for Wildlife Annual Field Weekend, Perup 21st October 2006.
  - Speaker at the Public Meeting for the Yarragadee Water Issue, Bunbury 26th November 2006.
  - Speaker at the Public Meeting for the Yarragadee Water Issue, Augusta 12th December 2006.
- Co-editor of Ecohealth
- A member of the following professional panels/committees
  - International Association for Ecology & Health (EcoHealth) – a founding Director and Vice President
  - Member of WA Threatened Species Scientific Committee
  - Department of Environment, State of the Environment Working Group (Fundamental Pressures)
  - Key member, Gondwana Link Science Council
  - Member, Rottneest Island Environment Advisory Committee
  - Editorial Board of EcoHealth.
- Invited to review 3 national ARC Discovery grant applications
- Media Commentator: Water and wetland issues (including regular contributor to RTR FM's Understorey Program)
- University Award for Excellence in Postgraduate Research Supervision
- Invited to examine theses from:
  - Murdoch University (Masters)
  - University of Tasmania (Masters, Env. Mgt)
  - Southern Cross University (PhD)
  - Griffith University (Honours)
- Invited to review papers for the following journals
  - *Restoration Ecology*
  - *Australian Zoologist*

## ENVIRONMENTAL CHEMISTRY AND FORENSICS



Dr Andrea Hinwood

### RESEARCH INTERESTS

There has been little work in Australia on exploring the relationships between environmental contaminants and human health. One of the major impediments is our ability to determine how much individuals are actually exposed to and how this information can be used to improve current health studies. Specific areas of interest relate to:

- The assessment of biomarkers for use in health studies
- Development and application of methods to estimate traffic emissions and other air pollutants
- Investigation of the health risks associated with contaminants in soil, specifically heavy metals.

Andrea is actively involved in several projects to investigate the relationship between air pollution and health in Australia. Other areas include the investigation of the health effects of heavy metal contaminated soil and drinking water.

Andrea is interested in the role of community perception and engagement in the EIA process as well as the development of methods to assess environmental and human health risks associated with multi media exposure and complex mixtures and the role of health impact assessment.

### CURRENT PROJECTS

- Air pollution and health effects
- Acid sulphate soil disturbance, environmental heavy metal concentrations and human exposure
- Estimation of traffic emissions for use in health studies
- Estimation of air quality and greenhouse emission improvements associated with the introduction of a new mobile air conditioner
- Development of a biomarker for wood smoke exposure studies
- A novel approach to air pollution monitoring combining time integrated sampling.

### RESEARCH LINKS

- Department of Environment
- Chemistry Centre
- National Research Centre Environmental
- Toxicology
- United States Environmental Protection Agency
- National Measurement Institute
- Flinders University

### COMMUNITY ENTERPRISE.

- Invitations to join the following Professional/Advisory Boards
  - Environmental Protections Authority (Deputy Chair)
  - Editorial Board International Society Environmental Forensics
  - Health Research Working Group, Air Quality Coordinating Committee
  - Air Monitoring Working Group, Air Quality Coordinating Committee
  - State of the Environment Steering and Working Group – Air

## FRESHWATER ECOSYSTEMS



Dr Mark Lund

### RESEARCH INTERESTS

Wetland ecology covers the ecology of inland water bodies (rivers, lakes and swamps). Mark's particular interests are in how wetlands work and how this knowledge can be used to conserve and rehabilitate wetlands.

### CURRENT PROJECTS

- Controlling acidity in mine lakes (Flooded mine pits) using biological approaches
- Controlling nuisance midges in urban wetlands through exploiting aspects of their life cycle
- Developing and using ecological risk assessment techniques for aquatic problems
- Understanding and managing the impact of urban storm water drainage
- Understanding and managing the impacts of irrigation on tropical rivers

### RESEARCH LINKS

- Curtin University of Technology
- Murdoch University Centre for Water Research
- Midge Research Group (City of Cockburn)
- Griffin and Wesfarmers Coal (CSML)
- Ord Irrigation Cooperative
- Department of Environment
- Water Studies Centre, Monash University
- Land & Water Australia (NPIRD Program)
- Department of Environment and Conservation
- Cities of Joondalup, Wanneroo and Gosnells.

### COMMUNITY ENTERPRISE

Reviewed a paper for publication in Hydrobiologia published by Springer.

Presented papers at the following conferences:

- International Conference on Acid Rock Drainage (ICARD)
- 2006 Water in Mining Conference
- Goldfield Environmental Management Group Workshop on Environmental Management



## Clint McCullough

### RESEARCH INTERESTS

- Aquatic ecology
- Ecotoxicology
- Acid mine lake ecology, chemistry and remediation
- Acid sulphate soil assessment and treatment

### CURRENT PROJECTS

- Development of an innovative treatment system for acidity problems in an urban lake ( Spoonbill Lakes resulting from Acid Sulfate Soils)
- Oxic liming and nutrient enrichment to remediate Collie mine lake through enhanced primary production as phytoremediation
- Environment limitations to the marron fishery in acid pit lake of Collie, south-west Western Australia
- Environmental remediation of low-sulfate pit lakes of Collie, south-west Australia
- Remediation of a south-west Australian acid pit lake waters with oxic liming and an aerobic wetland
- Microcosm experiments for remediation of acid pit lakes with bulk organic materials
- Biological remediation of acid mine waters in a sewage evaporation pond
- Field-scale remediation of a tropical acid pit lake with green waste and sewage
- Bioassay toxicity assessment of mining pit lake water remediated with limestone and phosphorus
- The effect of bioremediation of acid sulfate soil affected wetlands on benthic macroinvertebrate assemblages and water quality
- Ecological consequences of drought-induced acidification in coastal inland freshwater systems

### RESEARCH LINKS

- Aquatic Eco-technology, Hogeschool Zeeland Netherlands
- UFZ – Centre for Environmental Research, Germany
- eriss (Environmental Research Institute of the Supervising Scientist)
- Centre for Sustainable Mine Lakes
- Centre for Water Research, University of Western Australia
- Curtin University of Technology
- Colorado School of Mines
- City of Stirling

### COMMUNITY ENTERPRISE

- Presented papers at the following conferences:
  - International Conference on Acid Rock Drainage (ICARD)
  - 2006 Water in Mining Conference
  - Goldfield Environmental Management Group Workshop on Environmental Management
  - Interact 2006.



## Associate Professor Ray Froend

### RESEARCH INTERESTS

- Ecological water requirements – water regimes required to maintain and enhance conservation values of terrestrial, aquatic and riparian ecosystems
- Management of aquatic and groundwater dependent ecosystems - allocation planning of water resources to environmental

requirements. Development of monitoring strategies and programmes for assessing effectiveness of environmental water provisions.

- Groundwater dependent vegetation – Impact of altered groundwater regimes on native plants. Ecophysiology of phreatophytic vegetation. Population dynamics of phreatophytic species and response to long-term changes in groundwater regime and climate

- Ecology and biology of wetland plants – Recruitment biology of wetland tree, shrub and emergent species. Species response to altered water quantity and quality.

### CURRENT PROJECTS

- Ecological water requirements and ecosystem management:
  - Ecological water requirements of groundwater dependent ecosystems of the Swan Coastal Plain.
  - Ecological water requirements of terrestrial and wetland vegetation of the Southwest Yarragadee aquifer region
  - Framework for identifying vegetation water requirements under a changing climate.
  - Environmental flows of the Lower Ord River
  - Ecological risk assessment of mine dewatering impacts
- Groundwater dependent vegetation:
  - Hydrological habitat and water use efficiency of Tuart in the southwest
  - Modelling of ecohydrological response in the Gngangara Groundwater Mound region
  - Root response to fluctuating water tables
  - Response of Banksia to experimental drawdown in the Gngangara Groundwater Mound region
  - Predicting end of summer condition of wetland and terrestrial vegetation on the Gngangara and Jandakot Groundwater Mounds
- Ecology and biology of wetlands plants:
  - Wetland vegetation dynamics on the Gngangara Groundwater Mound
  - Yate Swamp (Lake Bryde Recovery Catchment) vegetation response to altered water regimes.

### RESEARCH LINKS

- Department of Water
- Cable Sands (WA) Pty Ltd
- Tiwest Venture
- CSIRO
- Murdoch University
- The University of Western Australia
- University of Technology, Western Sydney
- Water Corporation
- Tiwest Joint Venture
- Department of Environment and Conservation

### COMMUNITY ENTERPRISE.

- Appointed to the State Wetland Coordinating Committee
- Appointed to Aquatic Ecosystem Advisory Group of the National Water Commission
- Appointed to the Western Australia Sustainable Diversion Limit Expert Panel by the Department of Water
- Member, Advisory Committee for the Institute of Water and Environmental Resource Management, University of Technology, Sydney
- Appointed to Western Australian EPA Reference Panel on Natural Resource Management
- Refereed papers for the following scientific journals/organisations:
  - *Aquatic Ecosystem Health and Management*
  - *Austral Ecology*
  - *Australian Journal of Botany*
  - *Ecological Management and Restoration*
  - *Journal of Vegetation Science*

## MARINE ECOSYSTEMS



### Professor Paul Lavery

#### RESEARCH INTERESTS

The ecology and management of benthic marine ecosystems

Paul's research attempts to bring together the biology, chemistry and physics of systems to understand how they function, the ecosystem services they provide and how they might be affected by a variety of disturbances, such as eutrophication and

dredging. Much of his research is applied to developing appropriate monitoring and management approaches.

#### CURRENT PROJECTS

- Effects of dredging-related light reductions on benthic marine ecosystems
- The eco-physiology of seagrasses under reduced light conditions
- Trophic linkages between benthic marine ecosystems
- Carbon and nitrogen inputs to island and beach ecosystems
- Developing indicators of algal growth potential under nutrient enriched conditions.

#### RESEARCH LINKS

- Strategic Research Fund for the Marine Environment (SRFME)
- Geraldton Port Authority
- Department of Conservation and Environment
- CSIRO (Marine Research)
- Department of Defence (Navy)
- The University Technology, Sydney
- Stockholm Marine Research Centre

#### COMMUNITY ENTERPRISE

- Board Member of the Western Australian Institute of Chemical Sciences
- Refereed papers for the following scientific publications:
  - *Marine Ecology Progress Series*
  - *Ecological Modelling*
  - *Estuarine, Coastal and Shelf Science*



### Dr Glenn Hyndes

#### RESEARCH INTERESTS

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. Therefore it is crucial to develop a high level of understanding of the complex ecological processes in these coastal environments.

Glenn's research interests are broad and focus on various aspects of marine ecology in coastal environments, with a particular focus on:

- Biology of fish in coastal environments
- Examination of the importance of different coastal habitats to fish communities
- Trophic links among the mosaic of habitats in our coastal environments, through the migration of fauna, particularly fish, and the transport of detrital macrophytes among habitats. Emphasis has been placed on tracking biomarkers, such as stable isotopes, to trace food sources through the food web.

#### CURRENT PROJECTS

- Ecological interactions in coastal marine ecosystems: Trophodynamics
- Ecological interactions in coastal marine ecosystems: Rock Lobster
- Examining coral trout *Plectropomus leopardus* at the Houtman Abrolhos Islands, mid-west region of Western Australia
- Return of ecological function in transplanted seagrass meadows

#### RESEARCH LINKS

- Department of Natural Resources and Environment, Victoria
- Griffith University
- Fisheries Research & Development Corporation
- University of Queensland
- CSIRO Marine Research, Cleveland
- Oceanica
- Department of Fisheries WA
- CSIRO Marine Research, Floreat
- Albany Senior High School

#### COMMUNITY ENTERPRISE

- Technical Advisory Committee, WA Fisheries Research Advisory Board for Fisheries Research and Development Corporation
- Reviewed manuscripts for the following scientific publications:
  - *Journal of Fish Biology*
  - *Estuaries*,
  - *Marine Biology*
  - *Marine Ecology Progress Series*.
- Reviewed PhD thesis of Martin Gullström, *Seagrass Meadows: Community Ecology and Habitat Dynamics*, Göteborg University, Sweden.
- Presented at Dauphin Island Sea Lab, Alabama, USA; Environmental Protection Agency, Rhode Island, USA
- Participated in numerous workshops for the Western Australian Marine Science Institute, Technical Advisory panel for Fisheries Research and Development.



### Dr Mat Vanderklift

#### RESEARCH INTERESTS

- Ecological linkages between habitats in marine ecosystems
- Trophic ecology in marine ecosystems
- Factors influencing the abundance of flora and fauna in marine ecosystems
- Design and analysis of biological surveys
- The effects of species loss on marine ecosystems

- Using stable isotopes to study trophic ecology

#### CURRENT PROJECTS

- Quantification of ecological linkages between reef and seagrass habitats in Australia and North America
- Effects of consumers on ecological processes and the effects of removing consumers (e.g. by fishing)
- Importance of grazing and predation as processes structuring reef and seagrass communities
- Importance of spatial subsidies in supporting populations of herbivores
- Honing the effectiveness of stable isotopes as a tool in trophic ecology

#### RESEARCH LINKS

- CSIRO Marine Research
- Université de Nice, France
- University of Adelaide
- University of Western Australia
- University of South Alabama, USA
- Dauphin Island Sea Lab, USA
- Université P Sabatier – Toulouse III, France

#### COMMUNITY ENTERPRISE

- Reviewed manuscripts for the following scientific journals –
  - *Oecologia*
  - *Marine Ecology Progress Series*
  - *Marine & Freshwater Research*
  - *Aquatic Conservation*
  - *Bulletin of Marine Science*
  - *Botanica Marina*
  - *Marine Ecology*
  - *Austral Ecology*



#### Dr Kathryn McMahon

##### RESEARCH INTERESTS

My main research area is coastal marine ecology, specifically focusing on seagrasses in both tropical and temperate environment and includes the following topics:

- Seagrass health in respect to human impacts and natural disturbance
- Seagrass recovery processes and growth strategies

- Grazing interactions
- Population genetic and phylogenetics

#### CURRENT PROJECTS

- Effects of dredging-related light reductions on seagrass ecosystems
- The eco-physiology of seagrasses under reduced light conditions
- Species diversity in the *Posidonia* genus
- Long-term monitoring of seagrass health
- Grazing by swans on estuarine seagrasses

#### RESEARCH LINKS

- Strategic Research Fund for the Marine Environment (SRFME)
- Geraldton Port Authority
- Department of Environment and Conservation
- Cockburn Sound Management Council
- CSIRO (Marine Research)
- Department of Defence (Navy)
- James Cook University
- University of Queensland
- Great Barrier Reef Marine Park Authority

#### COMMUNITY ENTERPRISE

Invited to referee papers for *Restoration Ecology, Marine and Freshwater Research*

Presented research at the following conferences and workshops:

- *Strategic Research Fund for the Marine Environment, Perth, WA;*
- *Australian Marine Science Association, Cairns, QLD*
- *International Seagrass Biology Workshop, Zanzibar, Tanzania*



#### Dr Christine Hanson

##### RESEARCH INTERESTS

- Marine food web dynamics
- Biophysical oceanography
- Benthic-pelagic coupling

##### CURRENT PROJECTS

- Ecological interactions in coastal marine ecosystems: Trophodynamics

- Assessing the spatial extent of reef production on the epifauna inhabiting adjacent seagrass meadows in south-west Australia
- Temporal and spatial dynamics in phytoplankton community composition off south-western Australia
- Benthic-pelagic coupling in an oligotrophic coastal marine system: examining the role of suspension feeders

#### RESEARCH LINKS

- CSIRO Marine and Atmospheric Research (Floreat & Hobart)
- Strategic Research Fund for the Marine Environment (SRFME)
- University of Western Australia

#### COMMUNITY ENTERPRISE

- Invited to referee papers for:
  - *Journal of Geophysical Research – Oceans*
  - *Deep Sea Research*
  - *Continental Shelf Research*
- Presented research at the following conferences and workshops:
  - Strategic Research Fund for the Marine Environment, Perth, WA;
  - International Seagrass Biology Workshop, Zanzibar, Tanzania



#### Dr Thomas Wernberg

##### RESEARCH INTERESTS

- 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.
- Morphological variation and architecture in canopy-forming algae and its consequences for the ecology of the understory.

- Trophic linkages between kelp beds and adjacent habitats in the form of detached reef algae.
- Biomechanical properties of macroalgae and the prediction of physical disturbances.
- The ecology of invasive macroalgae and their impacts on native algal assemblages.

#### CURRENT PROJECTS

- Effects of ocean climate and eutrophication on the resilience of kelp beds to physical disturbances.
- Latitudinal variation in temperate reef communities and ecological processes
- The invasiveness and potential impacts of different species of *Caulerpa* from WA.

#### RESEARCH LINKS

- University of Western Australia
- CSIRO Marine Research
- University of Copenhagen, Denmark
- National Environmental Research Institute, Denmark
- University of Florida, USA

#### COMMUNITY ENTERPRISE

- Member of the WA branch committee for the Australian Marine Science Association
- Reviewed manuscripts for -
  - *Marine Biology*, published by Springer
  - *Aquatic Botany* published by Elsevier
- Presented papers at 41st European Marine Biology Symposium, Cork, Ireland.



## Dr Fernando Tuyá

### RESEARCH INTERESTS

My research is driven by the necessity of searching for rules and models to explain the patterns of organization of marine populations and communities from local to macroecological (biogeographical) scales. From this general interest, I'm particularly interested in:

- Ecological processes shaping temperate reefs from small to geographical scales.
- Trophic linkages between reefs and adjacent seagrass meadows.
- Effects of human perturbations on natural communities.
- Role of Marine Protected Areas as restoration actions to preserve marine biodiversity and fishery resources

### CURRENT PROJECTS

- The role of reefs on the top-down and bottom-up regulation of seagrass-associated invertebrates.
- Top-down effects of predators on the structure of food webs.
- Consequences of physical disturbances on the colonization patterns of invertebrates.
- Effect of the configuration of vegetated habitats on the distribution and diversity of associated invertebrates
- Aggregations of wild fishes around sea-cage fish farms
- Climatic effects on the resilience of kelp beds to physical disturbances

### RESEARCH LINKS

- University of Las Palmas de GC (Spain)
- University of Alicante (Spain)
- CSIRO Marine Research

### COMMUNITY ENTERPRISE

- Reviewed manuscripts for
  - *Oecologia*
  - *Marine Ecology Progress Series*
  - *Journal of Experimental Marine Biology and Ecology*
  - *Marine Biology*
  - *Estuarine, Coastal and Shelf Science*
  - *ICES Journal of Marine Science*
  - *Ciencias Marinas*

## PLANT CHEMISTRY



## Dr Ian Bennett

### RESEARCH INTERESTS

Dr Bennett's areas of interest and expertise are:

- The physiology of Australian plants
- Plant tissue culture
- Genetics of Australian plants
- Horticulture and floriculture of Australian plants

- Propagation and growth of plantation trees

### CURRENT PROJECTS

- Influence of phenolics on micro propagation of Myrtaceous plants
- Clonal propagation of hazelnut for truffle production
- Micropropagation and clonal variation of teak *Tectona grandis*

### RESEARCH LINKS

- Ornamental Plant and Orchid Centre, Maejo University, Chiang Mai Thailand
- Department of Biotechnology, Ramkhamhaeng University, Bangkok, Thailand
- Department of Horticulture, King Mongkut Institute of Technology Bangkok, Thailand
- ALCOA Australia Ltd
- Murdoch University
- Department of Environment and Conservation
- Integrated Tree Cropping Ltd.
- The Wine and Truffle Company



## Dr Mary Boyce

### RESEARCH INTERESTS

Analytical chemistry is Mary's principal area of research. In particular, she has been active in the development and application of emerging analytical technologies including capillary electrophoresis and solid-phase micro extraction. Her work involves fundamental research to

better understand the chemical processes involved in isolating and separating target compounds. As an analytical chemist, she also get the opportunity of collaborate with scientists from a number of fields.

### CURRENT PROJECTS

- Solid phase micro-extraction gas chromatography for characterization of Australian truffles
- Role of secondary metabolites in plant disease resistance
- Use of light emitting diodes for sensitive detection in capillary electrophoresis
- Sensitive detection of amino acids and sugars from biological matrices
- Micro emulsion capillary electrophoresis and its applications
- Role of solid phase micro-extraction in authenticating sandalwood
- Problem orientated learning in the chemistry classroom

### RESEARCH LINKS

- University of Tasmania
- Rewards Group
- The Wine and Truffle Company
- Dublin City University

## RESEARCH IN SCIENCE TEACHING AND LEARNING



Associate Professor  
Adrienne Kinnear

### RESEARCH INTERESTS

- The biodiversity and community structures of Western Australia's soil and litter fauna, and the impact of our land-use practices on these communities
- Western Australia's soil mite (Acari) fauna: Adding to our rudimentary knowledge of the distribution, taxonomy and community structure of

these little-known, but biodiverse soil and litter dwellers

- Teaching and Learning: Assessment strategies to improve students' learning in science; student skill development

### CURRENT PROJECTS

- Soil mites as indicators of soil health: Validation of molecular tools for the monitoring of disturbance effects on soil mite communities
- Impact of revegetation on soil mite communities in Mulga woodlands, Leonora
- Evaluating the efficacy of reflective teaching strategies in science for pre-service primary teachers

### RESEARCH LINKS

- GHG-SSCP Research Group, Ministry of the Environment, Government of Japan
- Charles Darwin University
- Macauley Land Use Research Institute, Aberdeen, Scotland
- School of Education, Edith Cowan University

### COMMUNITY ENTERPRISE

- Community member, Yellagonga Regional Park Advisory Committee
- ECU representative, Sustainability Sub-committee, City of Joondalup
- Contributor of FCHS Cool Scientist Program
- Science Ambassador, SCITECH WA



Dr Magda Wajrak

### RESEARCH INTERESTS

Heavy metal contamination of the groundwater is a serious environmental problem. A number of techniques which can be used to detect parts per billion (ppb) or arsenic in water are expensive and do not allow for field testing. A less expensive and simpler method is anodic stripping voltammetry. Magda's voltammetry

research looks at the development of detection methods for heavy metals, in particular arsenic, that is reliable, relatively easy to implement in the field, capable of detecting below 5ppb, allow for speciation and overcome interference from other species found in groundwater.

Multimedia has progressively become an important teaching tool in science disciplines, including chemistry. Chemistry is a 'visual' subject and its understanding can be greatly enhanced through the use of appropriate images and interactive computer simulations. To aid students in their understanding, a multimedia Acid-Base Titration Tutor's package has been developed, which includes animated molecular models depicting reactions occurring at the microscopic level using a number of common acid-base combination reactions.

More recently, as a part of the Australian Chemistry Enhanced Laboratory Learning (ACELL) project, novel chemistry experiments have been designed which enhance students' learning, probe their deeper understanding, and are more stimulating and industry relevant. Four experiments have been developed and implemented in the undergraduate chemistry degree:

- Analysis of silver in water samples using anodic stripping voltammetry (ASV)
- Finding best separating conditions for a mixture of polar and non-polar preservatives using High Performance Liquid Chromatography and DryLab program
- Absorption Spectrum of Ascorbic Acid
- Investigating factors that affect corrosion

### CURRENT PROJECTS

- Validation of the ASV method for the detection of arsenic using ground water samples from various sites in WA, such as Spoonbill Reserve, Cedric Street, Ikea Site and Gwelup
- Analysis of groundwater from Bangladesh, India and Nepal using ASV method (collaboration with Lab21 in Cambridge)
- Investigating electrode surface – this is fundamental research which uses Scanning Electrode Microscopy to understand what happens at the surface of the working electrode

### RESEARCH LINKS

- Department of Environment, W A
- Lab21 – Cambridge, U K
- University of Western Sydney, NSW
- Advanced Water Technologies, Melbourne

### COMMUNITY ENTERPRISE

- NTEU representative on the Board of Federation of Australian Scientific and Technological Societies (FASTS)
- Chair of Radio chemistry Education Committee, Australian Institute of Radiochemical Engineering (AIRE)
- Siemens Science Experience
- 'Cool Scientist' – School visits
- ECU Live and Labrats – Magic of Chemistry Show
- Member of the Australian Enhanced Laboratory Learning Project (ACELL)
- Member of HERDSA

## TERRESTRIAL ECOLOGY



### Professor William Stock

#### RESEARCH INTERESTS

Professor Stock's research is focused on understanding the structure and functioning of natural and human impacted terrestrial ecosystems in order to improve our ability to manage such systems. He has particular interests in biogeochemical cycling, ecological applications of stable isotopes, nitrogen

pollution, ecosystem impacts of invasive species and global change biology.

Will has worked in systems ranging from heathlands, savannas, warm deserts, cold deserts (Antarctica) to commercial forestry plantations and agricultural plant selection.

#### CURRENT PROJECTS

- Bottom up vs top down control of grassland states in a southern African savanna reserve at Hluhluwe Umfolozi
- Ecosystem effects of growing Acacia and Eucalyptus in mixed plantations
- Ecosystem impacts of atmospheric nitrogen enrichment in conserved bushland fragments of the Swan Coastal Plain
- A dendro-ecological investigation of water use by pines of the Gngangara Mound
- Impacts of fire on geophyte richness and abundance in Jarrah forests
- Shelterwood regeneration success in Jarrah forests
- Black cockatoo distributions in transformed landscapes

#### RESEARCH LINKS

- University of Cape Town, South Africa
- Australian National University
- University of Stellenbosch, South Africa
- South African National Biodiversity Institute
- Range & Forest Institute, University of Western Cape, South African
- Forest Science Centre, Melbourne
- ALCOA
- Water Corporation
- Department of Conservation and Land Management

#### COMMUNITY ENTERPRISE

- Refereed manuscripts of the following scientific journals:
  - South African Forestry Journal
  - Science of the Total Environment
  - South African Journal of Science
  - Oecologia
  - Environmental Science and Technology
  - New Phytologist
  - Plant and Soil
  - Plant Ecology
  - Functional Plant Biology
  - Restoration Ecology
- Member of the following Editorial Boards:
  - Austral Ecology
  - African Journal of Range and Forage Science
- Member of Conference Organising Committee
  - Ecological Society of Australia – 'Adapting to Change'
  - Invitations to review international competitive research proposals
  - National Research Foundation, South Africa: Conservation and Management of Ecosystems & Biodiversity Programme
  - FRD, South Africa: Evaluation of individuals for Quality Ranking
  - Consultant to Gunson Resources
  - Member of the following professional bodies
  - MERIWA - Minerals Research and Advisory Committee
  - Council Member, Royal Society of Western Australia



### Emeritus Professor Harry Recher

#### RESEARCH INTERESTS

His interests lie in the structure of vertebrate communities, avian foraging ecology, the effects of fire on vertebrate populations, habitat fragmentation and the restoration of degraded landscapes, and the management of conservation of forest ecosystems. He has worked extensively with birds, mammals and

forest invertebrates, but is primarily an avian ecologist. All projects are designed to provide guidelines for the management of natural ecosystems.

#### CURRENT PROJECTS

The eucalypt woodlands, particularly the Goldfields of Western Australia, focusing on avian communities, foraging habits, nesting and movement cycles, and habitat requirements.

#### RESEARCH LINKS

- Australian Wilderness Society (WildCountry Project)
- Australian National University
- Boston University, U S A
- Curtin University of Technology

#### COMMUNITY ENTERPRISE

- Editor, Pacific Conservation Biology
- Adjunct Professor, Environmental Biology at Curtin University of Technology
- Public lectures and workshops on ecology, environment, environmental ethics, biodiversity, landcare and conservation policy
- Advice to individuals, community groups, industry, local and state governments and the Commonwealth on environmental issues
- Minerals and Energy Research Advisory Committee (MRAC)
- Chair of the General Subcommittee of MRAC
- Council of the Royal Society of Western Australia
- Member of the ALCOA Mining Environmental Improvement Plan (2006-2007) Working Group.
- Invited to undertake individual research assessments (x3) on behalf of the National Research Foundation of South Africa.
- Honorary Research Associate, Department of Botany, University of Cape Town



## Dr Annette Koenders

### RESEARCH INTERESTS

- Molecular genetics and systematics
- Conservation and systematics of freshwater crayfish in the south-west of Western Australia
- Growth and regeneration of muscle tissue in crustaceans. Exploring the molecular processes underpinning the amazing regenerative capacity of crustacean muscle
- Authentic assessments in Biological Sciences

### CURRENT PROJECTS

- Crayfish burrowing activity in the Yarragadee discharge zone.
- Replacement mechanisms of Margaret River marron by the widespread, introduced marron.
- Systematics and conservation of burrowing crayfish in south west Australia
- Differential expression of alternate transcripts of Cdpas in the yabby, *Cherax destructor*
- Authentic laboratory assessment in undergraduate molecular biology units.

### RESEARCH LINKS

- Department of Environment and Conservation (WA)
- Department of Water (WA)
- Department of Fisheries (WA)
- Colorado State University, Ft. Collins, CO, USA
- Deakin University, Victoria
- Charles Darwin University, NT
- The Norwegian University of Science and Technology, Trondheim, Norway

### COMMUNITY ENTERPRISE

- Member of the Curriculum Council of WA



## Dr Graham Thompson

### RESEARCH INTERESTS

Australian native vertebrate fauna has developed a unique series of adaptations to survive and flourish in a diverse range of habitats that are very often harsh, unpredictably and undernourished. Graham has a broad range of interests in terrestrial vertebrate ecology and ecophysiology, particularly reptiles and

frogs. This has led to an interest in the effects of body size and shape on the ecology and physiology of vertebrates. His interest in the ecology of reptiles is currently being applied in the development of an index to assess rehabilitation success using reptile fauna as the bio-indicator. More recently his research has focussed improving terrestrial fauna surveys for the preparation of environmental impact assessments.

### CURRENT PROJECTS

- Improved terrestrial fauna surveys for environmental impact assessment
- Rehabilitation and degradation index
- Temporal and spatial changes in small terrestrial vertebrate fauna diversity
- Effects of size and shape on the ecology and performance traits of dragon lizards and goanna

### RESEARCH LINKS

- Coffey Environments
- Fortescue Metals Group
- University of Western Australia, Zoology Department
- Norilsk Nickel Pty Ltd
- Paddington Gold Pty Ltd

### COMMUNITY ENTERPRISE

- Member of the Department of Environment and Conservation's Guidelines for Terrestrial Biological Survey Group



## Dr Kristina Lemson

### RESEARCH INTERESTS

Dr Lemson, a botanist, focuses her research on the evolving diversity of flowering plants in the south-west of Western Australia. This area is one of 34 global 'diversity hotspots', recognised for its diverse and unique biota. Almost 80% of the plant species found here are found nowhere else. This diversity is attributed to a combination of millions of years of isolation

and specialization in response to extremes of climate and poor soils. The organisms present today have evolved as the earth's climate has changed over millions of years, and these will be the source of new organisms that evolve as future change occurs.

### CURRENT PROJECTS

Systematics and evolution:

- Systematics of epacrids (Ericaceae, subfamily Styphelioideae)
- Biogeography of epacrids
- Plant architecture and inflorescence structure
- Systematics and evolution of Ericaceae subfamily Styphelioideae (Epacrids), with an emphasis on the structure and evolution of inflorescences, floral morphology, pollination and reproduction strategies, biogeographical patterns between Australia, New Zealand, Malaysia and the Pacific
- The interface between systematics and conservation biology, through the evolution and assessment of patterns in plant diversity and endemism in the south-west of Australia, and the conservation of rare members of Ericaceae subfamily Epacridoideae
- Interactions between phylogeny, evolutionary theory and conservation practice
- Integration of morphological and molecular approaches to phylogeny reconstruction
- Conservation:
- Breeding biology of selected Western Australian epacrids
- Narrow endemism and the evolution and conservation of the south-west flora

### RESEARCH LINKS

- Western Australian Herbarium
- Department of Environment and Conservation
- The University of Western Australia
- Royal Botanic Gardens Sydney
- Manaaki Whenua Landcare Research New Zealand

### COMMUNITY ENTERPRISE

- Plant Biodiversity and Conservation Curator, The Robert Brown Herbarium (ECU)
- Visiting Scientist, local primary schools



## Dr Eddie Van Etten

### RESEARCH INTERESTS

Eddie is interested in terrestrial plant ecology and management in arid zones, urban areas and forested ecosystems. His research interests also include fire ecology and restoration of terrestrial ecosystems.

### CURRENT PROJECTS

- Vegetation patterns and conservation assessments of the arid and semi-arid zones

- Vegetation modelling and mapping using GIS
- Fire-weed cycle of urban remnant bushlands
- Salt-marsh vegetation and salt lake ecology
- Mine site, roadside and other disturbed land revegetation/restoration
- Jarrah forest ecology and management, including regeneration following logging
- Fire ecology and management of transitional rainfall vegetation

### RESEARCH LINKS

- Forest Products Commission
- Mulga Research Centre, Curtin University of Technology
- Department of Environment and Conservation
- Botanic Gardens and Parks Authority
- Australian Bush Heritage Fund
- Barrick Gold (Formerly Placer Dome)
- Fortescue Metals Groups
- ALCOA
- Main Roads, WA
- Kemberton Silica Sands
- Australian Wildlife Conservancy

### COMMUNITY ENTERPRISE

Invitations to join the following Professional/Advisory Boards:

- Gravity Discovery Centre, Environment and Education Committee
- Regional Councillor, Council for Ecological Society of Australia
- Minerals Research Advisory Committee
- WA Threatened Ecological Communities Scientific Advisory Committee



# Current Research Projects

The current research projects are listed giving the name of the project, the funding body and the principal researcher(s).

## ENVIRONMENTAL CHEMISTRY AND FORENSICS

*Estimation of air quality and greenhouse benefits from the introduction of HFC152A to mobile air conditioning technology.* Australian Greenhouse Office, Department of Environment, WA. Hinwood, A.

## FRESHWATER ECOSYSTEMS

*Gnangara Mound Monitoring – macroinvertebrates.* Department of Environment WA. Horwitz P.

*Phreatophytic vegetation and Groundwater Studies (Phase 2).* Water Corporation Froend, R.

*Remediation of acid coalmine lakes using biological processes and organic matter.* Australian Coal Association Research Program. Lund, M.

*Investigation of Yate Swamp Hydroperiod requirements within the Lake Bryce recovery catchment.* Department of Environment and Conservation. Froend, R. and Loomes, R.

*Determination of ecological water requirements for groundwater-dependent ecosystems – Southern Blackwood and Easter Scott Coastal Plain.* Department of Environment, WA. Froend, R.

*Centre for Sustainable Mine Voids – A proposal.* Lund M.

*Wetland Vegetation Monitoring: Environmental Monitoring and Investigations for Gnangara Mound.* Waters and Rivers Commission. Froend, R H.

*Development of an innovative treatment system of acidity problems in an urban lake (Spoonbill Lake) resulting from acid sulfate soils.* ECU and City of Stirling. McCullough, C.

*Mitigation of impacts of groundwater dependent vegetation through adaptive abstraction regimes.* Water Corporation. Froend, R.

*Selection of groundwater-dependent ecosystem criteria sites in the Bunbury-Busselton-Capel groundwater areas and establishment of vegetation transects.* Department of Environment, WA. Froend, R., Loomes, R. and Bertuch, M.

*Environmental Water Requirements Framework Development.* Department of Water WA. Froend, R. and Loomes R.

*Development of a Rehabilitation Plan for the Dredge Ponds of the Kemerton Silica Sand Pty Ltd Operational Site.* Kemerton Sand Pty Ltd. M Lund.

*Vegetation monitoring of groundwater dependent ecosystems on the Southern Blackwood Plateau and Eastern Scott Coastal Plain.* Department of Water, WA Froend, R.

*Environmental Water Requirements of priority water resources in the South Coastal Region.* Department of Water, WA. Froend, R.

## HEALTH AND ECOLOGY

*Stygofauna research monitoring.* Natural Resource Services Pty Ltd. Horwitz, P.

*Fire, organic soils and acidification.* Fire and Emergency Services Authority. Horwitz, P.

*Fire management implications for the wetlands on the Swan Coastal Plain.* Fire and Emergency Services Authority. Horwitz, P.

*Assisting recovery actions for Margaret River Marron.* Department of Fisheries. Horwitz, P.

*Neerabup fire suppression research and monitoring.* Fire and Emergency Services Authority. Horwitz, P.

## MARINE ECOSYSTEMS

*Seagrass health survey (Becher Point to Fremantle Region).* Department of Environment WA. Lavery P.

*Ecophysiology of Benthic primary producers.* Strategic Research Fund for Marine Environment (SRFME). Lavery, P.

*Assessing the benefits of closed fishing areas for spawning aggregations and egg production for coral trout.* ARC Grant. Hyndes, G.

*Ecological interactions in coastal marine ecosystems: Rock Lobster.* Department of Premier and Cabinet. Hyndes, G.

*Ecological interactions in coastal marine ecosystems: Trophodynamics.* Strategic Research Fund for Marine Environment (SRFME). Hyndes, G., Vanderklift M and Babcock, R.

*Evaluation of the return of ecological function in transplanted meadows.* Department of Industry and Resources, Cockburn Cement Ltd. Hyndes, G.

*Conservation genetics of humpback whales of Western Australia: Implications for the management of the Antarctic Group IV population.* Apache Energy and ARC. Hyndes, G., Brasseur, M.

*Effects of light reduction.* Geraldton Port Authority. Lavery, P.

*Population structure and management of the Humpback Whale in Western Australia.* International Fund for Animal Welfare. Hyndes, G.

*Using acoustic tracking to determine size of home range of the West Australian Dhufish (*Glaucosoma hebraicum*) for spatial-closure management.* Department of Fisheries, WA, Rottneest Island Authority, ECU. Hyndes, G.

*Consequences of reduced light availability in seagrass meadows for fauna and fisheries.* Department of Environment, WA. McMahon, K M.

## PLANT CHEMISTRY

*Micropropagation and clonal variation of Teak *Tectona grandis*.* Rewards Group Ltd. Bennett, I. and Boyce, M.

## TERRESTRIAL ECOLOGY

*Fish migration patterns in the Blackwood River.* Murdoch University. Koenders, A. and Horwitz.

*The cause(s) and management of the Eucalyptus gomphocephala decline epidemic in Western Australia.* ARC and Murdoch University. Froend, R. and Hardy, G.

*Investigating the Tuarts of the lower Moore River.* Department of Environment and Conservation, WA. van Etten, E.

*Fire and establishment of Jarrah seedlings in shelter wood.* Department of Environment and Conservation, WA. van Etten, E.

*Field studies into the biology and conservation requirements of Engaewa species in the South West and Warren DEC regions.* Department of Environment and Conservation, WA. Koenders, A., Horwitz, P and Burnham, Q.

*Grasstrees and mining: understanding the distribution of *Xanthorrhoea preissii* in the jarrah forest and the potential impact of bauxite mining.* ALCOA of Australia. Van Etten, E J.

## ECU EARLY CAREER RESEARCHER AND FACULTY GRANTS

*Benthic-pelagic coupling in an oligotrophic coastal marine system: examining the role of suspension feeders.* ECU Early Career Researcher Grant. Hanson, C. E.

*Assessing seagrass meadows in South West Australia.* ECU Faculty Small Grant. Hanson C.

*Nutrient enrichment and the *Caulerpa*-species.* ECU Faculty Small Grant. Wernberg, T.

*Species diversity assessment in the seagrass genus, *Posidonia* using morphological and molecular characters.* ECU Faculty Small Grant. K McMahon.

# Postgraduate Research Students

The following PhD, Masters and Honours students were supervised by members of the Centre –

## PhD

Melanie Baister – R Froend

The Ecohydrology of *Eucalyptus gomphocephala* (Tuart) Populations in the South-west of Australia.

David Blake - P Horwitz/W Stock/M Boyce

Fire induced hydro-biogeochemical responses in wetland sediments of the northern Swan Coastal Plain.

Muriel Brasseur - G Hyndes

Population structure and management of the Humpback Whale *Megaptera novaeangliae* in Western Australia.

John Bunn – P Horwitz/A Koenders

Mechanisms affecting the replacement of *Cherax tenuimanus* (Smith 1912) by *Cainii* Austin 2002 from the Margaret River.

Quinton Burnham – A Koenders/P Horwitz

Biogeography of the Australian burrowing freshwater crayfish genus *Engaewa* (Decapoda : Parastacidae).

Zoe Car – P Horwitz

Seeing with other eyes: Exploring western scientific and indigenous environmental knowledge.

Jeffry Cargill – W Stock/E van Etten

Fate of *Eucalyptus marginata* seed from canopy-store to emergence in the northern jarrah forests of Western Australia: a comparison between spring and autumn burns in shelterwood (retained overstorey) treatments.

May Carter – P Horwitz

Urban design, contact with nature and population health.

Catherine Collier – P Lavery

Seagrass responses to light availability.

Suzanne Cumming – M Lund/H.Recher

Ecology and behaviour of an urban corvid: the Australian Raven.

Paul Drake – R Froend

Plant water relations and xylem hydraulic properties of *Eucalyptus gomphocephala* D.C. (tuart).

Beatrice Franke – P Horwitz

Indicators of ecosystem health in a Western Australian recovery catchment.

Graham Fulton – H Recher/P Horwitz/ T Perkins.

The nesting ecology of an endangered woodland avifauna.

Adam Gartner – P Lavery

Trophic Implications of Seagrass Habitat Disturbance from Reduced Light

Ute Goeft – R Froend/ P Horwitz

Identification of Social Water Requirements (SWR's) for water resource planning.

Nan Hewitt – P Horwitz

Education interventions for irrigators on the Gnangara Mound.

Jason How – G Hyndes

Biology of the coral trout and the implications of movement patterns to Marine Protected Areas.

Pat Karatna – P Horwitz

Mangrove forest communities in south-eastern Thailand.

Rebekah Kenna – G Hyndes/P Lavery

Return of ecological function in transplanted seagrasses.

S (Pao) Khwanboonbumpen – M Lund

Developing cost-effective catchment management strategies for established residential suburbs to reduce nutrient discharge.

Lachlan MacArthur – G Hyndes

Habitat use, movements and trophic linkages of the western rock lobster *Panulirus cygnus*, within the inshore coastal waters of Western Australia.

Rory McAuley – G Hyndes

Biology and stock assessment of the thick skin shark *Carcharhinus plumbeus* in Western Australia, and further refinement of the stock assessment for dusky shark *Carcharhinus obscurus*.

Philip Mayes – H Recher/ G Thompson

Ecological Study of Mertens Water Monitor with the Ord River System.

Sumitra Moopayak – A Kinnear

Biofertilisers: The biotechnology and soil conditioning properties of polysaccharide-producing soil algae.

Stephen O'Dwyer – W Stock

Nitrogen deposition impacts on the flora of the Swan Coastal Plain and the Burrup Peninsula.

Craig Pentland – A Kinnear

Behaviour and population dynamics of translocated populations of the black-flanked rock wallaby, *Petrogale lateralis lateralis*.

Bea Sommer – P Horwitz/M Lund/M Boyce

Factors controlling wetland sediment response to alternate drying and wetting and how this affects water quality.

Chongdee Srinoparatwatana – G Hyndes

Population dynamics and stock assessment of *Notopteridae* and *Nandidae* in the trap fishery of Beung Borapet, Thailand.

K Shan Sureshan – M Lund/C McCullough

Management of water resources associated with abandoned mine voids in the Goldfields of Western Australia: A Risk Assessment approach

## MSc

Joel Andrew - R Froend

GPS based soil acidity monitoring as a land management tool

Christie Atkinson - M Lund

The ecology of the Australian Water Rat *Hydromys chrysogaster* in the Perth metropolitan area.

Janelle Atkinson - I Bennett

The osmolyte production and physiological responses of selected *Myrtaceae* species exposed to salt and water stress.

Muriel Bertuch - E van Etten

Mulga (*Acacia aneura* F.Muell.Ex Benth.) death adjacent to haul roads in the northern Goldfields

Rob Campbell - P Horwitz

Perceptions of soil health in the Bremer River Catchment

Stephen Danti - A Kinnear

The influence of different silvicultural treatments on saproxylic beetles in southwest forests of Western Australia

Vishal Darji - M Boyce

The determination of antioxidants by micro emulsion electrokinetic chromatography.

Belinda Delaney - I Bennett

Investigation of propagation methods for *Verticordia grandis* and other *V.* species to establish a successful protocol for hardening plantlets to field conditions to increase *in situ* survival.

Alicia Dudzinska - E van Etten

Grasstrees and mining: Understanding the distribution of *Xanthorrhoea preissii* in the jarrah forest.

Sandra Hall - M Lund

The contribution of industry and commercial activity to nutrient loads discharge from the Bannister Creek Catchment area.

Blair Hardman - D Moro/ W Stock

Response to translocation of the endangered rufous hare wallaby, or mala *Lagorchestes fasciatus*, reintroduced to the arid Peron Peninsula, Shark Bay WA.

Sofie Harrison - P Lavery

Do marine resources subsidise island ecosystems?

Mark Hewitt - M Lund

A process orientated approach in rehabilitating mine-damaged arid rangeland.

Dave Holley - P Lavery

Monitoring Dugong movements at Shark Bay.

Justin King - G Hyndes

Factors affecting *Artemia franciscana* culture and comparison between feeds and strains

Victoria Lazenby - A Hinwood

Personal Exposure of Children to Formaldehyde

Caroline McCormick - P Horwitz

Vulnerability of organic soils to fire on the Swan Coastal Plain.

Heather McQueen - A Hinwood

Estimating prenatal exposure to glyphosate formulations using maternal exposure assessment techniques - a preliminary investigation.

Lea McQuillan - P Lavery

Effect of sewage pollution on sponge communities.

Michael Mulligan - P Lavery

The effect of light reduction on *Amphibolis griffithii* meadows by activities such as dredging and land reclamation where turbidity causes a light reduction at the seafloor through increased light attenuation by suspended particles.

Wesu Ndilila - A Hinwood

Investigating Heavy Metal Exposure on the General Populace of the Copper Mining Town of Kitwe, Zambia.

Megan Oman - I Bennett

Resistance of *Eucalyptus marginata* to *Perthida glyphopa*."

Nathan Rowe - A Koenders

Characterisation of structural and functional changes of mutant proteins in autosomal dominant retinitis pigmentosa: contributions from structural biology and bioinformatics.

Monica Russell - A Kinnear

Abundance, distribution and habitat requirements of the Tree-Stem Trapdoor *A. castellum* in the West Australian wheatbelt.

Amanda Spooner - K Lemson

Systematics and conservation of *Lambertia* (Proteaceae).

Joyleen Unno - A Kinnear

Population ecology and life histories of soldier crabs in the Dampier Archipelago.

Marieke Weerheim - W Stock

How Black Cockatoos use their landscape: Habitat Characteristics at Multiple Spatial Scales.

Steve Wellman - E van Etten

The impact of recreational trampling on vegetation and soil of the jarrah forest Western Australia.

## Honours

Peter Balding - M Boyce

The determination of probes for the indirect detection of anions in capillary zone electrophoresis using light emitting diode detection.

Helen Barwick - P Lavery/K McMahon

The effect of light reduction treatments on mobile epifauna in an *Amphibolis griffithii* (Black) den Hartog seagrass ecosystem.

Caroline Canham - R Froend/W Stock

Water stress vulnerability of four *Banksia* species in contrasting ecohydrological habitats on the Gnarara Mound, Western Australia

Emily Gates - C Hanson/M Vanderklift/ G Hyndes

Determining carbon and nitrogen stable isotope discrimination for marine consumers.

Rebecca Parsons - I Bennett

Pollen characteristics of *Grevillea* species determined by *in vitro* germination

Sean Stankowski - I Bennett

Genetic diversity and gene flow in fragmented populations of the rare shrub, *Calothamnus* sp. Whicher

# CEM Publications 2006

## Books

Thompson S A and Thompson, G G (2006). Reptiles of the Western Australian Goldfields. *Goldfields Environmental Management Group, Kalgoorlie*.

## Book Chapters

Boyce, M. (2006). Application of electrokinetic chromatography to food and beverages. In *Electrokinetic Chromatography: Theory, Instrumentation and Applications*. U Pyell, Ed: Wiley & Sons, Chichester UK.

## Refereed Journals

Brueckner M, Duff J, McKenna R. and Horwitz P. (2006) What are they taking us for? On the Participatory Nature of the Western Australian Regional Forest Agreement Process. *Australasian Journal of Environmental Management* **13**: 6-16.

Calvino-Cancela M, Dunn RR, van Etten E J B, Lamont BB (2006). Emus as non-standard seed dispersers and their potential for long-distance dispersal. *Ecography* **29**: 632-640

Cartledge V A, Withers P C, McMaster K A, Thompson G G, Bradshaw S D (2006). Water balance of field-excavated aestivating Australian desert frogs, the cocoon-forming *Neobatrachus aquilonius* and the non-cocooning *Notaden nichollsi* (Amphibia:Myobatrachidae). *Journal of Experimental Biology* **209**: 3309-3321.

Cartledge V A, Withers P C, Thompson G G, McMaster K A (2006). Water relations of the burrowing sandhill frog, *Arenophryne rotunda* (Myobatrachidae). *Journal of Comparative Physiology B-Biochemical Systemic and Environmental Physiology* **176**: 295-302.

Crawley K R, Hyndes G A & Ayzavian S G (2006). Influence of different volumes and types of detached macrophytes on fish community structure in surf zones of sandy beaches. *Marine Ecology Progress Series* **307**: 233-246

Davis J, Horwitz P, Norris R, Chessman B, Mcquire M and Sommer B. (2006). Are river bioassessment methods using macroinvertebrates applicable to wetlands? *Hydrobiologia*. **572**: 115-128

Doupe, R., Froend, R. and Pettit, N. (2006) A comment on allocating regulated river water for the Ord River, Western Australia. *Ecological Management & Restoration* **7**: 32-36

Eamus D and Froend R (2006). Groundwater-dependent ecosystems: the where, what and why of GDEs. *Australian Journal of Botany* **54** 91-96

Eamus, D., Froend, R., Loomes, R., Hose, G. and Murray, B. (2006) A functional methodology for determining the groundwater regime needed to maintain the health of groundwater-dependent vegetation. *Australian Journal of Botany* **53**: 97-114

Fowler-Walker, M., Wernberg, T. & Connell, S. D. (2006). Differences in kelp morphology between wave sheltered and exposed localities: morphologically plastic or fixed traits? *Marine Biology*, **148**: 755-767

Froend, R H and Drake, P. (2006). Defining phreatophyte response to reduced water availability: preliminary investigations on the use of xylem cavitation vulnerability in *Banksia* woodland species. *Australian Journal of Botany* **54**: 173-179

Hamano H, Saito N, Kojima T, Kato S, Saito M, Kinnear A & Yamada K (2006). Death of Trees in the Wheat Belt in Western Australia: Identification of the Causes by Chemical Analysis of Soil. *Journal of Arid Land Studies* **15**: 231 – 234

Hardman B and Moro D (2006). Optimising the reintroduction success of hare-wallabies: is the release protocol important? *Biological Conservation* **128** 403-411.

Hardman B and Moro D (2006). Importance of diurnal refugia to a hare-wallaby reintroduction in Western Australia. *Wildlife Research* **33**: 355-359

Hewitt N. and Horwitz P. (2006). Learning and capacity building for irrigators in Western Australia's East Wimmeroo area: a theoretical framework for educational provision and a sketch of the socio-ecological context. *Applied Environmental Education and Communication* **5**: 41-49.

Hinwood A.L., Rodriguez C, Runnion T, Farrar D, Murray F, Horton A, Glass D, Sheppard V, Edwards J.W., Denison L, Whitworth T, Eiser C, Bulsara M, Gillett R, Powell J, Lawson S, Weeks I, Galbally I. (2006) Risk factors for Increased BTEX Exposure in Four Australian Cities *Chemosphere* **66**:533-451.

Hinwood A L, Berko H N, Farrar D, Galbally I E, Weeks, I A (2006). Volatile organic compounds in selected micro-environments. *Chemosphere* **63** : 421 - 429.

Hinwood A. De Klerk, N, Rodriguez C, Jacoby P, Runnion T, Rye P, Landau L, Murray F, Feldwick M, Spickett J. (2006). The relationship between changes in daily air pollution and hospitalisation in Perth, Australia 1992-1998: A case-crossover study. *International Journal of Environmental Health Research*. **16**: 27-46

Hinwood, A.L. Horwitz, P. Appleyard S, Barton C. and Wajrak, M. (2006). Acid sulphate soil disturbance and heavy metals in ground water: implications for human exposure - a pilot study. *Environmental Pollution* **143**: 100 - 105.

Holley D K, Lawler I R, Gales N J (2006). Summer survey of dugong distribution and abundance in Shark Bay reveals additional key habitat area. *Wildlife Research* **33**: 243-250

Horton A, Murray F, Bulsara M, Hinwood A, Farrar D (2006). Personal monitoring of benzene in Perth Western Australia; the contribution of sources to non-industrial personal exposure. *Atmospheric Environment* **40**: 2596-2606

Kabii T, Horwitz P. (2006). A review of landholder motivations and determinants for participation in conservation covenanting programmes. *Environmental Conservation* **33**: 11-20.

Kinnear A, Curry P, Kojima T & Yamada K (2006). Soil mites in re-afforested, semi-arid landscapes in Western Australia. *Journal of Arid Land Studies* **15**: 239 - 242

McAuley R B, Simpfordorfer C A, Hyndes G A, Allison R R , Chidlow J A, Newman S J, Lenanton RCJ (2006). Validated age and growth of the sandbar shark, *Carcharhinus plumbeus* (Nardo 1827) in the waters off Western Australia. *Environmental Biology of Fishes* **77** : 385-400.

Majer J D, Recher H.F. Graham R, Gupta R (2006). Trunk invertebrate faunas of Western Australian forests and woodlands: Seeking causes of patterns along a west-east gradient. *Austral Ecology* **31**: 503-511

Pearce, A F, Lynch, M J, Hanson, C E (2006). The Hillarys Transect (1): Seasonal and cross-shelf variability of physical and chemical water properties off Perth, Western Australia, 1996-98. *Continental Shelf Research* **26**: 1689-1729.

Pearce A, Faskel F & Hyndes G (2006). Nearshore sea temperature variability off Rottnest Island (Western Australia) derived from satellite data. *International Journal of Remote Sensing* **27** 2503-2518.

Phoenix GK, Hicks WK, Cinderby S, Kuylenstierna JCI, Stock, W.D. et al. (2006). Atmospheric nitrogen deposition in world biodiversity hotspots: the need for a greater global perspective in addressing N deposition impacts. *Global Change Biology* **12** 470-476.

Recher H.F (2006). A hypothesis to explain why the south-western subspecies of the Crested Shrike-tit *Falcunculus frontatus leucogaster* is rare and declining. *Emu* **160**: 181-186.

Recher H.F. Majer J D (2006). Effects of bird predation on canopy arthropods in wandoo Eucalyptus wandoo woodland. *Austral Ecology* **31**: 349-360.

Smit A J, Brearley A, Hyndes G A, Lavery P.S., Walker D I (2006).  $\delta^{15}N$  and  $\delta^{13}C$  analysis of a *Posidonia sinuosa* seagrass bed. *Aquatic Botany* **84**: 277-282

Stock WD and Evans JR (2006). Effects of water availability, nitrogen supply and atmospheric CO<sub>2</sub> concentrations on plant nitrogen natural abundance values. *Functional Plant Biology* **33**: 219-227.

Thomsen, M.; Wernberg, T.; Stæhr, P. & Pedersen, M. (2006). Spatio-temporal distribution patterns of the invasive macroalga *Sargassum muticum* within a Danish *Sargassum*-bed. *Helgoland Marine Research*, **60**: 50-58.

Thomsen M S, McGlathery K J, Tyler A C (2006). Macroalgal distribution patterns in a shallow, soft-bottom lagoon, with emphasis on the nonnative *Gracilaria vermiculophylla* and *Codium fragile*. *Estuaries and Coasts* **29**: 465-473.

Tuya F, Garcia-Diez C, Espino F, Haroun R J (2006). Assessment of the effectiveness of two marine reserves in the Canary Islands (eastern Atlantic). *Ciencias Marinas* **32**: 505-522.

Tuya F, Ortega-Borges L, DelRosario-Pinilla A B, Haroun R J (2006). Spatio-temporal variability in a key herbivore, the long-spined black sea urchin *Diadema antillarum*, *Echinodermata: Echinoidea* in the Canary Islands. *Journal of the Marine Biological Association of the United Kingdom* **86**: 791-797.

Tuya F, Sanchez-Jerez P, Dempster T, Boyra A, Haroun R J. (2006). Changes in demersal wild fish aggregations beneath a sea-cage fish farm after the cessation of farming. *Journal of Fish Biology* **69**: 682-697.

Tuya F, Hernandez J C, Clemente S. (2006). Is there a link between the type of habitat and the patterns of abundance of holothurians in shallow rock reefs? *Hydrobiologia* **571**: 191-199.

Tuya F, Haroun R J. (2006). Spatial patterns and response to wave exposure of shallow water algal assemblages across the Canarian Archipelago: a multi-scaled approach. *Marine Ecology – Progress Series* **311**: 15-28.

Vanderklift, M.A., Kendrick, G.A. & Smit (2006). Differences in trophic position among sympatric sea urchin species. *Estuarine, Coastal and Shelf Science* **66**:291-297.

Wernberg, T., Vanderklift, M.A., How, J. & Lavery, P.S. (2006). Export of detached algae from reefs to adjacent seagrass beds. *Oecologia*, **147**: 692-701.

Wernberg, T. (2006). Scale of impact determines early post-disturbance assemblage structure in subtidal *Fucus* beds in the Baltic Sea (Bornholm, Denmark). *European Journal of Phycology* **41**: 105-113.

Westera M B, Lavery P S (2006). A comparison of hole punch and needle punch methods for the measurement of seagrass productivity. *Aquatic Botany* **85**: 267-269

Woodward A J, Bennett I J and Pusswonge S (2006). The effect of nitrogen source and concentration, medium pH and buffering on *in vitro* shoot growth and rooting in *Eucalyptus marginata*. *Scientia Horticulturae*. **110**: 208-213

## Non-Refereed Journal Articles

### Book Reviews

Horwitz, P (2006). Book Review: Sustainability and Health – Supporting global ecological integrity in public health. *Australian and New Zealand Journal of Public Health*. **30**: 395

### Refereed Conference Proceedings

Lund, M A, McCullough C D & Yuden Yuden (2006). Proceedings of 7th International Conference on Acid Rock Drainage (ICARD) St Louis Missouri 26-30 March. In-situ pit lake treatment of acidity when sulfate concentrations are low. *American Society of Mining and Reclamation*. Pg. 1106-1121.

Lund, M A, McCullough C D & Yuden Yuden (2006). Proceedings of 7th International Conference on Acid Rock Drainage (ICARD) St Louis Missouri 26-30 March. Microcosm testing of municipal sewage and green waster for full-scale remediation of an acid coal pit lake, in semi-arid tropical Australia. *American Society of Mining and Reclamation*. Pg. 1179-1197.

McCullough, C D & Lund M A (2006). Proceedings of the 2006 Water in Mining Conference Brisbane Australia 24 – 216 September. Pit lake sustainability: what is it and how do I get it? *Australasian Institute of Mining and Metallurgy*. Pg. 323-330.

McCullough, C D, Lund, M A and May J M. (2006) Proceedings of 7th International Conference on Acid Rock Drainage (ICARD), St Louis, Missouri 26-30 March. Microcosm testing of municipal sewage and green waste for full-scale remediation of an acid coal pit lakes, in semi-arid tropical Australia. *American Society of Mining and Reclamation* 1177-1197.

Swartz D J & Kinnear A (2006). The impact of irrigation on the soil mite communities of *Eucalyptus Globus* plantations in south western Australia. In *Acarology XI: Proceedings of the International Congress*. Morales-Malacara J.B. Behan-Pelletier V., Ueckermann E., Pfrez T.M., Estrada E., Gispert C. & Badii M. (Eds). Instituto de Biología, UNAM; Facultad de Ciencias, UNAM; Sociedad Latinoamericana de Acarología. México, 2006.

### Non-Refereed Conference Proceedings

Froend, R. (2006) Phreatophyte response to a changing Environment: A Case Study from the Gngangara Mound. *First National Workshop on Mining and Groundwater-Dependent Ecosystems*. Adelaide, South Australia. June 2006.

Hanson, Hyndes, Vanderklift, Babcock, R. (2006) Trophic dynamics in nearshore benthic communities off temperate Western Australia: examining the role of seagrasses. *International Seagrass Biology Workshop*. Zanzibar, Tanzania October 2006

Horwitz P & Nicols P. (2006). Environmental Care: tending to one. *International Association for Human Caring 28th Annual Congress*, Fremantle, Australia. June 2006.

McCullough C D & Lund M A (2006). Pit lakes: benefit or bane to companies, communities and the environment? *Goldfield Environmental Management Group Workshop on Environmental Management 2006*. Perth, Australia. May-2006

McMahon, K. & Lavery, P. Resilience of seagrass systems to dredging: Perspectives from temperate and tropical regions. *Australian Marine Science Association 44<sup>th</sup> Annual Conference & Society of Wetland Scientists 27<sup>th</sup> International Conference*, Cairns, Australia July 2006.

McMahon, K. & Lavery, P. Dredging in seagrass systems: A case study with the *Amphibolis griffithii*. *International Seagrass Biology Workshop VII*. Zanzibar, Tanzania. September 2006

McMahon, K & Waycott, M. Seagrass species diversity in northern Kenyan seagrass habitats. *International Seagrass Biology Workshop VII*. Zanzibar, Tanzania. September 2006.

Perkins, T. & Curtis, C. Can Network City deliver a sustainable urban future? *2nd International conference on environmental, cultural, economic and social sustainability*. Hanoi. Vietnam. January 2006.

Thompson, G. G. The impact of land clearing and mining on arid-adapted frogs. *Proceedings of Goldfields Environmental Management Group Workshop*, Kalgoorlie, Australia. May 2006. pp 18-35.

Thompson, G G and Thompson, S A. Small vertebrate colonisers of mine site rehabilitation wast dumps in the Goldfields of Western Australia. *Mine Closure 2006. Proceedings of the First International Seminar on Mine Closure*. Perth, Australia. September 2006. pp 309-318

Thompson, S A and Thompson, G G. Quantification of rehabilitation success on mine site waste dumps. *Mine Closure 2006. Proceedings of the First International Seminar on Mine Closure*. Perth, Australia. September 2006. pp 731-740

Van Dam R A, McCullough C D, Hogan A, Humphrey C L, Nou T, Houston M, Iles M & Douglas M M (2006). Ecotoxicology of MgSO<sub>4</sub> in Magela Creek, Northern Territory: the final chapter. *Interact 2006*, Perth Australia. 25-29 April 2006.

van Etten E J B (2006). Vegetation Assessments and the Law - Separating the significant from the commonplace. *Goldfields Environmental Management Group Workshop on Environmental Management 2006*. May 2006.

Wernberg T, Kendrick G A, Thomsen M S, Tuya F & Staehr P A (2006). The effect of ocean climate on macroalgae, their photo-physiology and responses to disturbance regimes - a case study from south-western Australia. *European Marine Biology Symposium*. University College Cork, Ireland. July 2006.

## Reports

Froend, R. and Loomes, R. (2006). Environmental Monitoring of Wetland Vegetation - Gngangara Mound 2005. Report to the Department of Environment. (CEM Report 2006-01)

Loomes, R., Rogan, R., Froend, R., Ladd, P. and Duffy, P. (2006). End of Summer assessment of condition of Gngangara and Jandakot criteria groundwater dependent ecosystems. Report to the Department of Water. (CEM Report 2006-02)

How, J. and Lavery, P. (2006). Separation point easement – baseline benthic habitat mapping and faunal survey. Report to the Central West TAFE. (CEM Report 2006-03)

Lavery, P. and McMahon, K. (2006). A survey of selected seagrass meadows in the Fremantle-Warnbro Sound region, 2006. Report to the Cockburn Sound Management Council and Department of the Environment. (CEM Report 2006-04)

Collier, C. (2006). Seagrasses: their light requirements and responses to light reduction. Report to the Melbourne Port Authority. (CEM Report 2006-05)

Lavery, P. and McMahon, K. (2006). Monitoring of seagrass meadows on the Eastern Shore of Garden Island, Western Australia, 2006. Report to the Department of Defence. (CEM Report 2006-07)

Babcock, R.; Clapin, G.; England, P.; Kleczkowski, M.; Murphy, N.; Phillips, J.; Sampey, A.; Vanderklift, M.; Cook, K.; Stuart-Andrews, C.; Waddington, W.; Wernberg, T. (2006). Chapter 6: Benthic ecosystem dynamics. Strategic Research for the Marine Environment, final report. Commonwealth Scientific and Industrial Research Organisation.

Evans L, Cronin D, Doupe R G, Hunt D, Lymbery A J, McCullough C D, and Tsvetnenko Y. (2006). Potential of pit lakes as a positive post-mining option – examples, issues and opportunities. Unpublished report to Rio Tinto Incorporated Centre for Sustainable Mine Lakes, Perth Western Australia.

Van Dam R, Hogan A, McCullough C D, Humphrey C, Nou S, and Douglas M (2006). Influence of calcium on the ecotoxicity of magnesium: Implications for water quality trigger values. In *eriss research summary 2004-2005, Supervising Scientist Report 189* (Eds.) Evans KG, Rovis-Hermann J A W & Jones D R. *Supervising Scientist* Darwin Australia pp 15-19.

Edwards T E, van Etten E J B & Froend R H (2006). Environmental correlates and associations of tuart decline at Yalgorup. *Tuart Decline Research Findings – Tuart Bulletin* **2** Nov 2006.



# CEM Members 2006

The Centre is comprised of a Director, a management Committee, Academic Staff Members, Postdoctoral Fellows, Research Staff, Honorary Research Associates and 63 Postgraduate and Honours students. Members have a wide range of research interests which can be seen in their profiles.

## Director

Professor Will Stock

## Management Committee

Dr Ian Bennett.

Associate Professor R Froend

Dr Andrea Hinwood

Dr Annette Koenders

Dr Mark Lund

Dr Eddie van Etten,

Dr Thomas Wernberg

## Academic Staff Members

Dr Mary Boyce

Associate Professor Pierre Horwitz

Dr Glenn Hyndes

Associate Professor Adrienne Kinnear

Dr Monica Leggett

Dr Kristina Lemson

Dr Alan Needham

Mr Tim Perkins

Emeritus Professor Harry Recher

Dr Graham Thompson

Dr Magda Wajrak

## Postdoctoral Fellows.

Dr Christine Hanson

Mr Clint McCullough

Dr Kathryn McMahon

Dr Fernando Tuya

## Research Staff

Ms. Robyn Loomes

Ms Muriel Bertuch

## Honorary Research Associates

Dr Mat Vanderklift

Dr David Goodall

Dr Nick Gales

# Conference Attendance & Presentations

Members of the CEM presented their research findings at the Conferences listed below

- 2nd International Conference on Environmental, Cultural, Economic and Social Sustainability. Hanoi, Vietnam.
- 2nd Congress of Italian Evolutionary Biologists, Florence, Italy.
- 7th International Conference on Acid Rock Drainage (ICARD) St Louis Missouri, USA.
- 7th International Seagrass Biology Workshop. Zanzibar, Tanzania.
- 10th International Conference of the American Cetacean Society, California, USA.
- 2006 Water in Mining Conference Brisbane, Australia.
- Australian Marine Science Association 44th Annual Conference & Society of Wetland Scientists 27th International Conference, Cairns, Australia.
- EcoHealth One Conference, Wisconsin, USA.
- Ecological Society of Australia Conference – Are Plantations equivalent to Native Forests, Sydney, Australia.
- European Marine Biology Symposium. University College Cork, Ireland.
- First National Workshop on Mining and Groundwater-Dependent Ecosystems. Adelaide, South Australia.
- First International Seminar on Mine Closure 2006.
- Goldfields Environmental Management Group Workshop on Environmental Management 2006. Perth Australia.
- HERDSA 2006: Critical Visions, Perth Australia.
- Interact 2006, Perth Australia
- International Association for Human Caring 28th Annual Congress, Fremantle, Western Australia.

- International Congress of Natural Arsenic in Groundwaters of Latin America, Mexico City, Mexico.
- International Congress Society of Latin American Acarology, México
- International Conference on Environmental Epidemiology and Exposure Analysis, Paris, France
- International Geographical Union Conference 2006: Regional responses to Global Change, Brisbane, Australia.
- International Conference on Environmental Epidemiology and Exposure Analysis, Paris, France.
- 16th Symposium of the International Association of Astacology – IAA Gold Coast, Australia
- Hydro Eco 2006: International Multidisciplinary Conference on Hydrology and Ecology, Prague, Czech Republic.
- Interact 2006, Perth Australia
- Woodland Decline Symposium, Mandurah, Australia. November 2006

## CEM Fieldwork Equipment/Expenses Support

In 2006, \$14,113 was allocated to postgraduate research students who applied for fieldwork equipment and expenses. Preference was given to applications for equipment which directly benefits a number of CEM members and postgraduate students. To this end, joint applications are encouraged. The largest single item purchased this year was a Dewpoint Water Potential Meter.

# Public Lectures & Seminars 2006

CEM seminars are held in association with the School of Natural Sciences and the Consortium for Health and Ecology. All seminars are held on Friday afternoons to provide staff and postgraduate students with an opportunity to learn of current research developments.

## Guest Speakers.

**Dr Martin de Graaf,**  
Research Scientist, Freshwater Fisheries, WA Marine and Fisheries Research Laboratories Ecology, Evolution and Exploitation of Lake Tana's cyprinid fish.

**Dr Isabelle Schoen**  
Royal Belgian Institute of Natural Sciences 200 Million Years without Sex – Evolutionary Consequences of Ancient Asexuality in the Darwinulidae (Ostracoda, Crustacea).

**Dr Fernando Tuya**  
Post-doctoral Research Fellow, Centre for Ecosystem Management, ECU. Wild fish aggregations at sea-cage fish farms: a case for protection.

**Dr Angus Hopkins**  
Principal Research Scientist, CALM Science Division. Developments in Global Observation Systems at the International Level.

**Dr Rachel Standish**  
Post-Doctoral Research Fellow, Murdoch University Old field Regeneration in the W.A. Wheatbelt.

**Prof William Bond**  
Botany Dept, University of Cape Town, South Africa How much of the world is 'green'? Resource vs. consumer limitation of ecosystems.

**Dr Christine Hanson**  
Postdoctoral Research Fellow Centre for Ecosystem Management, Edith Cowan University From large-scale biological oceanography to near shore trophic dynamics: investigating Western Australia's marine ecosystem.

**Dr Michael Breadmore**  
Australian Centre for Research on Separation Science, University of Tasmania.

Microfluidics: A new chip off an old block.

**Dr Edmund February**  
Department of Botany, University of Cape Town. Changing Management Policies in South African National Parks.

**Prof Will Stock**  
Centre for Ecosystem Management Edith Cowan University. Australian Weeds: Geophytes from southern Africa.

**Clint McCullough**  
Centre for Ecosystem Management Edith Cowan University. Mining Pit Lakes: Liabilities or Opportunities?

**Dr Maria Calvino-Cancela**  
Post-Doctoral Fellow, Dept of Environmental Biology, Curtin University of Technology. Seed dispersal by emus of ant-dispersed and unassisted seeds: Implications of long distance dispersal.

**Dr Ian Jamie**  
Macquarie University, Sydney Dept of Chemistry and Biomolecular Sciences (Visiting Teaching Fellow, ECU) Identification of volatile organic compounds (BVOCs) emitted by plant species using solid phase microextraction (SPME).

**Justin R. Read**  
School of Chemistry, The University of Sydney  
School of Chemistry and Physics, The University of Adelaide  
Chemistry Education Research: Providing Evidence to Guide Improvements in Teaching and Learning.

**Dr. Thomas Wernberg**  
Postdoctoral Research Fellow Centre for Ecosystem Management Edith Cowan University. Effects of ocean climate on macroalgae: species distributions, photo-physiology and responses to disturbance regimes.

**Dr. Aaron Gove**  
Postdoctoral Research Fellow Dept. of Environmental Biology Curtin University. Ant Mediated Seed Dispersal.

## Student Presentations

**Ben Gilna,**  
PhD Scholar, Centre for Resource and Environmental Studies, Australian National University. Landscape Biotechnology - Putting New Tools to Work

**Karen Crawley, Centre for Ecosystem Management, ECU (now Environmental Audit Section, Dept of Environment) Detached Macrophytes in Surf Zones: Significance in Supporting Secondary Production. (Final PhD Seminar)**

**Catherine Collier, Centre for Ecosystem Management, ECU**  
Characterising the Responses of the Seagrass *Posidonia sinuosa* to Changes in Light Availability (Final PhD Seminar)

**Andrew Jardine PhD Candidate School of Population Health, University of Western Australia.** Human Health Implications of Dryland Salinity.

**Sofie Harrison**  
Masters Student Centre for Ecosystem Management, School of Natural Sciences, ECU. The influence of seabird-derived nutrients on island ecosystems in the oligotrophic marine waters of south-western Australia (Final Masters Seminar)

## Special Mini-Symposium: Acidity, Health and the Environment

**A/Prof Pierre Horwitz, CEM, ECU.** Fire, wetlands and water chemistry on the Swan Coastal Plain: some preliminary results

**Dr Andrea Hinwood, CEM, ECU.** Acid sulphate soil disturbance, heavy metals and human exposure - some preliminary investigations

**Dr Mark Lund, CEM, ECU.** Tackling urban acidity: A remediation project for Spoonbill Lakes in City of Stirling

# Professional and Scientific Societies

American Society of Plant Taxonomists  
Aquatic Ecosystem Health and Management Society  
Australian and New Zealand Society for Comparative Physiology and Biochemistry  
Australian Bush Heritage Fund Inc.  
Australian Epidemiological Association  
Australian Institute for Biology Inc.  
Australian Mammal Society  
Australian Marine Sciences Association  
Australian Rangeland Society  
Australian Society for Biochemistry and Molecular biology  
Australian Society for Ecotoxicology  
Australian Society for Limnology  
Australian Society for Phycology and Aquatic Botany  
Australian Systematic Botany Society  
British Ecological Society  
CASANZ - Clean Air Society of Australia and New Zealand  
Curriculum Council WA  
Ecological Society of Australia  
Environmental Forensics Society  
Environmental Protection Authority of Western Australia  
Freshwater Biological Association  
Goldfields Environmental Management Group

HERDSA – Higher Education and Research Society of Australasia  
INTECOL – The International Association for Ecology  
International Association of Plant Tissue Culture & Biotechnology  
International Association of Vegetation Science  
International Biogeography Society  
International Ecohealth and Management  
International Plant Propagators Society  
International Seagrass Association  
International Society for Environmental Epidemiology  
International Society for Salt Lake Research  
International Water Association  
Institute of Australian Geographers  
Institute of Foresters of Australia  
National Tertiary Education Union  
New Zealand Limnological Society  
North American Lake Management Society  
Planning Institute of Australia  
Royal Australian Chemical Institute  
Royal Society of Western Australia  
Society of Australian Systematic Biologists  
Society for Ecological Restoration  
Society for Conservation Biology  
World Seagrass Association



*Cover photograph by Will Stock. Photos contained within this report by Will Stock, Jennie Stock, Muriel Bertuch, Kathryn McMahon, Paul Lavery, Clint McCullough, David Blake and Magda Wajrak'.*

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