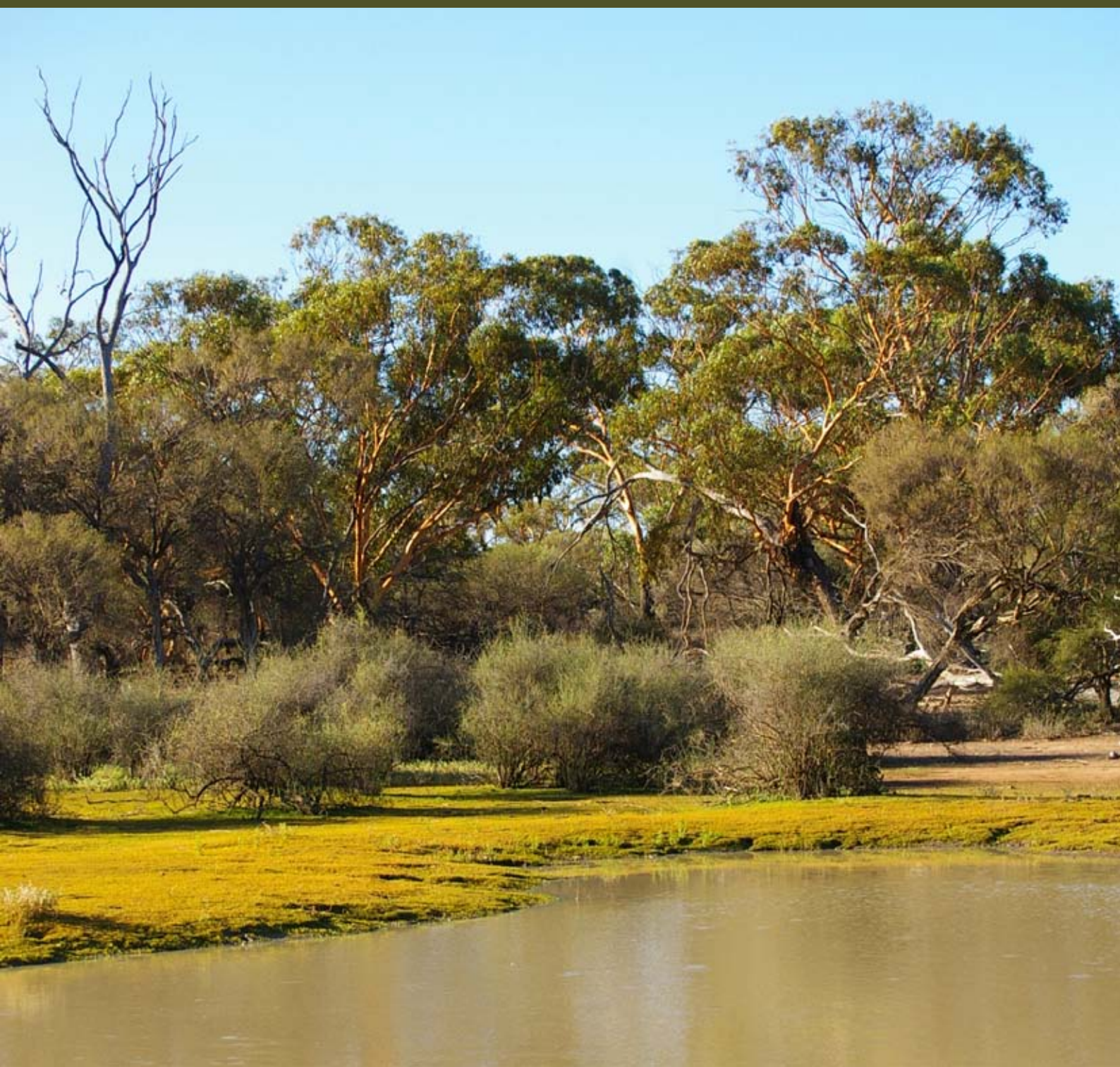


Centre for Ecosystem Management 2008 Annual Report



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Overview 2008



The Centre for Ecosystem Management underwent substantial changes in its structure, membership and focus during 2008. With the departure of a number of marine scientists, who formed a new Centre for Marine Ecosystems Research, the CEM took the opportunity to restructure. The new CEM is no longer the research arm of the School of Natural Sciences but has members from across ECU who focus their research on the broad themes of sustainability, biodiversity and health and ecology.

Despite all the changes experienced with the rebirth of the CEM, members had an outstanding research year. Some \$1.27 million was raised for research during 2008. The magnitude of the research funding is a consequence of constructive engagement and research links between the researchers in the CEM and State, National and International government organizations and research agencies. Members of the CEM also continued to produce high quality outputs in the form of refereed papers (34), reports (32) and conference proceedings (3). The breadth

of research interests in the CEM can be seen from the published outputs given later in this report. Centre members also made significant contributions to professional and community activities outside ECU. CEM members were invited to referee over 20 papers for national and international journals, were editors of 2 journals, sat on 3 editorial boards and contributed to 26 professional or advisory boards or committees.

The breadth and scope

of the contributions made by members of the CEM is remarkable and reflects the strong research culture of the Centre and its members.

During the year 3 PhD students and 2 MSc students completed their studies under the supervision of CEM members.

This report acknowledges the continued high quality and quantity research efforts of the members of the CEM and I look forward to the growth and evolution of the reborn CEM over the next few years.

Will Stock, Head: CEM.



Highlights 2008

CEM research contributes to the Gngangara Sustainability Strategy deliberations

Will Stock and Leonie Valentine received funding from the Forest Products Commission to investigate the foraging ecology of Carnaby's Black Cockatoos (CBCs), especially their dependence on pine plantations on the Gngangara. This is essential information required for the development of a sustainable groundwater, biodiversity and land use strategy for the Gngangara and it will contribute to the development of a Gngangara Sustainability Strategy. Carnaby's Cockatoo is an endangered species, endemic to the south-west of Western Australian, which is listed as threatened under State and Commonwealth legislation. The rapid urbanization of Perth over the last 70 years has resulted in the removal of extensive tracts of native vegetation and the 17 000 ha of existing pine plantation currently provides an important habitat and food source. Clearing of pine plantations without re-planting (to increase rainfall recharge of the Gngangara aquifer) is expected to have an impact on existing cockatoo populations. This project is focusing on a number of key issues and these include the range and availability of food resources and their energetic contribution to CBC diets, the size of CBC populations in the Gngangara study area, the identification of significant roosting, nesting, flight paths and feeding patterns of CBCs and a prediction of the possible impacts of pine clearing over the next 15 years on CBC populations. Studies are continuing but early studies show that CBC populations peak at 3000 birds in the study area, that pine seeds are a critical resource for CBCs and 15 000 ha of pine plantation provides enough energy to support up to 3 000 birds for a six month period and that Banksia seed in native vegetation is another critical resource and could support up to 5 000 CBCs for a six month period. Pines also provide valuable roosting sites as well as feeding habitat. Hopefully the future management of the Gngangara will take note of the important role that pines play in the persistence of CBCs and that suitable replacement roost and foraging sites will be provided for this iconic species. Report available from: <http://portal.water.wa.gov.au/portal/page/portal/gss/Reports>



Drought, birds and micro-refuges in the great western woodlands

Harry Recher and his colleague William Davis an Emeritus Professor from Boston University have been studying the bird populations of the largest remaining woodlands in the southern hemisphere. Their observations in 2008 took place in the third successive year of winter drought in the Great Western Woodlands with less than half the expected rain from May through August. Winter rain is essential in these woodlands for the growth of plants and insects. Insect-eating birds time their breeding with peaks in arthropod abundances, but after three years of drought bird numbers had declined and few nested. By 2007, ground-foraging birds were affected as the drought limited the availability of soil and litter arthropods. By 2008, all birds were affected. Such effects of drought are not unexpected, but what was unexpected was the successful nesting of a few ground-foraging birds, while all others failed. Since some birds nested in the same places in 2007 and 2008, it is possible that some individuals are so good at finding food that they can rear young when others fail. It is also equally likely that successful individuals occupied territories that were protected from the drought and provided food under the worst conditions. Recher and Davis call these 'micro-refuges' and suggest that they may be critical for the long-term survival of species in drought affected habitats. If their ideas are correct then this adds a new dimension to conservation requiring more precise management of habitats than is currently practiced.



The HAPSITE™ chemical identification system

The Centres for Ecosystem Management, Marine Ecosystems Research and Public Health have expanding research programs in the detection, analysis and impacts of environmental contaminants in a variety of settings. One of the significant impediments to these programs is the complexity in deployment of sample devices; cost of sample analysis and therefore the frequency, duration and timescales of sampling events in addition to significant costs. The three centres got together and applied for funds under a Computing, Health and Science faculty research infrastructure scheme and were fortunate to secure substantial funding for a portable HAPSITE™ analyser.

The HAPSITE™ Chemical Identification System (Gas Chromatography Mass Spectrometry (GCMS)) is a portable instrument that enables real time analysis of air, soil and water for a broad screen of volatile organic chemical compounds. It enables detection to parts per trillion in the

environment. The equipment has been designed to be robust in the field situation as well as being very sensitive. The instrument can also be used in the laboratory setting for detection of low concentrations of organic compounds in a variety of media.

This portable HAPSITE GCMS is the only portable GCMS recommended by environmental agencies (USEPA and DECWA) and the Chemistry Centre of WA. The instrument is housed and maintained at the School of Natural Sciences on behalf of the three Centres.



Body shape and ecology of Australian lizards

Graham Thompson and his colleague Phil Withers have been examining linkages between body shape and the ecology of dragon lizards. They looked at 17 species of Western Australian Ctenophorus dragon lizards and showed that retreat choice accounts for much of the size-free variation in body shape. Those species that dig their own burrow, as a retreat, have short tails and hind limbs, whereas those that do not generally retreat to a burrow have longer lower hind limbs and hind feet. Three of the four species that retreat to crevices or under rocks have a dorso-ventrally flattened head and body, and relatively long upper fore-limbs. The fourth rock-retreating species does not have a dorso-ventrally flattened head and body; its body shape is intermediate between those species in the three ecological groups. In 2008 Graham and colleagues undertook a similar analysis of Australian goannas and were again able to demonstrate that retreat choice (choices are wide and include those that retreat to oblique crevices between large rocks or rock faces, those that retreat to burrows dug into the ground, those that retreat to spaces under rocks or in tree hollows, and those that retreat to trees but not tree hollows) accounts for much of the size-free variation in body shape. Although there is an underlying historical pattern to the varanid ecotypes, these did not weaken the link between body shape and ecotype based on retreat choice.



Developing a framework for the management of groundwater dependent ecosystems in the south-west of WA

Ray Froend and Dimity Boggs have been tackling the question of the ecological water requirements of areas of important bushland in the south-west that are likely to be impacted by changes in groundwater availability. The highlight of the field season has been a series of week-long field trips across the southern Swan Coastal Plain, Blackwood Plateau and Scott Coastal Plain. At each site a range of ecophysiological measures are undertaken to ascertain plant water requirements and the extent of their groundwater dependence. Measures of plant stress, stomatal regulation and transpiration have been made on selected taxa including *Melaleuca preissiana*, *Pericalymma ellipticum*, *Taxandria parviceps* and *Callistemon glaucus* at each of the sites. These measures will be complemented by oxygen and hydrogen isotope analysis of plant, soil and groundwater to further define the relationship between groundwater and plant water use. The aim of this research is to develop an assessment framework for the Department of Water that will enable them to use vegetation and other site (lithology and hydrology) characteristics to identify areas that are at high risk from changes in groundwater levels. Direct abstraction of groundwater and climate change are seen as the major threats to vulnerable plant communities in this region. The research is funded by the Department of Water and the CEM.



Highlights 2008

Kimberley Expedition Cruise Tourism

Expedition cruising along the 3000 km Kimberley coast in Australia's remote north-west has gained increasing popularity in recent years for its spectacular scenery, Aboriginal rock art and native wildlife which forms the platform for a strong and uniquely Australian tourism experience. In recent years, the expedition cruise industry has grown rapidly, contributing to increasing concerns from government agencies, tourism operators, other stakeholders and the Indigenous custodians about the lack of appropriate tourism and environmental management processes in the area. A recent project lead by Pascal Scherrer from the CEM, Ross Dowling (ECU) and Amanda Smith (Murdoch) provided an overview of activities and environmental and cultural impacts of the Kimberley cruise industry. It showed that current environmental impacts were low, though there is considerable potential for impacts, particularly to isolated island environments. The issue of cultural and spiritual impacts at sites of Aboriginal significance, coupled with issues of on-site visitor management however requires urgent attention. The results clearly highlight the need for the development and implementation of good practice guidelines and operational standards to address the vast variations in operational practices. The project was commended for opening a platform of communication between stakeholders and the report is widely used in current local, state and federal planning processes.



Assessing maternal exposure to persistent toxic substances and risk of adverse birth outcomes

Dr Andrea Hinwood, from the CEM, in collaboration with UWA, the National Measurement Institute, the Telethon Institute for Child Health Research and the Arctic Monitoring Assessment Program (AMAP, Norway) have commenced a study to assess maternal exposure to Persistent Toxic Substances (PTSs) and the potential for adverse birth outcomes in the South West of WA. The study is supported by from the Australian Research Council (ARC) linkage grants scheme and is part of an international effort to understand the exposure of women and children to chemicals and the risk of adverse health outcomes.

Current research indicates that a number of persistent toxic substances such as heavy metals, brominated flame retardants, pesticides and herbicides are accumulating in the environment. Urbanisation, industrial development, agriculture and environmental change all contribute to the accumulation, over time, of persistent toxic substances. Globally, a number of PTS (including metals) are recognised as being responsible for adverse neurological development and other health effects in children. The unborn and newborn child are especially sensitive to the toxic effects of many persistent organic pollutants and heavy metals found in the environment. These substances may exert their toxicity for decades because of their resistance to degradation. Of particular concern are adverse reproductive and pregnancy outcomes, reduced childhood defence against diseases (immune system impacts), and impairment of children's mental development. In addition, some PTS under study may increase the long term risk of cancer.

The research team is seeking participation from 160 non-smoking pregnant women aged 18 and above living in Bunbury, Collie, Busselton, Dunsborough, Margret River, Denmark, Albany or Esperance. Participants will be required to answer a questionnaire about lifestyle and diet, keep a diet diary and provide a blood, urine and drinking water sample.

Dust and soil samples from around the home will also be collected. Dr Hinwood says that although research has been carried out in a number of other countries, only a few studies have investigated persistent environmental pollutants and their health effects in Australia.

“We are hoping to determine the levels of persistent toxic chemicals in pregnant women in WA and in particular, if there are any regional differences or differences caused by diet and environmental factors. We need to determine at what level these chemicals exist and if these levels are high enough to cause health effects.”



Fire ecology and management in the transitional rainfall zone of Western Australia

Eddie van Etten, Will Stock and partner investigators have initiated a project in the often ignored band of largely intact vegetation of considerable biodiversity and conservation significance which lies between the wheatbelt and the arid interior of W.A. The vegetation

of the region is fire prone and there is considerable concern about the number and size of uncontrolled wildfires in the region. There is a paucity of fundamental information on fire ecology in these ecosystems and this lack of critical ecological information has hampered fire management throughout the region. It is expected that fire management approaches and strategies developed for the higher rainfall ecosystems south-west may not always be appropriate for this region

Our collaborative partners in this research are the main land managers of the region: the Department of Environment and Conservation, Bush Heritage Australia and the Australian Wildlife Conservancy. The research program consists of a series of projects which will span several years. These projects stem from a workshop involving key stakeholders in 2006 and were further developed through a series of meetings and field visits involving scientists from each of the research partners. Research activities in 2008 sought to underpin fire management planning for selected reserves in the region, particularly Eurardy Reserve inland from Kalbarri. Reviews and field surveys of responses and adaptations to fire of plant species and analysis of landscape-scale patterns of fire have been conducted. The project has also been used as an opportunity to involve our undergraduate students in applied research and the Ecosystem Management class of 2008 spent several days at Charles Darwin Reserve (north of Dalwallinu) comparing fire shrubland ecosystems of different fire age in terms of biota and soils.

Results to date indicate that much of the fire-prone vegetation in the region is dense shrubland on sandplains and laterite. Some species are associated with either long unburnt or recently burnt shrubland, which suggests a range of fire ages needs to be maintained across landscapes to conserve biodiversity. The majority of plants in these shrublands are seeders, ‘plants’ which are killed by fire and rely on seed stored on the plant or in the soil to recover after a fire. This contrasts with heathlands and shrublands of the wheatbelt and coastal sandplains to the south which are dominated by ‘resprouters’. There are also a few true fire-requiring species some of which require smoke to promote seed germination.

Other key ecosystems of the region rarely carry fire, if at all and these systems contain more fire sensitive species with fewer adaptations to withstand and persist after fire. Such ecosystems include york and salmon gum woodlands, and saltmarsh vegetation. The main concern for these systems is the intense, fast-moving fires from shrublands burning across vegetation boundaries to damage these more fire sensitive ecosystems.



Highlights 2008

CEM research contributes to local landfill post closure development planning

Edith Cowan University postgraduate student Marie Raphael was awarded a waste management research scholarship from the Mindarie Regional Council of Western Australia in 2008. Marie is investigating the views of the local community about the Tamala Park landfill's post closure options. Marie is supervised by Dr Andrea Hinwood, Dr Eddie Van Etten and Associate Professor Pierre Horwitz. The aims of the research project are to develop landfill post-closure development options for Tamala Park based on community preferences and to explore future community collaboration in the development of these options. Community views were collected by distributing 868 questionnaires to residents in suburbs adjacent to the landfill. This was followed by three focus groups with interested individuals from the questionnaire respondents. The research results are currently being analyzed and the project will be completed by December 2009. The results of the project will provide the Mindarie Regional Council with a set of preferred options for future uses of the Tamala Park site.



Identifying major nutrient contaminant sources for Lake Joondalup

Beenyup Swamp, in the south of Yellagonga Regional Park, has been identified by a number of studies as the main source up to 75% of nutrients (particularly phosphorus (P)) entering Lake Joondalup. The consequences of these nutrients entering Lake Joondalup are increasingly poor water quality, algal blooms; and resulting from both of these, nuisance midge problems. Research funded by the Cities of Joondalup and Wanneroo and the Department to Environment of Conservation studied this problem in two stages in 2008 involving two 3rd year natural sciences projects. The students, Kathrine Goldsmith and Rebecca Gunner, were supervised by Associate Prof. Mark Lund and Dr Clint McCullough.

Stage 1 examined whether Beenyup Swamp contained sufficient nutrients within its sediments to account for the quantities of nutrients that are believed to be exported to Lake Joondalup. A total of 21 sampling sites across Beenyup Swamp were randomly sampled. At each site water and sediment were collected for analysis of nutrients and metals. The open area of the Swamp formed a large and distinct organic sediment, while sediments at the Swamp outlet were sandy. Two other sediments types encompassed the sites located around the edge of the Swamp. This difference of pattern may reflect Swamp water flow paths, with drain-in and drain-out sites grouped together with open water areas and their borders. Swamp open water sediment had extremely high concentrations of phosphorus that were more than four times higher than sediments of Lakes Goollelal and Joondalup. It was estimated that there was at least 50 t of phosphorus within this part of the Swamp, sufficient to supply the estimated loads into Lake Joondalup for a number of years. This sediment was also highly enriched with copper and zinc compared to other sediments of Lakes Goollelal and Joondalup, the source of which are unknown. The ability for P to be released from the sediment in Beenyup Swamp also required investigation. Stage 2 studies experimentally tested factors responsible for P release from sediments. Drying of sediments can cause release of P through breakdown of the sediment and organic matter, rewetting then releases the P back to the Swamp. In Beenyup Swamp most of the stored P is bound to iron (Fe). Iron exists in two forms, insoluble Fe^{3+} which binds P and soluble Fe^{2+} , which releases P. When the oxidation reduction potential drops then Fe^{3+} is reduced to Fe^{2+} and P released. A common way of achieving this in natural wetlands is a reduction in dissolved oxygen concentrations in the overlying water to anoxia.

Replicated treatments and controls of Beenyup sediments and overlying water were collected and experimentally manipulated in the laboratory to test the effects of drying and anoxia on P release. The results of this study suggested that, despite containing high concentrations of P, it does not appear that Swamp sediment is the main source of P exported from Beenyup Swamp. Instead, it is suspected that direct groundwater input is the main source of nutrients exported from Beenyup Swamp to Lake Joondalup. Further work is being undertaken to verify P exports from Beenyup Swamp.



CEM Members



Associate Professor Ray Froend

Ray's interests focus on ecological water requirements and ecosystem management. Specific interests include the water regimes required to maintain and enhance conservation values of terrestrial, aquatic and riparian ecosystems. Management of aquatic and groundwater dependent ecosystems are key issues as is allocation planning of water

resources to meet environmental requirements. Much of his research involves the development of monitoring strategies and programmes for assessing effectiveness of environmental water provisions. He also studies the impacts of altered groundwater regimes on native plants including the ecophysiology of phreatophytic vegetation and the response of these plants to long-term changes in groundwater regime and climate. Other interests include the ecology and biology of wetlands and plant responses to altered water quantity and quality.



Dr David Goodall

David, a botanist by training, has for many years concentrated his interest on vegetation particularly in arid areas. He was Editor-in-Chief of "Ecosystems of the World", a series of 38 volumes which was completed at the end of 2005. He also has a long-term interest in the use of numerical methods to classify entities described by a great variety of

attributes, such as plants, and areas of bushland. For this purpose he has developed a series of interlinked computer programs, which are still being improved and expanded.



Dr Andrea Hinwood

There has been little work in Australia exploring the relationships between environmental contaminants and human health. One of the major impediments is our inability 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, the development of novel exposure metrics, and the investigation of the relationships between environmental exposures and health effects. Andrea is actively involved in several projects to investigate the relationship between pollutants and health including 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.



Associate Professor Pierre Horwitz

Pierre's primary research interests encompass the inter-relationship between human health, community well-being and ecological integrity, developing participatory approaches for the management of aquatic systems and the conservation of natural resources in general. Sustainability and health; social and ecological resilience;

poverty and health inequalities are also issues of concern. He has interests in 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 and the contribution of flagships, keystones and other icon species to biodiversity conservation and the well-being of human communities.



Associate Professor Adrienne Kinnear

Adrienne researches the biodiversity and community structures of Western Australia's soil and litter fauna, and the impact of our land-use practices on these communities. Adrienne is researching Western Australia's soil mite (acari) fauna by adding to our

rudimentary knowledge of the distribution, taxonomy and community structure of these little-known, but biodiverse soil and litter dwellers. Adrienne also has a strong interest in teaching and learning: assessment strategies to improve students' learning in science and to aid in student skill development.



Dr Annette Koenders

Annette's interests focus on the conservation and systematics of freshwater crayfish in the south-west of Western Australia. She also has projects investigating the groundwater dependence of freshwater invertebrates and the molecular genetics and systematics of crustaceans. Other interests include the molecular mechanisms of growth and

regeneration of muscle tissue in crustaceans and the molecular genetics of native trees.



Dr Kristina Lemson

Kristina uses phylogenetic methods to document and describe the diversity and evolution of plants. She is particularly interested in evolutionary patterns of diversity among species in the high rainfall south-west region and the semi-arid Coolgardie interzone. Kristina's research uses the methods of phylogenetic analysis to investigate diversity,

and to complement ecologically based work. Her systematics research uses morphological methods, with an emphasis on plant architecture and inflorescence structure, floral morphology, and anatomy, and seeks to integrate morphological and molecular approaches to phylogeny reconstruction. Dr Lemson also curates the Robert Brown Herbarium (ECU), a facility that supports research and teaching activities within the School of Natural Sciences.



Associate Professor Mark Lund

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.



Dr Clint McCullough

Clint has broad environmental science research interests that include general aquatic ecology and ecotoxicology, and has an area of specific interest in the remediation, chemistry and ecology of mine pit lakes. He is particularly interested in lake and wetland biota such as macroinvertebrate communities and the effects that pollutants may have on these organisms,

and how these affects may then be mitigated or remediated.



Emeritus Professor Harry Recher

Harry's 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 and 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.



Dr Pascal Scherrer

Pascal has a background in environmental science and ecotourism, his main research interest is in sustainable tourism and alpine ecology, addressing the areas of environmental and social impacts and their relationship. Recent projects include an assessment of environmental and social impacts of Kimberley coastal tourism; an

assessment of long-term vegetation changes in the Kosciuszko alpine area relating to land-use change; and collaborative projects with social marketing and leisure researchers on health aspects of tourism.



Dr Bea Sommer

Bea researches wetland sediment/water interactions. She has broad interests in wetland ecology, aquatic macroinvertebrates and the impacts of climate change on these systems. Her particular interests include groundwater/surface water interactions, ecological water requirements of aquatic fauna and flora, wetland management and

acid sulfate soils (particularly in relation to drought-induced acidification of wetlands). Other interests include the impact of mining operations (mainly de-watering) on aquatic ecosystems, nutrient and carbon cycling in wetlands and the impacts of fire on the chemistry and ecology of humic wetland systems,



Professor William Stock

Will'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.



Dr Graham Thompson

Graham's recent research has focused on improving terrestrial fauna assessments and surveys to support environmental impact assessments. In this context, most of his research has addressed questions on the efficacy of trapping and survey protocols for mammals and reptiles in mesic, arid and semi-arid habitats and determining the

adequacy of fauna survey effort. Graham also has a long standing interest in the ecology and physiology of goannas and the effects of body size and shape on the ecology and performance traits of reptiles.



Dr Eddie Van Etten

Eddie is interested in terrestrial plant ecology and management in arid zones, urban bushland remnants and forested ecosystems. He is particularly involved in research in fire ecology and restoration of terrestrial ecosystems.

Operational Grants

Members of the CEM received a total of 1.27 million during 2008 for research to be undertaken on the grants listed.

- Wetland Macroinvertebrates and Water Quality (Northeast Gngangara Mound) (HORWITZ)
- Project 4.1 - Wetland Macroinvertebrates and Water Quality (Gngangara Mound) (HORWITZ)
- Can Mulching and Planting of the Riparian Zone of an Acid Sulphate Affected Wetland Improve Water Quality or Enhance Aquatic Ecological Value? (MCCULLOUGH, LUND)
- Midge and Related Research at Lake Joondalup (LUND, MCCULLOUGH)
- Structural Characterization of Suspended Detrital Floc in the Yancheop Wetland Suite, Swan Coastal Plain, Western Australia (SOMMER)
- Eco-Hydrological Study - Gngangara Mound (FROEND)
- Impact of Pine Removal on Carnaby Cockatoo Feeding and Future Populations on the Gngangara (STOCK)
- Assessment of Wetland Invertebrate & Fish Biodiversity for the Gngangara Sustainability Study (SOMMER, HORWITZ)
- Macroinvertebrate Sampling in the KSS Project Area Wetlands (LUND, MCCULLOUGH)
- Management Framework for Groundwater Dependent Vegetation - South West (FROEND)
- Surface and Interstitial Invertebrate Communities in and near Spearwood Creek, a Tributary of the Lower Blackwood River (KOENDERS, HORWITZ)
- Literature Review of the Ecophysiology of Riparian Plants (FROEND, BOYD)
- Investigation of the Relationship between Maternal Exposure to Metals and Adverse Birth Outcomes (HINWOOD)
- Characterisation of Fish Usage of Yarragadee Discharge Based on Water Chemistry (KOENDERS, HORWITZ)
- Kemerton Silica Sand (KSS) Terrestrial Invertebrate Survey (KINNEAR)
- Liege Street Wetland Aeration Trial (LUND, MCCULLOUGH)
- Extension of the Monitoring Program for the Collinsville Pit Lake Remediation Experiment (LUND, MCCULLOUGH)
- How do Acid Sulphate Soils Interact with Stormwater and Wetlands Constructed to Reduce Nutrient Loading: A Case Study of Brushfield Constructed Wetland in City of Stirling (LUND, MCCULLOUGH)
- Vegetation Monitoring - Swan Coastal Plain (FROEND, LOOMES, DAVIES)
- Environmental Monitoring and Investigations for Gngangara Mound - Wetland Macroinvertebrate Monitoring (HORWITZ)
- Study of migration patterns, habitat and water requirements of fish and invertebrates in the Blackwood River (HORWITZ, KOENDERS)
- Field studies into the reproduction biology and conservation requirements of Hairy Marron in the South West DEC region (HORWITZ, KOENDERS, BUNN)
- Rehabilitation of Kemerton Silica Sands Dredge Ponds: Natural Wetland Characterisation (LUND, MCCULLOUGH, VAN ETTEN)
- Rehabilitation of Kemerton Silica Sands Dredge Ponds: Rehabilitation Assessment & Improvement (VAN ETTEN, LUND, MCCULLOUGH)
- Evaluation of post-mining rehabilitation at the Kemerton Silica Sands Project in November 2008 (VAN ETTEN, MCCULLOUGH, LUND)
- Vegetation classification and mapping at Mt Gibson Wildlife Sanctuary (VAN ETTEN)
- Black cockatoo use of extensive post-mining revegetated and agriculturally transformed landscapes (STOCK)
- Mitigation of impacts on groundwater dependent vegetation through adaptive abstraction regimes (FROEND, STOCK)
- Impact of Disturbed Acid Sulphate Soils on Freshwater Ecosystems, Western Australia (HORWITZ)
- Environmental water requirements of priority water resources in the South Coastal Region (FROEND, LOOMES, HORWITZ)
- Field studies into the biology and conservation requirements of Engaewa species in the South West and Warren DEC regions (KOENDERS, HORWITZ, BURNHAM)
- Vegetation Monitoring of Groundwater Dependent Ecosystems on the Southern Blackwood Plateau and Eastern Scott Coastal Plain (FROEND, LOOMES, DAVIES)
- Development of a Rehabilitation Plan for the Dredge Ponds of the Kemerton Silica Sand Pty Ltd Operational Site (LUND, VAN ETTEN, MCCULLOUGH)
- EWR Framework Development (FROEND, LOOMES)
- Mitigation of impacts on groundwater dependent vegetation through adaptive abstraction regimes (FROEND, DAVIES, STOCK)
- Fire and establishment of Jarrah seedlings in shelterwood (VAN ETTEN, STOCK)
- Development of an innovative treatment system for acidity problems in an urban lake (Spoonbill Lakes) resulting from acid sulfate soils (MCCULLOUGH, LUND)
- Fire management implications for the wetlands on the Swan Coastal Plain (HORWITZ, BLAKE, HINWOOD, FROEND, VAN ETTEN)
- Fire, organic soils and acidification (HORWITZ, BLAKE)
- Wetland Vegetation Monitoring: Environmental Monitoring and Investigations for Gngangara Mound (FROEND)
- Fish migration patterns in the Blackwood River (KOENDERS, HORWITZ)
- Stygofauna research monitoring (HORWITZ)
- Investigation of Yate Swamp Hydroperiod requirements within the Lake Bryde recovery catchment (FROEND, LOOMES)
- Remediation of acid coalmine lakes using biological processes and organic matter (LUND, MCCULLOUGH)
- The Social Ecology of Ningaloo Tourism (HORWITZ, SCHERRER)
- Biology and Habitat Requirements of Blackstriped Jollytail (MCCULLOUGH, LUND)
- An Assessment of Rottneest Island's Sustainable Visitor Capacity (NORTHCOTE, SCHERRER, MACBETH)

Publications

Journal Articles

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- Alonso, A., Sheridan, L. and **Scherrer, P.** (2008). Importance of tasting rooms for Canary Islands' wineries. *British Food Journal* **110**: 977-988.
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- Atkinson, C.A. Lund, M.A.** and Morris, K.D. (2008) BiblioRakali: the Australian water rat, *Hydromys chrysogaster* Geoffroy, 1804 (Muridae: Hydromyinae), a subject-specific bibliography. *Conservation Science Western Australia* **7**:65-71.
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- Cousin, J.A.** and Phillips, R.D. (2008) Habitat complexity explains species-specific occupancy but not species richness in Western Australian woodland. *Australian Journal of Zoology* **56**: 95-102.
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2008-03: CD McCullough, MA Lund and JM May. Treating acidity in coal pit lakes using sewage and green waste: microcosm and field scale trials at the Collinsville Coal Project (Queensland). ACARP Project Report C14052.

2008-04: R Loomes, J Wilson and RH Froend. End of Summer Assessment of Condition of Gnangara and Jandakot Criteria Groundwater Dependent Ecosystems. Western Australian Department of Water.

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2008-10: EJB van Etten, CD McCullough and MA Lund. Evaluation of rehabilitation efforts at the Kemerton Silica Sands Pty. Ltd. project area, June 2007. Commercial-in-confidence report to Kemerton Silica Sands Pty Ltd.

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2008-14: T Boyd, M Bertuch, G Ogden and RH Froend. Investigation of *Eucalyptus occidentalis* Hydroperiod Requirements at Yate Swamp. Western Australian Department of Environment and Conservation.

2008-15: CD McCullough, MA Lund, A Das, and R Watkins. Development of an innovative treatment system for acidity problems in an urban lake (Spoonbill Lakes) resulting from acid sulfate soils (ASS). City of Stirling.

2008-16: CD McCullough and MA Lund. Aquatic macroinvertebrates in seasonal and rehabilitated wetlands of the Kemerton Silica Sand Pty Ltd project area (2007). Kemerton Silica Sand Pty Ltd.

2008-17: EJB van Etten, CD McCullough and MA Lund. Riparian vegetation characteristics of seasonal wetlands in Kemerton, south-western Australia. Kemerton Silica Sand Pty Ltd.

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2008-22: R Loomes, J Wilson and RH Freund. 2008 Monitoring of Groundwater Dependent Vegetation – Southern Blackwood Plateau and Scott Coastal Plain. Western Australian Department of Water.

2008-23: R Loomes, J Wilson and RH Freund. 2008 Vegetation Monitoring – Swan Coastal Plain (Bunbury, Busselton/ Capel Groundwater Areas). Western Australian Department of Water.

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2008-25: P Horwitz, D Blake, J Cargill, RH Freund, A Hinwood, R Loomes, H McQueen, R Rogan and EJB van Etten. Fire Management Implications for Wetlands on the Swan Coastal Plain, Western Australia. Fire and Emergency Services Authority of Western Australia.

2008-26: P Horwitz. Stygofauna Taxonomy. Newcrest Mining Limited (NCM), Telfer Operations - Stygofauna Monitoring.

2008-27: B Sommer, P Horwitz and CD McCullough. Impact of Acid Sulfate Soils on Freshwater Ecosystems of Southwest WA. Western Australian Department of Water.

2008-29: S Judd and P Horwitz. Gngangara Mound Macroinvertebrate Monitoring Program Interim Report Spring 2008. Western Australian Department of Water.

2008-30: K McKay and P Horwitz. Annual Report for the Wetland Macroinvertebrate Monitoring Program of the Gngangara Mound Environmental Monitoring Project – Spring 2007 to Summer 2008. Western Australian Department of Water.

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Kinnear, A., Middleton S., Boyce M., Sparrow H. and Cullity M. (2008). Success and persistence in academic study: a comparison of student and staff perspectives. E-Culture Conference, Edith Cowan University.

Non Refereed Papers/Proceedings/Forewards

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McCullough, C.D.; Lund, M.A. and May, J. M. (2008). Field scale trials treating acidity in coal pit lakes using sewage and green waste. Proceedings of the 10th International Mine Water Association (IMWA) Congress. Karlovy Vary, Czech Republic. Rapantova, N. & Hrkal, Z. (eds.), 599-602pp. ISBN 978-80-248-1767-5.

Van Etten, E.J.B. (2008). Changing land use and management ethos in Western Australia's rangelands: how mining companies may contribute to landscape to regional scale land management and conservation. Goldfields Environmental Management Workshop 2008 Proceedings, pp. 34-42. Goldfields Environmental Management Group Inc., Boulder, W.A.

Recher, H.F. (2008) Foreword: Close encounters of a different kind. Pp. VII-IX in. 'Too Close for Comfort: Contentious Issues in Human-Wildlife Encounters'. ed by D. Lunney, A. Munn and W. Meikle. Royal Zoological Society of New South Wales, Mosman.

Recher, H. F. (2008). Birds in the Great Western Woodlands. P. 15 in 'The Extraordinary Nature of the Great Western Woodlands' ed by A. Watson, S. Judd, J. Watson, A. Lam and D. Mackenzie, The Wilderness Society of WA Inc., Perth, WA, Australia

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Recher, H. F. (2008). Forum on Conservation. Pacific Conservation Biology **14**: 228-229.

Sommer, B. (2008). Impact of Acid Sulfate Soils on freshwater ecosystems, WA. Presented at the Technical Working Group for the W.A. Strategic Reserve Project TWG workshop, Bunbury, on 27-28 March 2008.

Sommer, B. (2008). *Ground- and surface water acidity on the eastern Scott Coastal Plain: mineral or organic?* Poster presented at the 47th Annual Conference of the Australian Society for Limnology at Mandurah, WA, 29th September to 4th October 2008.

Horwitz, P. (2008). Keynote Address: Freshwater crayfish, conservation lists and passionate associations. International Association of Astacology, Kuopio, Finland. August 2008.

Pickering, C. and **Scherrer, P.** (2008). Managing tourists on the top of Australia: past, present and future challenges. Pp. 319-325. In: R. Dowling & D. Newsome (Eds.). Proceedings of the Inaugural Global Geotourism Conference, 17-20 August 2008, Fremantle, Australia. ISBN 1 86308 146 1.

Scherrer, P., Smith, A.J. & Dowling R. 2008. Tourism and the Kimberley Coastal Waterways: a review of environmental and cultural aspects of expedition cruising along the Kimberley coast, Western Australia. Photobook, Edith Cowan University.

Scherrer, P. 2008 Kimberley Cruising: Environmental and Cultural Aspects of a Growing Industry, Tourism Research Report, FACET News, Winter 2008, p. 16.

Thompson, S.A. and **Thompson, G.G.** (2008) Searching and monitoring for malleefowl; ground, aerial and thermal surveys. In 'Goldfields Environmental Management Workshop 2008'. Kalgoorlie pp. 17-28. (Goldfields Environmental Management Group).



Post Graduate Students

The following PhD and Masters students were supervised by members of the Centre – * **Completed 2008**

PhD

David Blake - *P Horwitz/W Stock/M Boyce*. Fire induced hydro-biogeochemical responses in wetland sediments of the northern Swan Coastal Plain.

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).

Caroline Canham – *R Froend/W Stock*. Phreatophyte root growth dynamics and relationships between growth phenology, plant water relations and groundwater.

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.

Kelly Chapman – *P Horwitz / P Scherrer / J Northcote*. Tourism research to tourism practice: working to build adaptive institutions in Western Australia's Ningaloo Region.

Graham Fulton – *P Horwitz/ T Perkins*. The nesting ecology of an endangered woodland avifauna.

***Ute Goeft** – *R Froend/ P Horwitz*. Identification of Social Water Requirements (SWR's) for water resource planning.

Pat Karatna – *P Horwitz*. Mangrove forest communities in south-eastern Thailand.

***Sumitra Moopayak** – *A Kinnear*. Biofertilisers: The biotechnology and soil conditioning properties of polysaccharide-producing soil algae.

Craig Pentland – *A Kinnear*. Behaviour and population dynamics of translocated populations of the black-flanked rock wallaby, *Petrogale lateralis lateralis*.

Malarvili Ramalingam – *A Hinwood/M Boyce*. Maternal Exposure to Metals and Contribution of Environmental Sources

MSc

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.

David Galeotti – *C McCullough/M Lund*. Biology and Habitat Requirements of Blackstriped Jollytail.

Victoria Lazenby – *A Hinwood*. Personal Exposure of Children to Formaldehyde

Heather McQueen – *A Hinwood*. Estimating prenatal exposure to glyphosate formulations using maternal exposure assessment techniques - a preliminary investigation.

***Wesu Ndilila** – *A Hinwood*. Investigating Heavy Metal Exposure on the General Populace of the Copper Mining Town of Kitwe, Zambia.

William Phelps - *M Lund/B. Sommer/C McCullough*. Structural characterization of suspended detrital floc in the Yanchep Wetland suite, Swan Coastl Plain, Western Australia.

Marie Raphael – *A Hinwood, E van Etten*. Defining appropriate options for post-closure land-use of Tamala Park: A community participation process

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

Ryan Sawyer - *C McCullough/M Lund*. The Impact of Acid Sulfate Soils on Water Quality Treatment in a Constructed Urban Stormwater Treatment Wetland in Gwelup, Western Australia.

Joy Unno – *A Kinnear/V Semenuik*. Biology and ecology of the Western Australian soldier crab, *Mictyris occidentalis*

***Marieke Weerheim** – *W Stock*. How Black Cockatoos use their landscape: Habitat Characteristics at Multiple Spatial Scales.

Visitors

Dr Isabelle Schön, Principal Researcher Freshwater Biology, Royal Belgian Institute of Natural Sciences, Brussels, Belgium. Dr Schön works on the genetics, morphological taxonomy, systematics and biogeography of non-marine ostracods

Research Links and Collaborations

Chemistry Centre, (WA)	ALCOA
Department of Environment and Conservation, (WA)	Mindarie Regional Council
University of Western Australia	Main Roads, WA
United States Environmental Protection Agency	Fire and Emergency Services Authority
National Measurement Institute	Kemerton Silica Sands
Flinders University	Western Australian Herbarium
Arctic Assessment and Monitoring Program	Royal Botanic Gardens, Sydney
Australian Research Council	Charles Darwin University
Department of Water, (WA)	Florida State University (USA)
Cable Sands (WA) Pty Ltd	Lane Community College, Oregon (USA)
CSIRO	University of Cape Town, South Africa
Murdoch University	Australian National University
The University of Western Australia	The Australian Museum, Sydney
University of Technology, Western Sydney	Coffey Environments
Water Corporation	Fortescue Metals Group
Tiwest Joint Venture	Norilsk Nickel Pty Ltd
Curtin University of Technology	Paddington Gold Pty Ltd
Midge Research Group (City of Cockburn)	Rottneest Island Authority
Griffin and Wesfarmers Coal (CSML)	Murray Shire
Cities of Joondalup, Stirling and Wanneroo	Kimberley Land Council
Department of Fisheries (WA)	Wunambal Gaambera Aboriginal Corporation
Deakin University, Victoria	Chevron Australia
Colorado State University	Kemerton Silica Sands
University of Hawaii	GME Resources
Worldwide Fund for Nature (WWF)	GhG-SSCP Research Group, Ministry of the Environment, Government of Japan
University of British Columbia	The Norwegian University of Science and Technology, Trondheim, Norway
Consortium for Conservation Medicine	Aquatic Eco-Technology, Hogeschool Zeeland Netherlands
University of Sunshine Coast, Queensland	UFZ – Centre for Environmental Research, Germany
WA Museum	eriss (Environmental Research Institute of the Supervising Scientist, NT)
The Wilderness Society	Australian Tropical Herbarium, James Cook University
Greening Australia (WA)	Manaaki Whenua Landcare Research, New Zealand
Friends of Fitzgerald River National Park	Sustainable Tourism Cooperative Research Centre (STCRC)
University of Tasmania	Australian Wilderness Society (Wild Country Project)
Forest Products Commission	Macauley Land Use Research Institute, Aberdeen, Scotland
Bush Heritage Australia	
Australian Wildlife Conservancy	

Community Engagement

Committee contributions

- State Wetland Coordinating Committee
- Aquatic Ecosystem Advisory Group of the National Water Commission
- Advisory Committee for the Institute of Water and Environmental Resource Management, University of Technology, Sydney
- Western Australian EPA Reference Panel on Natural Resource Management
- Western Australia Sustainable Diversion Limit Expert Panel by the Department of Water
- Environmental Protection Authority WA (Deputy Chair)
- Pacific Basin Consortium for Health and Environment
- Clean Air Society –Deputy Chair SIG – Risk Assessment
- Member, Rottneet Island Environment Advisory Committee
- Organising Committee Asia Pacific Ecohealth Conference 2007, Deakin University, Melbourne
- Department of Environment and Conservation Gngara Sustainability Strategy Scientific Advisory Committee
- WA Threatened Species Scientific Committee
- Regional Councillor, Ecological Society of Australia
- Minerals Research Advisory Committee
- WA Threatened Ecological Communities Scientific - Committee
- Stakeholder Steering Committee for ALCOA's 2nd Mining Environmental Plan
- Convenor of the local chapter of the Australian Systematic Botany Society
- Department of Environment and Conservation's Guidelines for Terrestrial Biological Survey Group
- Environmental Advisory Committee of the City of Wanneroo
- Advisory Committee for Yanchep National Park
- Yellagonga Regional Park Advisory Committee
- Sustainability Sub-committee, City of Joondalup
- Science ambassador, SCITECH (WA)
- Honorary Senior Fellow, The Australian Museum, Sydney
- Brooklyn and Lower Hawkesbury Estuarine Management Committee, NSW
- Scientific Reference Group, Bell Miner Associated Dieback Working Group, NSW
- Birds Australia, Common Names Committee

Editorial positions

- Editor, Pacific Conservation Biology
- Co-editor of Ecohealth
- Editorial Board International Society Environmental Forensics
- Associate Editor of Austral Ecology
- Editorial Board of the African Journal of Range and Forage Science

Refereed papers for

Perspectives in Plant Ecology, Evolution and Systematics, Scientia Horticulturae, Rangeland Ecology and Management, Ecosystems, Journal of Biogeography, Biological Invasions, Journal Toxicology and Environmental Health, Pacific Science, Journal of Vegetation Science, Plant and Soil, New Phytologist, Austral Ecology, Nuytsia , Aquatic Ecosystem Health and Management, Ecological Management and Restoration, Hydrobiologia, Chemosphere, International Journal of Mining, Reclamation and Environment, Ecohealth, Journal of Crustacean Biology, Journal Environmental Management, Natural Areas Journal, Restoration Ecology, Web Ecology, Conservation Science Western Australia.





CENTRE *for*
ECOSYSTEM
MANAGEMENT

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