AUSTRALIAN ECOSYSTEMS:

200 Years of Utilisation, Degradation and Reconstruction

Geraldton, Western Australia

August 28 - September 2, 1988

Programme and Abstracts

ECOLOGICAL SOCIETY OF AUSTRALIA

29870-8-88

AUSTRALIAN ECOSYSTEMS :

200 YEARS OF UTILISATION, DEGRADATION AND RECONSTRUCTION

A perspective for Australian ecosystems in the next century

ECOLOGICAL SOCIETY OF AUSTRALIA

BIENNIAL SYMPOSIUM

GERALDTON, WESTERN AUSTRALIA

August 28 - September 2, 1988

ORGANISING COMMITTEE:

Convenor	Dr R.A. How W.A. Museum, Francis Street, Perth, W.A. 6000
Members	Mr A.J.M. Hopkins Department of Conservation and Land Management, P.O. Box 51, Wanneroo, W.A. 6065
	Dr J.D. Majer Curtin University of Technology Box U1987, Perth, W.A. 6001
	Dr D.A. Saunders CSIRO Division of Wildlife and Ecology LMB No 4, P.O. Midland, W.A. 6056
Proceedings Editor	Dr D.A. Saunders CSIRO Division of Wildlife and Ecology LMB No 4, P.O. Midland, W.A. 6056

Contents

Acknowledgements

The Organising Committee thank the following for their support of this symposium:

Alcoa of Australia
Ansett Airlines of Australia
Associated Minerals Consolidated Ltd
Australian Groundwater Consultants
CSIRO Division of Wildlife and Ecology
Curtin University of Technology
CRA Exploration Pty Ltd
Dames and Moore Pty Ltd
Department of Conservation and Land Management
Environmental Protection Authority
Geographical Association of Western Australia
Geraldton Museum
Geraldton Tourist Bureau
Hamersley Iron Pty Ltd
Kinhill Stearns
LeProvost, Semeniuk and Chalmer
Maunsell and Partners Pty Ltd
Western Australian Museum
Woodside Offshore Petroleum Pty Ltd
Worsley Alumina Pty Ltd

Liz Aspher
John Beard
David Bell
Peter Clough
John Dell
Dinky Goble-Garratt
Ted Griffin
Judith Harvey
Raelene Hick
Grace Itzstein
Greg Keighery
Dennis King
Libby Mattiske
Anne Nevin
Cathy Taylor
Narelle Taylor
Rod Wilson

Symposium Program

Sunday 28 August

0830	Pre-conference tour departs
1700-1900	Registration at venue
1900	Informal gathering at venue

Monday 29 August

0800	Late Registration
0900	Opening session and official welcome
0920	Address from Senator Richardson. Minister for the Arts, Sport, the Environment, Tourism and Territories. Read by Dr P. Bridgewater

EVOLUTIONARY AND LANDUSE HISTORY - Chairman: A.J. McComb

0940	Environmental History - learning from the past for the future. R.L. Clark and R.J. Wasson
1020	Changes in the sub-tropical forests of Fraser Island, past and present - lessons for future management. M.E. Longmore
1040	MORNING TEA
1110	Sydney vegetation 1788-1988. D.H. Benson and J. Howell
1130	Restoration of biological scenarios : the role of museum collections. B.Y. Main
1150	Aboriginal use of country : temporal and spatial variations in the Western Desert. F. Walsh
1210	Poster Session

SOILS: THEIR PLANNED USE - Chairman: G.R. Beeston

1400	Impact of land development on land degradation in Australia. R.A. Nulsen
1420	Soil faunal communities : some lessons from a species analysis of soils of the eastern goldfields region of Western Australia. A. Kinnear
1440	Satellite monitoring of Willandra Lakes World Heritage Region. A.L. O'Neill and A.K. Milne

1500 Land evaluation - containing land use within land potential. A. Lindsay and K. Rowe (to be read by G. Beeston)

1520 AFTERNOON TEA

USES AND IMPACTS ON AQUATIC SYSTEMS - Chairman: P.K. Anderson

1550 The impact of nutrient enrichment on nearshore and estuarine ecosystems in Western Australia. K. Hillman and R.J. Lukatelich

1610 Resolving the conflict between conservation and human exploitative use of the Abrolhos coral reefs. A. Hatcher, G. Wright and B. Hatcher

1630 Our use of the coast : research needs, ecological changes and corrections. P.G. Fairweather

1650 Australian upland streams: ecological degradation, conversion and possible restoration. P.S. Lake and R. Marchant

1730 CIVIC RECEPTION

Tuesday 30 August

MANAGEMENT OF AUSTRALIAN VEGETATION - Chairman: R.O. Slatyer

0900 From frontier to fragments : European impact on Australia's native vegetation. R.J. Hobbs and A.J.M. Hopkins

0940 The role of anthropochorous vegetation in present and future landscapes of Australia. P.B. Bridgewater

1000 The revegetation of Victoria - the first stages. S. Burke and R. Youl

1020 The dynamic structure of a Hawkesbury Sandstone plant community in relation to the objectives of fire management. R.M. Muston

1040 MORNING TEA

CASE STUDY: MANAGEMENT OF THE ARID ZONE - Chairman: R.J. Hobbs

1110 Where the creeks run dry or ten feet high : managing arid Australia. M. Friedal, G. Allan, B. Ford, G. Griffin, S.R. Morton, G. Pickup and D.M. Stafford Smith

1130 Pattern and productivity in arid lands. D.M. Stafford Smith and G. Pickup

1150 Impact of European settlement on the vertebrate animals of arid Australia. S.R. Morton

1210 Uluru National Park : an assessment of fire management. L. Baker and G. Allan

1230 LUNCH

INTERACTION BETWEEN GRAZING AND NATURAL ECOSYSTEMS - Chairman: D.A. Saunders

1400 Effects of grazing on Australian ecosystems. A.D. Wilson

1440 Lessons from 100 years of changes in semi-arid New South Wales. J. Pickard

1500 Shrub-grass dynamics on the Bogong High Plains, Victoria. R.J. Williams

1520 AFTERNOON TEA

CONCURRENT SESSIONS : GRAZING AND VEGETATION

VEGETATION - Chairman: R.O. Slatyer

1550 The urban environment - new niches. M.D. Fox and E.H. Norris

1610 How important is the understorey for the survival of remnants of native woodlands on farms. J. Landsberg and J. Morse

1630 The European Honeybee in Australian ecosystems - ecological effects of selective foraging and implications for management. R.J. Wills, M.N. Lyons and D.T. Bell

GRAZING - Chairman: D.A. Saunders

1550 Recruitment in arid zone shrub/tree populations. T.D. Auld

1610 Changes in herbaceous species following cessation of grazing. J.G. McIver and C.J. Gardener

1630 Dry tropical rangelands : solving one problem and creating another. G.J. Gardener and J.G. McIver

1930 CONFERENCE DINNER

Wednesday 31 August

THE UNIQUE AUSTRALIAN FAUNA - ITS PAST AND ITS FUTURE FAUNA - Chairman: A.R. Main

0900 Australia's terrestrial vertebrate fauna : principles of extinction and management. H.F. Recher and L. Lim

0940 The impact of the agricultural and pastoral industries on the birds in the southern half of Western Australia : past, present and future. D.A. Saunders and P.J. Curry

1000 State forests in Australia and their use in wildlife conservation. S.M. Davey and T.W. Norton

1020 Ants as indicators of habitat quality in Australian terrestrial ecosystems. A.N. Andersen

1040 MORNING TEA

PLANNING, LANDUSE AND MANAGEMENT AT A REGIONAL AND LOCAL SCALE - Chairman: A.J.M. Hopkins

1110 Naturalness : the concept and its application to Australian ecosystems. S.G. Taylor and R.G. Lesslie

1130 The importance of including cultural resources in environmental management : Two examples from coastal Western Australia. G. Wright and K. Morse

1150 A conservation study of the Central Western Region of N.S.W. 1815-1988. D.C. Goldney and I.J.S. Bowie

1210 Managing nature management. R. McKellar

1230 LUNCH

PLANNING CONTINUED - Chairwoman: S. Taylor

1400 Land management in Australia - preparing for the third century of European occupation. V.R. Squires

1440 Habitat mapping and fauna predictive modelling through the integration of satellite imagery and other geographical information. A.L. O'Neill, J. Hibberd, R. Sim and J. Marthick

1500 Human disturbance of the Murray floodplain in South Australia. F.J. van der Sommen

1520 AFTERNOON TEA

CONCURRENT SESSIONS : FAUNA AND PLANNING

FAUNA - Chairman: A.R. Main

1550 The value of road reserves to bird communities in the W.A. Wheatbelt. P. Cale

1610 The Numbat (Myrmecobius fasciatus) : history of decline and potential for recovery. J.A. Friend

1630 Factors affecting small mammal distribution and abundance in the Eastern Otways. I. Vegetation and historical factors. B.A. Wilson, D. Robertson, D.J. Moloney, G.R. Newell and W.S. Laidlaw

1650 Factors affecting small mammal distribution and abundance in the Eastern Otways. II. Fire and mining. D.J. Moloney, B.A. Wilson and K. Kentish

PLANNING - Chairwoman: S. Taylor

1550 Reconstruction of South Australia's arid lands : the conservation option. B. Cohen

1610 Natural regions of Western New South Wales. G. Morgan

1630 Identifying the National Estate. Issues and directions in the assessment of significance of places. M. O'Brien

1650 Restoration of plant communities after fire : case studies of Banksia-dominated vegetation. B.B. Lamont, R.M. Cowling, N.J. Enright, S.M. Connell and S.J. Bergl.

2000 ANNUAL GENERAL MEETING OF ECOLOGICAL SOCIETY OF AUSTRALIA

Thursday 1 September

RECONSTRUCTION OF EXTENSIVELY MODIFIED ECOSYSTEMS - Chairman: D. Brooks

Zoological considerations

0900 Land reclamation : when will the animals return? J.D. Majer

0920 Two hundred years of disturbance : how it has aided our understanding of succession in Australia. B.J. Fox

Botanical considerations

0940 Seed ecology in relation to reclamation. D.T. Bell, S. Vlahos and S.M. Bellairs

1000 The role of the seed bank in mineral sands rehabilitation at Eneabba, W.A. L.J. Carey and M. Jefferies

1020 Weed management and revegetation programmes. F.D. Panetta and R.H. Groves

1040 MORNING TEA

1110 Selecting trees for saltland reclamation. P.G. van der Moezel and D.T. Bell

Agronomic considerations

1130 Rehabilitation agronomy - techniques for revegetating degraded land. C.V. Malcolm

Case studies

1150 Re-establishment of a functional forest ecosystem following bauxite mining in the Darling Range, W.A. S.C. Ward, J.M. Koch and O.G. Nichols

1210 "Greening" of steelplant sites. S.C. Thompson and S. Makin

1230 LUNCH

THE GENETIC RESOURCE BASE FOR THE FUTURE - Chairman: H.F. Recher

1400 Conservation of genetic resources in Australia's flora and fauna. S.D. Hopper and D.J. Coates

ECOPOLITICS AND PRESIDENTIAL ADDRESS - Chairman: H.F. Recher

1430	Ecopolitics: Ecologists and the battle for the Earth. W. Hare
1500	AFTERNOON TEA
1530	After the first 200 : The future of ecology and ecologists in Australia. Presidential address. A.J. McComb
1610	PLENARY SESSION. Chairman: A.J.M. Hopkins
2000	PUBLIC FORUM. Chairman: Hon. J.P Carr MLA

Friday 2 September

OPEN FORUM

CONCURRENT SESSIONS

MORNING SESSION I - Chairman: R. Braithwaite

0900 Population changes in arid-zone lizards. C.R. James

0920 Increased basking in female skinks : reducing costs of reproduction? L. Schwarzkopf

0940 Biogeography of the reptiles of the Dampier Archipelago : deterministic assemblages. G.W. Connell

1000 Influence of pitfall and drift-fence design on capture rates of small vertebrates in semi-arid habitats of Western Australia. G.R. Friend, G.R. Smith, D.S. Mitchell and C.R. Dickman

1020 Seasonal changes in aggressiveness of White-cheeked and New-holland honeyeaters : are they related to changes in nectar availability? D.P. Armstrong

MORNING SESSION II - Chairman: J.S. Beard

0900 What is "available" phosphorous in forest ecosystems? M. Adams

0920 Effects of prescribed burning on N-cycling and tree growth in a snowgum forest. H. Keith

0940 Nutrient cycling studies in wet tropical rainforest. R.A. Congdon, J.L. Herbohn and C. Maycock

1000 Inferences on rarity in Eucalyptus paliformis from a phylogeny of the green ash group of eucalypts, estimates using allozyme data. S. Prober, J.C. Bell and G. Moran

1020 Principles and methods for the regeneration of Western Australia's rangelands. B.M.R. Ward and R.A. Shepherd

1040 MORNING TEA

MIDMORNING SESSION I - Chairman: Barry Fox

1110 The dugong in Shark Bay : expanding knowledge of a unique herbivore niche. P.K. Anderson

1130 Inbreeding and competition: problems for the conservation of marsupials on offshore islands? C.R. Dickman and A.J. Lynam

1150 NW coastal islands - management of a valuable resource. K.D. Morris

1210 Prey handling times and prey captive success in three sympatric small dasyurids. M.C. Calver, J.S. Bradley and D.R. King

MIDMORNING SESSION II - Chairman: P. Fairweather

1110 Aspects of nitrogen cycling in two dominant macroalgae : the kelp Ecklonia radiata and Sargassum sp. E.I. Paling

1130 Macroalgal succession in the Peel-Harvey Estuarine system. P. Lavery

1150 Patterns in spinifex grassland, Great Sandy Desert. E.M. Goble-Garratt and D.T. Bell

1210 Responses of native plants to herbicides. J. Dodd and J.R. Peirce

1230 LUNCH

AFTERNOON SESSION I - Chairman: S. Morton

1400 The role of harvester and forager termites in an Australian savanna. M. Hodda

1420 Piping of tropical eucalypts by termites : predation or mutualism? R.W. Braithwaite

1440 The effects of neighbouring sponges on the rates of sexual and asexual reproduction in a colonial marine invertebrate. L. Stocker

1500 Improving the target specificity of dingo baiting. M.C. Calver and J. Gardner

AFTERNOON SESSION II - Chairman: M. Fox

1400 Geographic information and modelling systems : the practitioner's panecea or science seduced? J.A. Beck

1420 Competition and pollination. R.J. Whelan and R.L. Goldingay

1440 The effect of herbivory on the distribution of Eucalyptus pauciflora in the Brindabella Range, SE Australia. J.E. Williams

1500 Fire management and fire ecology : a manager's perspective. N. Preece.

1520 AFTERNOON TEA

1550 OPEN FORUM POSTER SESSION

1700 END OF ESA SYMPOSIUM AND OPEN FORUM

0940 MONDAY 29 AUGUST

ENVIRONMENTAL HISTORY - LEARNING FROM THE PAST FOR THE FUTURE

R.L. Clark and R.J. Wasson

CSIRO Division of Water Resources, P.O. Box 1666, Canberra, A.C.T., 2601

Managing ecosystems without any knowledge of their history may well invite disaster. Simple description is inadequate for understanding rates, directions and magnitudes of change in complex systems. In this paper, questions of scale and resolution are raised in the context of the Quaternary history of the Australian environment. The effects of European land uses can only be perceived, measured or predicted with knowledge of the dynamics of the environment in the period immediately before settlement. Palaeoecological methods can be used to study the recent past on timescales of decades to hundreds of years, with resolution at the level of events, seasons, years or decades. Such work complements and bridges the gap between long-term environmental history and monitoring or process studies, and covers the critical period before and since 1788. Examples are given of the application of recent environmental history to ecological theory and to practical questions of ecosystem management in different parts of Australia.

1020 MONDAY 29 AUGUST

CHANGES IN THE SUB-TROPICAL FORESTS OF FRASER ISLAND, PAST AND PRESENT-LESSONS FOR FUTURE MANAGEMENT

M.E. Longmore

Centre for Remote Sensing, University of New South Wales and Department of Biogeography and Geomorphology, Research School of Pacific Studies, A.N.U.

The modern sub-tropical forests of Fraser Island are subjected to frequent burning, particularly in Forestry areas, to maximise regeneration of commercial timber species and to decrease fire hazards for island visitors. Evidence of forest change and fire occurrence is recorded in the Quaternary deposits of the perched freshwater lakes. Records extend back over the last 300,000 years, the last 40,000 years and the last 10,000 years at different sites. The long-term trends are compared to evidence of fire response in modern vegetation derived from Landsat multi-spectral scanner data collected over the last decade.

What questions can historical studies and modern space technology answer about the potential future trends of the island's forest ecosystems under current management practices? And, do we want any answers?

1110 MONDAY 29 AUGUST

SYDNEY VEGETATION 1788-1988

D.H. Benson and J. Howell

National Herbarium of New South Wales, Royal Botanic Gardens, Mrs Macquarie's Road, Sydney, N.S.W., 2000, Australia

Sydney, the site of the first European colonisation in Australia, is fortunate in having so much infertile soil, supporting vegetation rich in species. Much has been preserved to provide an Enviable urban setting of major national parks, with bushland remnants conspicuous in many suburban areas. However, during 200 years European settlement has removed most of the indigenous vegetation from the more fertile soils and destroyed or modified many wetlands and sand dune complexes.

For this Bicentennial retrospective, detective work was necessary to reconstruct a picture of the lost vegetation of 1788 as, despite the novelty and variety of Sydney's flora, acclaimed by Joseph Banks and company in 1770, the First Fleet arrived without a botanist. The present remaining native vegetation, has been mapped and classified into structural forms and floristic groupings, and types in need of reservation have been identified. In low fertility areas, loss of indigenous understorey is occurring despite preservation of canopy dominants, as weed invasion follows nutrient enrichment of drainage lines. Guidelines for future management have been developed to cater for growing public concern to conserve bushland in urban areas.

1130 MONDAY 29 AUGUST

RESTORATION OF BIOLOGICAL SCENARIOS: THE ROLE OF MUSEUM COLLECTIONS

Barbara York Main

Zoology Department, University of Western Australia, Nedlands, W.A. 6009, Australia

Biological collections (albeit fragmentary) from Australia, preceded European settlement. Later collections were made in association with 18th and 19th century explorations. On a regional basis, using W.A. as an example, southern W.A. benchmark collections began with Dampier, were continued with the French explorations and culminated with the Berlin/Hamburg Museums' expedition of 1905. Major collections varying for different taxa have subsequently accrued through concerted planning and opportunistic acquisition. Distribution of the biota is now disrupted. Thus the cumulative value of natural history collections is increasing inversely with the diminution of natural landscapes and habitats. As a consequence biologists will need to look more closely at archival collections in order to reconstruct (theoretically) earlier biological scenarios. Selected taxa from respective areas are examined here to demonstrate this proposition. Such hypothetical 'scenario' reconstructions could in turn be the basis for rehabilitation of representative landscapes. In this context museums should enjoy a revitalisation - of use, of value-recognition, of support. The dust is lifting from the cabinets!

1150 MONDAY 29 AUGUST

ABORIGINAL USE OF COUNTRY: TEMPORAL AND SPATIAL VARIATIONS IN THE WESTERN DESERT

Fiona Walsh

Department of Botany, University of Western Australia, Nedlands, W.A. 6009

Quantitative vegetation surveys and ethnographic techniques have been used to reconstruct the traditional patterns of hunting and gathering of the Martujarra and Warnman Aborigines.

Plant resource selection is considered at three levels: 1) the potential use of a large number of species for food, 2) the targetting of plant communities that had a high species diversity, and 3) the selection of occupation sites that ensured access to a variety of plant communities. These results may be used to predict the movement pathways, spatial use and manipulation of resources in proximity to and between traditional occupation sites.

The Martujarra and Warnman recognised seasonal cycles of water, plant and animal resource availability and these were partial determinants of aggregation and dispersal. Also the spatial and temporal patterns of land use varied in relation to prevailing landform types. Consequently, it may be inappropriate to consider land use and associated management practices to be homogeneous throughout the Western Desert.

1420 MONDAY 29 AUGUST

SOIL FAUNAL COMMUNITIES: SOME LESSONS FROM A SPECIES-ANALYSIS OF SOILS OF THE EASTERN GOLDFIELDS REGION OF WESTERN AUSTRALIA

Adrianne Kinnear

Western Australian College of Advanced Education, P.O. Box 217, Doubleview, W.A.

In the past there has been an understandable emphasis on "broad-brush" taxonomic approaches to soil community studies in this country which, while they have laid down valuable descriptive beginnings, are proving to be of limited value for the development of general principles, for the elucidation of ecological roles and for the generation of data useful for management and conservation.

This study is distinctive in that (i) it represents one of the first reported attempts to described the complete species-component of an Australian soil community, (ii) it is the first study of the soil fauna of "serpentinite-type" soils containing heavy metals of current economic importance, and (iii) the study area exemplifies a unique combination of biochemical, and geological variables superimposed on aged, semi-arid soils. The conclusions of the study raise interesting questions about established generalisations of soil fauna of semi-arid regions. When viewed in the light of knowledge of the Australian scene, the results demonstrate the increased biological value of species-level analyses. More importantly, they highlight a need to address some critical issues in Australian soil ecology; in particular:

*the species-identification problem - is there a case for ecologically-useful taxonomy?
*elucidating the ecological roles of the soil fauna - are simplistic approaches effective?
*applied soil ecology - how much and what sort?

1440 MONDAY 29 AUGUST

SATELLITE MONITORING OF WILLANDRA LAKES WORLD HERITAGE REGION

A.L. O'Neill[1] and A.K. Milne[2]

[1]Geography Department, University of Wollongong, P.O. Box 1144, Wollongong 2500
[2]Centre for Remote Sensing, University of N.S.W., P.O. Box 1, Kensington 2033

Remote sensing from satellite imagery provides opportunities to produce frequent, cost effective and accurate mapping of environmental attributes.

Research in the Willandra Lakes World Heritage Region in western, semi-arid N.S.W. has shown the accuracy with which Landsat Multi-spectral Scanner and Thematic Mapper imagery can be used to map soil, vegetation and geomorphic associations. Techniques have been developed to use this data to accurately map areas which have changed due to fire, erosion, drought, grazing pressures, cropping and clearing. The importance of developing appropriate field measurements to correlate with the sensor data is discussed as is the need to integrate remotely sensed data with other terrain information via geographic information systems.

1500 MONDAY 29 AUGUST

LAND EVALUATION - CONTAINING LAND USE WITH LAND POTENTIAL

Andrea Lindsay and Ken Rowe

Graduate School of Environmental Science, Monash University, Clayton, Victoria, 3168

Production from land involves modifying ecosystems. If degradation is to be contained, land-use decisions must be based on adequate knowledge of the land and its responses to use; and be presented in a form which planners and land managers can understand and apply.

Any evaluation of the impact of land-use on land must be based on a wholistic and interactive model. Basic components will be information about the land use or production for which evaluation is being made, management inputs, the nature of the land, impacts on the land and interrelationships between these variables.

The Victorian land capability assessment approach is based on this four component model. It allows predictions to be made about one component on the basis of another whilst the other two are specified. Most commonly land characteristics are used to predict limitations, and implicitly the kind and level of management required to allow the desired use without unacceptable impact on the land. Another form indicates effects of variations in land characteristics on use, given specific management inputs and no resulting unacceptable impacts.

Difficulties arise because of imperfect knowledge of interrelationships. This knowledge is based on extensive field experience or research and is continually growing. Consequently an important feature of the system is an updating procedure.

Examples of common applications of the procedure are provided with recent studies into potential wider application.

1550 MONDAY 29 AUGUST

THE IMPACT OF NUTRIENT ENRICHMENT ON NEARSHORE AND ESTUARINE ECOSYSTEMS IN WESTERN AUSTRALIA

K. Hillman and R.J. Lukatelich

Department of Botany, Centre for Water Research, The University of Western Australia, Nedlands, Western Australia, 6009

This paper will describe how industrial development and agricultural practises have caused the nutrient enrichment of nearshore and estuarine ecosystems, and discuss management strategies that may be used to overcome the resulting eutrophication problems. The discussion will be structured around data from two ecosystems: the Peel-Harvey estuarine system and Cockburn Sound. →

The Peel-Harvey estuarine system is a broad, shallow waterbody with restricted exchange with the ocean, in which clearing and drainage in the catchment (especially the coastal plain portion) have greatly increased the amount of nutrients entering the system since the 1950s. Environmental deterioration in the marine embayment of Cockburn Sound also dates from the 1950s, but has been caused by nutrient enrichment from industrial outfalls following the development of the areas as a major industrial complex and harbour.

Emphasis will be given to two major principles underlying the management of aquatic ecosystems : that such ecosystems cannot be studied as isolated water bodies, and that a multidisciplinary approach is essential for successful management.

1610 MONDAY 29 AUGUST

RESOLVING THE CONFLICT BETWEEN CONSERVATION AND HUMAN EXPLOITATIVE USE OF THE ABROLHOS CORAL REEFS

Annamarie Hatcher, Guy Wright[1] and Bruce Hatcher

Hatcher Research Associates, 52a Marine Terrace, Marmion, W.A. 6020, Australia

[1]Present address: Department of Anthropology, University of Western Australia, Nedlands, W.A., 6009, Australia

The atolls of the Houtman Abrolhos, located about 50 km. west of Geraldton, are the southernmost coral reef structures in the Indian Ocean. They have attracted the interest of scientists, tourists and fishermen. In the past, the sustained yield of the lucrative rock-lobster fishery has been the primary management goal. Recently, pressure from conservation groups has led to the consideration of more equitable plans of ecosystem management. Using our expertise as two ecologists and a social anthropologist, we have found that the critical aspect of management-oriented research was matching the scales of social and ecological data collection. Using data on benthic community structure collected at spatial scales determined by patterns of human use, we have been able to identify specific areas of potential conflict, thus providing managers with information relevant to zoning decisions. By using an approach which was sensitive to the human component of the ecosystem as well as the ecological realities, we have provided a basis for equitable management of the reefs, and at least partially defused the confrontation among interest groups.

1630 MONDAY 29 AUGUST

OUR USE OF THE COAST: RESEARCH NEEDS, ECOLOGICAL CHANGES AND CORRECTIONS

Peter G. Fairweather

Centre for Environmental & Urban Studies, Macquarie University, N.S.W., 2109, Australia

Australian society uses our coastal and nearshore marine ecosystems for a variety of recreational, industrial and social ends. This range of uses includes the oceans' role as a receptacle for sewage and other pollution, the provision of organisms for food or bait, as a site for recreational activities like play, fishing or boating, and as a victim of reclamation for residential, tourist and industrial developments next to the sea.

Here I outline how these uses have evolved during the 200 years of settlement. We know precious little about how communities in sandy, rocky and muddy stretches of open coast, our estuaries and near-shore reefs function. The scant ecological information on the impacts of these uses on flora and fauna is reviewed via the use of searches of the recent literature. Some coastal habitats, such as sandy beaches, are grossly underrepresented in our published work. Much of our understanding on impacts lies locked away in the "grey" literature, and therefore beyond the assessment of peer review. Attention will also be paid to attempts to ameliorate, overcome and rectify impacts. The siting of marine reserves highlights the need for planning and research in marine conservation.

1650 MONDAY 29 AUGUST

AUSTRALIAN UPLAND STREAMS: ECOLOGICAL DEGRADATION, CONVERSION AND POSSIBLE RESTORATION

P.S. Lake and R. Marchant

Zoology Dept, Centre for Stream Ecology, Monash University, and Museum of Victoria, Melbourne, Australia

It is very evident that many land use practices carried out by European man on upland catchments have detrimentally affected streams, but the ecological effects have been rarely investigated.

Unambiguous evidence of ecological effects is available for some catchment land use practices such as mining. Persistent pollution has resulted from heavy metal mining. The impacts of nutrient addition to upland streams seem to be controvertible.

The construction and operation of dams with subsequent river regulation, and river channelization have both altered stream communities. The introduction of new predators, such as salmonids, have had significant effects on both native fish and stream invertebrates.

In many situations, e.g. heavy metal pollution, it is almost impossible to devise satisfactory ways for ecological restoration. However, given sympathetic management, it is possible to alleviate the undesirable effects of channelization, nutrient addition, river regulation and forestry activities. There is a very obvious need for long-term ecological research on stream management and restoration.

0900 TUESDAY 30 AUGUST

FROM FRONTIER TO FRAGMENTS: EUROPEAN IMPACT ON AUSTRALIA'S NATIVE VEGETATION

R.J. Hobbs[1] and A.J.M. Hopkins[2]

[1]CSIRO Division of Wildlife & Ecology, LMB 4, P.O. Midland, W.A., 6056
[2]Department of Conservation & Land Management, P.O. Box 51, Wanneroo, W.A. 6065

The early European settlers brought an array of attitudes to land and land-use practices that contrasted markedly with those of the aboriginal people. Included were notions of ownership and dominance, accompanied by clearing for agriculture and herding and grazing of ungulates. These practices have greatly changed the Australian landscape over the past 200 years in ways which are only now being appreciated. Increasingly, attention is turning towards sustainable land management and away from short-term economic imperatives.

Here we review the impacts of Europeans on the native vegetation, focusing particularly on ecological processes. We examine the changing attitudes towards vegetation, discuss current problems in vegetation management, and identify priorities for future research and management.

0940 TUESDAY 30 AUGUST

THE ROLE OF ANTHROPOCHOROUS VEGETATION IN PRESENT AND FUTURE LANDSCAPES OF AUSTRALIA

P.B. Bridgewater

Bureau of Flora and Fauna, GPO Box 1383, Canberra, ACT, 2601

Anthropochorous vegetation is defined as a grouping of plant communities which are ad-mixtures of native, naturalised and alien species. Such communities may be transitional phases in the degeneration of a native plant community, or they may be metastable communities capable of persistence through disturbance cycles. Genesis of Anthropochorous vegetation is chiefly through breakdown of phytogeographic barriers by introduction of alien species in the last 150-200 years.

Maintenance of such vegetation depends on human intervention through varying management practices and little of such vegetation would persist in a stable form without "interventionist" management. Future landscapes in Australia will inevitably have large components of Anthropochorous vegetation. Ecologists will have a major role in setting and developing appropriate management strategies, they will also have to communicate to the wider community the important contribution to landscape stability and biodiversity maintenance that such vegetation makes.

1000 TUESDAY 30 AUGUST

THE REVEGETATION OF VICTORIA - THE FIRST STAGES

S. Burke and R. Youl

Land Protection Division, 250 Victoria Parade, East Melbourne, 3002

In 1980 a major campaign commenced, involving government, landholders, community bodies, industry, private foundations and enthusiastic individuals, to carry out revegetation throughout rural Victoria.

Victorians increasingly recognise the value of local provenances of indigenous vegetation, natural regeneration and of fencing of remnants of bush on farms to control grazing. Planting is the most popular technique, but direct seeding is being more widely used. Public education, provision of financial assistance, political support and media involvement are vital - there are tasks for everyone in revegetation.

Within cities and towns, urban forestry is growing - this is the protection of remnants of indigenous vegetation and the creation of native forests that resemble natural bush and line roads, easements, drainage channels and factory and quarry boundaries.

Commercialism has a role, including consultancy, seed collection, specialist nurseries and on-farm sawmilling. Making money from revegetation is a fine incentive for its expansion.

1020 TUESDAY 30 AUGUST

THE DYNAMIC STRUCTURE OF A HAWKESBURY SANDSTONE PLANT COMMUNITY IN RELATION TO THE OBJECTIVES OF FIRE MANAGEMENT

R.M. Muston

Department of Biology, University of Wollongong, P.O. 1144, Wollongong, N.S.W., 2519, Australia

Fire-induced changes in the species composition and species distribution within a Hawkesbury Sandstone plant community were investigated in a long-term study.

No chronological change in the species composition of the plant community was observed during the 13-year post-fire period. The species composition of the community had been established by 4 years after the fire. The results suggest that in this fire-prone community replenishment of the initial species composition can occur in the absence of fire. High fire intensity does not necessarily lead to changes in the frequency of particular groups of species. A mechanism for post-fire community change associated with the "Obligate Seeder" survival strategy was identified.

1110 TUESDAY 30 AUGUST

WHERE THE CREEKS RUN DRY OR TEN FEET HIGH: MANAGING ARID AUSTRALIA

M. Friedel, G. Allan, B. Foran, G. Griffin, S. Morton, G. Pickup and M. Stafford Smith.

CSIRO Division of Wildlife & Ecology, P.O. Box 2111, Alice Springs, N.T., 5750, Australia

Sustained production in our arid lands is possible, as some innovative practitioners are showing.

Over the last 150 years, introduced animals and plants, changed fire regimes, and inappropriate government requirements have lead to the loss of native flora and fauna, to lowered production and to soil erosion. Both pastoral lands and conservation areas have suffered.

Now, a number of land managers are showing that some of the trends can be reversed, without loss of viability of their enterprises. Practical experience, coupled with scientific research, points to management systems which can prevent further degradation and, in some cases, repair past damage.

We present examples of arid zone pastoralists and park managers who are leading the way, and outline some of the science which is being applied or developed to maintain or repair important ecosystems.

1130 TUESDAY 30 AUGUST

PATTERN AND PRODUCTIVITY IN ARID LANDS

D.M. Stafford Smith and G. Pickup

CSIRO Division of Wildlife & Ecology, P.O. Box 2111, Alice Springs, N.T., 5750

Spatial and temporal variability is extra-ordinarily important in Australia's ancient arid landscapes. To avoid swamping by noise we must stratify studies of any physical or biological features of the landscape.

Patterns in space include tree canopy effects, groving in mulga woodlands, erosion cells, dunes, and whole landscape catenas. Often organisms can exist in pockets of a landscape that could not support them if it were unpatterned. Patterns contain both stochastic elements (e.g. erosion cells on a floodplain) and trended elements (e.g. the overlaid influence of cattle grazing on the same floodplains, trending out from waterpoints).

Spatial variability provides buffering up to some threshold, often limiting the size of any generating forces; above the threshold, however, dramatic changes can take place. The impact of cattle has caused erosion patterns in some landscapes to pass over such a threshold, so that the landscape patterns are now functioning in a fundamentally different way. An understanding of the interactions of thresholds and pattern is needed if we are to interpret past changes and plan future management.

1150 TUESDAY 30 AUGUST

IMPACT OF EUROPEAN SETTLEMENT ON THE VERTEBRATE ANIMALS OF ARID AUSTRALIA

S.R. Morton

CSIRO Division of Wildlife & Ecology, P.O. Box 2111, Alice Springs, N.T., 5750, Australia

The mammals of inland Australia were seriously affected by European settlement, and a high proportion declined dramatically in range or became extinct. Native birds fared much better, and although several species have declined in range it is likely that none is extinct. Reptiles and frogs appear to have suffered no extinctions.

Why has the impact of settlement differed so markedly among the vertebrates, and can the differences provide us with clues as to better management of relict populations? I argue that these differences are explicable in terms of patterns of water and nutrient availability across arid Australia, and of the physiologies and life histories of each group. The line of reasoning has potentially important consequences for priorities in management and for programs of reintroduction.

1210 TUESDAY 30 AUGUST

ULURU NATIONAL PARK: AN ASSESSMENT OF FIRE MANAGEMENT

L. Baker and G. Allan

Uluru National Park, P.O. Box 119, Yulara, N.T., 5751
CSIRO, P.O. Box 2111, Alice Springs, N.T., 5750

Uluru National Park is an arid zone park which has been listed as a Biosphere Reserve and been nominated for World Heritage Listing. The Park is on Aboriginal land and is co-operatively managed by traditional owners and ANPWO under a Board of Management.

Traditionally the region was actively managed through the use of fire. The arrival of European people interfered with traditional practices and for approximately 50 years fire management was not pursued. As a result the new fire regime is dominated by infrequent large scale wildfires which have created large areas of single-aged spinifex and Acacia shrublands.

CSIRO devised a fire management strategy for Uluru National Park based on the concept of traditional burning of frequent small patch burns. A fire management programme based on this strategy has been implemented since 1982.

After six years of implementation, an assessment of the effectiveness of the programme has been undertaken. A comparison has been made between the relatively managed area of Uluru and the unmanaged areas of the surrounding region for plant species richness and habitat diversity.

This paper will attempt to illustrate the effectiveness of the fire management programme in promoting habitat diversity and as a means of inhibiting the spread of wildfires.

1400 TUESDAY 30 AUGUST

EFFECT OF GRAZING ON AUSTRALIAN ECOSYSTEMS

A.D. Wilson

CSIRO Division of Wildlife and Ecology, Private Bag, P.O., Deniliquin 2710, Australia

This paper reviews the effect of grazing on the extensive arid, semi-arid and highland regions that still remain as semi-natural ecosystems.

It outlines at a theoretical level the nature of grazing and its interactions with climatic variation and fire in influencing plant and animal populations. Examples of change in representative ecosystems are presented. As a generalisation these changes show a decrease in perennial and an increase in annual herbaceous species, whilst shrubs and trees have decreased in the arid, but increased in the semi-arid. Few, if any, plant species have been lost entirely. Loss of lichen crust and increase in soil movement is general. Mammal populations show marked change.

It is concluded that the conservation efforts should now be concentrated on land that remains under grazing use. Conservation in parks and reserves is an important and contrasting activity, but one that is necessarily limited in area.

1440 TUESDAY 30 AUGUST

LESSONS FROM 100 YEARS OF CHANGES IN SEMI-ARID NEW SOUTH WALES

John Pickard

Western Lands Commission, GPO Box 4351, Sydney, N.S.W., 2001

Over 100 years of European farming and grazing in the semi-arid zone of New South Wales have wrought substantial changes to the ecosystems. The general nature of these changes is known, but specific details are lacking. Indeed, critical examination reveals that dogma prevails over hard evidence. This paper described progress from the first phase of a major program aimed at providing details of the nature, magnitude and direction of these changes. The sites of early photographs have been located and the scene rephotographed.

Changes have operated on different timescales (years, decades and centuries) in the same area. There is not yet sufficient data to determine which combinations of weather, climate, fire and management are responsible for the changes. The impact of legislation has generally been negative. Recent policies of property amalgamation and more direct controls on the limits of management may reverse this trend.

1500 TUESDAY 30 AUGUST

SHRUB-GRASS DYNAMICS ON THE BOGONG HIGH PLAINS, VICTORIA

R.J. Williams

Botany Department, Monash University, Clayton, 3168

The Bogong High Plains have been utilized for summer grazing of domestic livestock since the 1850s. This paper reviews the factors affecting the dynamics of heathland and grassland communities, with special reference to the effects of cattle grazing on the shrub-grass balance. The dynamics of these subalpine communities depends upon interactions between site, disturbance and the life history of the shrubs. The distribution of heathland and grassland is correlated closely with exposure and topography, with heathland dominant on the more sheltered, steeper slopes. Ecesis of shrubs depends largely upon disturbance, and both past and present grazing by cattle is a primary agent of disturbance, causing bare ground patches on which shrubs may establish. In grassland, such grazing-related disturbances may facilitate the invasion of disturbed inter-tussock spaces by shrubs. However, the subsequent development and persistence of shrubs depends upon both their palatability and life history characteristics. The expansion of palatable shrubs may be inhibited by grazing. Obligate seed reproducers are generally replaced at senescence by grasses, whereas facultative seed reproducers may persist long after establishment. Both the direction and rate of such vegetation changes are affected by the co-incidence of infrequent biotic and climatic events. The implications of these data are discussed in terms of present and past concepts of succession and climax, and the consequences of various management options are proposed.

1550 TUESDAY 30 AUGUST

RECRUITMENT IN ARID ZONE SHRUB/TREE POPULATIONS

Tony D. Auld

National Parks and Wildlife Service, N.S.W., P.O. Box N189, Grosvenor Street, Sydney, N.S.W., 2000

Many arid zone plant communities have been subjected to a changed grazing regime over the last 200 years with the introduction of domestic stock and the rabbit and the provision of water leading to an increase in some native herbivores (kangaroos). The consequences of such a changed grazing regime are potentially very great for plant populations, although because of the longevity of many arid zone plants such changes may not be evident in the short term. The future of these plant communities depends on an adequate management strategy which allows recruitment of new individuals.

This study assesses the existing population structure of six plant species, Acacia loderi, A. oswaldii, A. carnei, A. ligulata, Casuarina cristata and Heterodendrum oleifolium from Kinchega National Park N.S.W. The consequences of important stages in the life cycle i.e. seedling and sucker recruitment, seed production, dispersal, seed longevity, seedling and sucker survival in relation to environmental variables and grazing, are examined. Factors limiting potential recruitment and survival of recruits are highlighted. These data will be used to develop a management strategy for the continued survival of the study species.

1550 TUESDAY 30 AUGUST

THE URBAN ENVIRONMENT - NEW NICHES

M.D. Fox and E.H. Norris

National Herbarium of New South Wales, Royal Botanic Gardens, N.S.W., 2000, Australia

The outcome of the establishment of industrial and agricultural societies in Australia was the creation of new habitats. These largely comprised settled urban habitats and modified rural areas. In both cases both native and introduced organisms found new niches to occupy. This paper reviews some case studies of successful and unsuccessful transitions: of native species becoming commensal and of introduced species becoming naturalized. In particular the urban environment, a highly modified environment but one retaining some natural features, provides an abundance of resources. These are partitioned among a melange of native and introduced species. Native herbivores have switched to eat some introduced plants and native predators to introduced prey. Similarly, introduced herbivores consume some native plants and alien predators find prey among the native commensal animals. New habitats continue to be created and new communities established. Future trends will include more native species becoming weedy as well as continuing introductions from overseas sources.

1610 TUESDAY 30 AUGUST

CHANGES IN HERBACEOUS SPECIES FOLLOWING CESSATION OF GRAZING

J.G. McIvor and C.J. Gardener

CSIRO, Davies Laboratory, Townsville, Qld, 4814

Cattle grazing is the major land use in the semi-arid woodlands of north-eastern Australia. Effects of high grazing pressures have become apparent in some areas (less available herbage, changed species composition, reduced plant cover). Since these changes are likely to be associated with soil erosion, a reduction in grazing pressure is frequently suggested to reverse the changes. However, it is not always clear if an overgrazed pasture will regenerate and before control of grazing pressure is recommended, we need to be able to predict how pastures will respond.

A study was made of the relationships between soil and vegetation characteristics of pastures grazed to different degrees, and their growth when grazing was prevented. The pasture and soil characteristics were related to site condition values (based on pasture growth and the proportion of desirable species) to determine which were useful for predicting pasture value. Most characteristics were of little use but basal area was closely related. The perennial grasses (the most important species group for vegetation stability) have short-lived seeds and do not develop persistent soil seed banks. Hence if seedset is prevented for a number of years regeneration depends on existing plants (or the introduction of seeds from other areas).

1610 TUESDAY 30 AUGUST

HOW IMPORTANT IS THE UNDERSTOREY FOR THE SURVIVAL OF REMNANTS OF NATIVE WOODLANDS ON FARMS?

Jill Landsberg and Jock Morse

CSIRO Division of Forest Research, P.O. Box 4008, Queen Victoria Tce., Canberra, A.C.T., 2600

Rural tree decline has major consequences for conservation of biota, soil and water, at scales which affect both individual farmers, and rural and urban communities. Severe defoliation of tree canopies by insects is often a feature of declining trees on rural, particularly pastoral, lands. It has been suggested that populations of herbivorous insects can reach damaging levels in stands of trees growing amongst pasture, partly because populations of insectivorous birds and arthropods in such systems are very low. By contrast, populations of herbivorous insects should be kept in check in minimally modified woodlands, because in such woodlands a diverse shrub understorey provides habitat and alternative food sources for predators and parasites. These theories are being tested in remnant stands of native trees in pastoral regions in which dieback is prevalent. Tree vitality, the extent of defoliation, insect populations, and the survival of herbivorous insects are being measured in matched stands of trees which contrast in having understories dominated by either pasture or shrubs. Preliminary results of this work will be presented.

1630 TUESDAY 30 AUGUST

DRY TROPICAL RANGELANDS : SOLVING ONE PROBLEM AND CREATING ANOTHER

Chris J. Gardener and John G. McIvor

CSIRO, Davies Laboratory, Townsville, Qld, 4814

The open woodlands of northern Queensland have been grazed for approximately 120 years. Botanic shifts have occurred, but there was little degradation during the first 100 years. The main limitation to cattle production was poor quality herbage. Stocking rates were low to enable maximum selection of the most nutritious plants. Mortalities in the British breeds were high during droughts and subsequent herd build up was limited by poor breeding performance.

Two approaches to improving cattle nutrition existed. While some scientists favoured sowing legume-based pastures, graziers opted for feed supplements and better adapted zebu cattle. This resulted in greatly improved survival and growth rates, with an accompanying increase in herbage consumption and grazing pressure. Some pastures, particularly in the "better" areas (e.g. Burdekin catchment) are now suffering from severe overgrazing with almost complete loss of herbaceous cover, shrub invasion and soil erosion. Only a reduction in grazing pressure can prevent rapid expansion of this problem. Pasture improvement can only help solve the problem if stocking rates are not again increased to recoup the investment. In the Burdekin catchment, silt and suspended colloids in the dam, irrigation aquifers and water filtration plants will lead to pressures to moderate land use.

1630 TUESDAY 30 AUGUST

THE EUROPEAN HONEYBEE IN AUSTRALIAN ECOSYSTEMS - ECOLOGICAL EFFECTS OF SELECTIVE FORAGING AND IMPLICATIONS FOR MANAGEMENT

R.T. Wills, M.N. Lyons and D.T. Bell

Department of Botany, University of Western Australia, Nedlands, W.A., 6009

Utilisation of floral resources in native shrublands in the south-west of Western Australia by the introduced European honeybee (Apis mellifera) was examined over a period of 30 months. Attributes of reproductive biology, including flowering phenology and post-fire reproductive strategies, were assessed for all species. The quantification of flowering for 413 species in 66 families revealed a flowering peak of 241 species in late winter. While most species recovered post-fire primarily by resprouting (70%), a greater fraction of seeders than resprouters flowered in the dry early autumn months. A. mellifera utilised 30% of all species as a source of pollen and/or nectar. Honeybee and native bee species both tended to favour seeding species. Some workers have presented evidence to suggest that plant seed set declines in the presence of honeybees, while depletion of pollen and nectar resources by honeybees has been shown to cause a reduction in population densities of native pollinators such as honeyeaters and native bees. In addition, sites in this study which had been burnt more frequently had fewer seeding species. Declining seed reserves could result in loss of seeding plant species and have a significant impact on plant community stability, particularly as honeybees tend to forage on post-fire reseeding species. For areas of native vegetation with the combined objectives of apicultural production and flora and fauna conservation, a unique set of ecological management problems are presented.

0900 WEDNESDAY 31 AUGUST

AUSTRALIA'S TERRESTRIAL VERTEBRATE FAUNA: PRINCIPLES OF EXTINCTION AND MANAGEMENT

Harry F. Recher[1] and Leong Lim[2]

[1]Dept. of Ecosystem Management, University of New England, Armidale, 2351
[2]National Parks & Wildlife Service (N.S.W.), Box N189, Grosvenor St. P.O., Sydney, 2000

This paper will review the status of Australia's terrestrial vertebrate fauna. Species which have gone extinct or which have suffered a significant reduction in abundance since European settlement will be identified. Those which have not declined will also be identified and each group searched for attributes which might explain contrasting patterns of increase and decrease.

Attributes common to either decline or abundance will be used to predict future trends in the survival of Australia's terrestrial vertebrates. These underlying principles - should they exist - will then be used to develop a plan for the management of the continent's vertebrates. This plan will be contrasted to existing policies for the conservation of Australia's biota.

0940 WEDNESDAY 31 AUGUST

THE IMPACT OF THE AGRICULTURAL AND PASTORAL INDUSTRIES ON THE BIRDS IN THE SOUTHERN HALF OF WESTERN AUSTRALIA: PAST, PRESENT AND FUTURE.

D.A. Saunders[1] and P.J. Curry[2]

[1]CSIRO, Division of Wildlife and Ecology, LMB No. 4, P.O. Midland, W.A., 6056
[2]Division of Resources Management, Department of Agriculture, Baron-Hay Court, South Perth, W.A., 6157

The pastoral industry involves grazing stock on native vegetation and provides water points every 50 km^2 across the landscape. The agricultural industry has resulted in extensive clearing of native vegetation for cereal cropping and pasture, leaving scattered remnants across the landscape and providing water points every 2.5 km^2.

The present-day avifauna of the Murchison River Catchment (pastoral) is composed of a majority of species for which there are no clear indications of any change in status; a small group of species have declined or become extinct, and a larger group of species have increased in range, abundance or both. The avifauna of the central wheatbelt has changed markedly over the last 60 years: species have become reduced in numbers or locally extinct; other species have invaded the region from the adjacent pastoral country, with only a few species not undergoing some change in status. Factors underlying these changes are discussed, as are possible scenarios for future changes in these environments and their management.

1000 WEDNESDAY 31 AUGUST

STATE FORESTS IN AUSTRALIA AND THEIR USE IN WILDLIFE CONSERVATION

S.M. Davey[1] and T.W. Norton[2]

[1][2]Department of Forestry, The Australian National University
[2]Centre for Resource and Environmental Studies, The Australian National University, G.P.O., Box 4, Canberra City, 2601

Management practices used for wildlife conservation in State Forests are reviewed and future research directions discussed in light of new concepts and theory generated from studies in several forests in south-east Australia. Comments concerning the management of important floristic communities and the conservation of rare owls and dasyurid marsupials are also given. Longterm forest studies of the spatial and temporal use of resources by arboreal marsupials demonstrate the dynamic nature of these resources in space and time. Wildlife values, and therefore National Estate values, of forests may change markedly over short time-spans (tens of years) but these changes are shown to be relatively predictable. Such predictability is the key to developing longterm management prescriptions. Clearly, maintenance of high-quality habitat for, at least, arboreal marsupials is possible given carefully planned and supervised manipulation (e.g. selective logging, fire) of habitat. These procedures, however, will be considerably more expensive than those currently practiced in State Forests. Habitat manipulation to maintain wildlife values in National Parks also appears inevitable in the longer term and should play a significant role in wildlife conservation. Introduction of these practices will require a major change in current attitudes in society, and legislation.

1020 WEDNESDAY 31 AUGUST

ANTS AS INDICATORS OF HABITAT QUALITY IN AUSTRALIAN TERRESTRIAL ECOSYSTEMS

Alan N. Andersen

CSIRO Division of Wildlife and Ecology, Tropical Ecosystems Research Centre, PMB 44, Winnellie, N.T., 5789, Australia

Sound environmental assessment techniques are required to evaluate the impacts of western civilisation on Australian ecosystems.

Currently, the faunal components of most environmental assessment programs deal exclusively with vertebrates, an emphasis that corresponds inversely with the ecological importance of vertebrates in most Australian ecosystems. Invertebrates play integral roles in all ecological processes involving animals, and are likely to be far more efficient and reliable bio-indicators of habitat quality than are vertebrates. Ants are particularly good candidates for use as bio-indicators in Australian terrestrial ecosystems, because of their great abundance, diversity, ubiquity, functional importance, ability to be rapidly sampled and processed, and sensitivity to environmental change. Data on ants are best interpreted at the 'ecological category' level, so that the specific biology of individual species need not be known (and usually isn't).

1110 WEDNESDAY 31 AUGUST

NATURALNESS: THE CONCEPT AND ITS APPLICATION TO AUSTRALIAN ECOSYSTEMS

S.G. Taylor and R.G. Lesslie

Department of Geography, University of Adelaide, G.P.O. Box 498, Adelaide, S.A., 5001, Australia

The concept of naturalness is implicit in all attempts to assess the extent to which Australian ecosystems have been modified by 200 years of European settlement, as well as by 50,000 years of Aboriginal occupation. Natural ecosystems usually are defined as 'not modified by human influences' and are treated as the starting point in time and space for an ordinal sequence of ecosystems that differ with respect to a single continuous variable, degree of modification by human influences (or naturalness). The principles of disturbance ecology suggest that it would be more appropriate to group ecosystems into a number of nominal categories that reflect differences in kind of modification by the various agents of ecosystem change, including human influences, before attempting to measure degree of modification by any given agent or combination of agents. Such a classification is presented for terrestrial ecosystems in Australia and the advantages of this classification as a conceptual framework for studies of ecosystem modification are discussed.

1130 WEDNESDAY 31 AUGUST

THE IMPORTANCE OF INCLUDING CULTURAL RESOURCES IN ENVIRONMENTAL MANAGEMENT: TWO EXAMPLES FROM COASTAL WESTERN AUSTRALIA.

[1]Guy Wright and Kate Morse[2]

[1]Department of Anthropology, University of Western Australia, Nedlands, 6009
[2]Department of Anthropology, Western Australian Museum, Francis St., Perth, 6000

This paper amounts to a plea that environmental managers recognize human culture as integral to management philosophies and strategies. Two cases are presented from coastal Western Australia. In one, a complex and controversial environmental planning problem at the Abrolhos Islands was partially resolved through adequate consultation with user groups and the linking of anthropological and marine ecological expertise. In the second case, the low priority given to Aboriginal archaeological sites is diminishing the heritage and educational value of an otherwise first class marine park at North West Cape.

By outlining our experiences in trying to convince planners and managers of the need to include cultural resources in environmental planning, we hope to promote a view that human activities should be part and parcel of plans for preserving the integrity of ecological systems.

1150 WEDNESDAY 31 AUGUST

A CONSERVATION STUDY OF THE CENTRAL WESTERN REGION OF NSW 1815-1988

D.G. Goldney and I.J.S. Bowie

School of Applied Sciences, Mitchell CAE, Bathurst, N.S.W., 2795

A report on a conservation study of the Central Western Region of NSW has recently been submitted to the Commonwealth Heritage Commission. The region is one of the oldest and most disturbed people-dominated agricultural regions in Australia. The report

a) identifies the conservation status of faunal and floral species in the region
b) establishes the extent and pattern of remnant forest and woodland habitats and categorises the tenures and management status of these remnants and
c) locates and assesses the significance of over 800 non urban sites and areas with scenic and/or scientific importance.

The report provides a context within which these conservation significances can be understood by describing biophysical features of the region and the impact of people on them. Arising out of these considerations are a number of recommendations for development and conservation.

1210 WEDNESDAY 31 AUGUST

MANAGING NATURE MANAGEMENT

Richard McKellar

Environmental and Planning Consultant, Nannup, W.A., 6275

The successful management of natural areas or natural resources to maintain their conservation values requires the integration of three complex dynamic systems: the system to be managed (e.g. the natural system); the management system (e.g. the managing institution); and the socio-political environment.

Of these, the most easily manipulated to achieve good integration is the management system. It is important, therefore, that this system retain sufficient flexibility to allow for changes or inflexibility in the other systems.

1400 WEDNESDAY 31 AUGUST

LAND MANAGEMENT IN AUSTRALIA - PREPARING FOR THE THIRD CENTURY OF EUROPEAN OCCUPATION

Victor R. Squires

Faculty of Natural Resources, Roseworthy Agricultural College, Roseworthy, South Australia, 5371

Australia is one of the world's major producers and exporters of meat and food grains, but some regions are experiencing resource limitations related to water use and distribution and allocation. The land management problems to be faced in Australia into the third century of European settlement are likely to expand and intensify for agriculture. The long term future of Australia's agriculture is uncertain, especially if we follow the present course. The fundamental land management problem is the divergence between private and public interests. Short-term gains to private land users are frequently in conflict with long-term resource conservation, which is essentially a societal goal.

Three major issues have been identified as the most critical : the need to treat renewable resources as systems, to involve users in natural resource decision-making, and the need to sustain long-term productivity.

1440 WEDNESDAY 31 AUGUST

HABITAT MAPPING AND FAUNA PREDICTIVE MODELLING THROUGH THE INTEGRATION OF SATELLITE IMAGERY AND OTHER GEOGRAPHICAL INFORMATION

A.L. O'Neill[1], J. Hibberd[2], R. Sim[1] and J. Marthick[1]

[1]Geography Department, University of Wollongong, P.O. Box 1144, Wollongong, 2500

[2]South East Region, N.S.W. National Parks & Wildlife Service, P.O. Box 733, Queanbeyan, 2620

Driven by the need for accurate and changing information on vegetation, habitat and fauna distribution for conservation management, this paper describes some of the techniques that are being examined to integrate satellite imagery with other already existing data.

Climatic data, terrain variables and vegetation structure and floristics are the main data sources being used to predict fauna distribution. Together with the Thematic Mapper imagery received from the Landsat 5 satellite which has a 30 metre ground resolution and the SPOT satellite data with a resolution of 20 and 10 metres, this information is being used to develop predictive models for fauna distribution.

This work has major implications and potential benefits for the management of vegetation communities and native fauna by conservation authorities especially where there is a lack of detailed survey information.

1500 WEDNESDAY 31 AUGUST

HUMAN DISTURBANCE OF THE MURRAY FLOODPLAIN IN SOUTH AUSTRALIA

F.J. van der Sommen

Department of Land Resources Management, Roseworthy Agricultural College, Roseworthy, S.A., 5371

The spatial pattern, structure, vigour and composition of the dominant perennial vegetation of the mid River Murray floodplain in South Australia has been shown to be closely associated with the fluvial meander microrelief. Such an association occurs both with meander facets as well as meanders of varying age and the associated surface and subsurface hydrology. The complex meander system, resulting from ancestral and recent fluvial activity, has been digitised from coloured aerial photographs in ARCINFO and classified using PATN, a pattern analysis programme using geomorphic and macro vegetation attributes.

Cultural processes which have modified the natural state of floodplain vegetation have been examined. Grazing by stock and vermin has been isolated as the most significant factors in determining structure and composition of riparian vegetation. Ground water depth and quality changes resulting from catchment and stream perturbations have been found to have varying impact on vegetation vigour. The impact on foliar chloride concentrations in tree vegetation has been established. The implications of surface flow in streams and across floodplains are also examined and strategies for rectifying these are discussed.

1610 WEDNESDAY 31 AUGUST

NATURAL REGIONS OF WESTERN NEW SOUTH WALES

Gethin Morgan

'Pinnacle West', Bundarra Road, Armidale, 2350, Australia

Western New South Wales is classified into twelve natural regions. Each has a particular climate and geological origin, and other biophysical attributes, and hence has distinctive land use options, constraints and problems.

Natural regions provide a basis for understanding the way the Australian environment functions, and a framework for ecosystem research and land management. They provide a basis for determining trends in agricultural productivity, soil condition, species diversity and other indicators of change in Australian ecosystems.

Similar regional classifications are available for several other states, notably South Australia, but their significance and utility has not been clearly demonstrated. To illustrate a basic use, the conservation status of the ecosystems of Western New South Wales is determined using this regional classification. The National Park system is shown to be grossly deficient, with over 70% of western ecosystems unrepresented in existing conservation areas. The use of natural regions for determining regional land use objectives is outlined.

1610 WEDNESDAY 31 AUGUST

THE NUMBAT (MYRMECOBIUS FASCIATUS) : HISTORY OF DECLINE AND POTENTIAL FOR RECOVERY

J.A. Friend

Department of Conservation and Land Management, P.O. Box 51, Wanneroo, W.A., 6065

At the time of white settlement in Australia, numbats occurred across much of the southern half of the continent. Today populations are limited to a few areas of forest and woodland in south-western Australia. Even these passed through a period of decline during the 1970s, and the species became extinct in several isolated habitat remnants. At Dryandra Forest, there has been no evidence of food shortage, but selective poisoning of foxes has been followed by a substantial increase in numbats.

A programme of re-establishment of populations in areas of the numbat's former occurrence commenced in 1985. Animals either translocated from Dryandra Forest or released from a captive breeding colony have been used to restock a wheatbelt nature reserve where the species became extinct in the 1970s. Fox control has been carried out continuously, and breeding and establishment of young have occurred each year. Present indication are that the new population is viable. The potential now exists for translocations to further sites within the species' former range.

1550 WEDNESDAY 31 AUGUST

THE VALUE OF ROAD RESERVES TO BIRD COMMUNITIES IN THE W.A. WHEATBELT

P. Cale

260 Selby St., Floreat Park, W.A., 6014, Australia

An inevitable result of agricultural activities in an area, is the extensive fragmentation of the "natural" vegetation. In the Western Australian wheatbelt this has resulted in a new landscape consisting of large areas of generally inhospitable agricultural land, dotted with small remnants of "natural" vegetation, which are often connected by road reserve corridors.

The value of these road reserves to bird communities was investigated in 9 reserves, in the Western Australian wheatbelt near Kellerberrin, over a one year period. Over 65% of species found within the study region throughout the year, were recorded in these corridors, indicating that they are an important habitat resource for birds, at least for a part of each year. Four characteristics of the corridors: 1) corridor width, 2) corridor length, 3) vegetation structure, and 4) size of the connecting remnants; were investigated. Of these only vegetation structure and corridor width, were found to influence the species richness and stability of these bird communities.

Results of individual species are used to explain some of the findings in terms of dispersal and foraging patterns, and the significance of these findings to the management of vegetation corridors, for use by birds is discussed.

1550 WEDNESDAY 31 AUGUST

RECONSTRUCTION OF SOUTH AUSTRALIA'S ARID LANDS: THE CONSERVATION OPTION

B. Cohen

National Parks and Wildlife Service, Northern Region, P.O. Box 483, Port Augusta, S.A., 5700

South Australian government policy aims to create the world's largest network of arid lands national parks. Land holdings by the National Parks and Wildlife Service in the arid zone now total 5,874,019 hectares in 14 parks. These include arid montane associations in the Flinders and Gammon Ranges, gibber and mesa land systems of Witjira National Park, the Simpson Desert parallel sand dunes, the diverse vegetation associations of the Great Victoria Desert, and features such as Lake Eyre and Dalhousie Springs.

These impressive achievements in arid land conservation are not as straight-forward as they might seem. There is a trend away from conservation management based on the traditional national parks model and more of a move towards multiple use of reserves, albeit with conservation as the stated prime objective. These other uses of reserves include mineral and hydrocarbon exploration, mining, grazing, tourism developments and management for Aboriginal use. This paper documents the expansion in the arid parks system of S.A., takes a look at what is actually conserved and speculates on the future implications of these new trends for the conservation of South Australia's arid lands.

1630 WEDNESDAY 31 AUGUST

FACTORS AFFECTING SMALL MAMMAL DISTRIBUTION AND ABUNDANCE IN THE EASTERN OTWAYS. I. VEGETATION AND HISTORICAL FACTORS.

B.A. Wilson, D. Robertson, D.J. Moloney, G.R. Newell and W.S. Laidlaw

Biological Sciences, Deakin University, 3217, Victoria

The eastern Otway Ranges in southern Victoria is a diverse area containing 15 small mammal species and >690 vascular plant species. Activities such as clearing, logging and softwood planting have occurred since settlement. The wide range of vegetation communities include closed shrublands, coastal dry heathlands, woodlands, wet and dry sclerophyll forests. Significant small mammals are Pseudomys novaehollandiae, Antechinus minimus and Sminthopsis leucopus. The major factors affecting small mammal distribution and abundance are vegetation floristics and structure, fire and mining activities. A multivariate analysis of floristic data identified 11 different communities. The highest diversity of native small mammals occurred in low woodland and low open forest, and the highest mean abundance occurred in the sand dune community. Mus musculus, A. stuartii, Rattus fuscipes and R. lutreolus were the most widely distributed species occurring in 7-8 communities. In the sclerophyllous communities fire and infestation of Phytophthora cinnamomi were also identified as factors affecting diversity and abundance of small mammals. To protect the significant small mammal fauna management prescriptions will need to preserve vegetation communities, limit the spread of P. cinnamomi and resolve conflicting recreational uses.

1630 WEDNESDAY 31 AUGUST

IDENTIFYING THE NATIONAL ESTATE. ISSUES AND DIRECTIONS IN THE ASSESSMENT OF SIGNIFICANCE OF PLACES

M. O'Brien

Australian Heritage Commission, GPO Box 1567, Canberra, ACT, 2601

The Australian Heritage Commission is responsible for compiling the Register of the National Estate, that is, a listing of places which have "aesthetic, historic, scientific or social significance or other special value ...". To accomplish an authoritative Register, the criteria and the assessment process must address scientific, aesthetic and historic values in a manner which is sufficiently rigorous, while simultaneously reflects community concerns and values.

This paper discusses the major issues arising and gives an historical account of the development of the Commission's criteria and assessment methodology, including the intended path of future development. Recent work has underlined the necessity to separate clearly the concepts of "criteria" and "thresholds" and to separate the analysis step (scientific, aesthetic, historic and social) from the step of ascribing significance.

1650 WEDNESDAY 31 AUGUST

FACTORS AFFECTING SMALL MAMMAL DISTRIBUTION AND ABUNDANCE IN THE EASTERN OTWAYS. II. FIRE AND MINING.

D.J. Moloney, B.A. Wilson and K. Kentish

Biological Sciences, Deakin University, 3217, Victoria

Studies of small mammal recolonization after the 1983 "Ash Wednesday" wildfire have shown that all species present in the area before the fire (n=15) have been captured. However one species, Antechinus minimus, has not survived. Overall native species abundance was low for the first two years after the fire but increased in the third and fourth years. Mus musculus has a high abundance (>60/ha) from years 2-3 and then decreased rapidly. Survival of small mammals was greatest in partially burnt sites and expansion into regenerating burnt areas increased in the third and fourth year. Vegetation regeneration was extensive after three years; cover abundances of >75% were recorded at selected sites. Open-cut mining is another major disturbance factor. Small mammal populations and vegetation communities on revegetated areas have been studied and compared to nearby unmined areas. Five years after revegetation the diversity of plant species and % ground cover were lower than the unmined areas. There was no evidence of recolonization by six species of native small mammal occurring in adjacent heath woodlands. Mus was the only resident species. Future management initiatives should include fire regimes consistent with maintaining small mammal diversity and their habitat, maintenance of viable corridors and improved regeneration procedures after mining.

1650 WEDNESDAY 31 AUGUST

RESTORATION OF PLANT COMMUNITIES AFTER FIRE: CASE STUDIES OF BANKSIA-DOMINATED VEGETATION

Byron B. Lamont[1], R.M. Cowling[2], Neal J. Enright[3], Stephen M. Connell[1] and Stephen J. Bergl[1].

[1]School of Biology, Curtin University of Technology, Perth, 6001, Australia
[2]Dept. of Botany, University of Cape Town, Rondebosch 7700, South Africa
[3]Dept. of Geography, University of Auckland, New Zealand

Fire is a major management tool in Australia's sclerophyll vegetation. Collection of year-by-year data on seed production and mortality has been undertaken on a wide range of Banksia species in Western Australia. We can now predict the extent of release of viable seed given stand age and fire intensity. Seedling recruitment is less predictable, depending on the season of burn, herbivore activity and severity of drought. Modelling shows spatial and temporal variation in fire frequency helps to account for the high species richness of the region. Until the age-dependent pattern of responses to fire is understood, population decline and local extinctions through frequent wild or 'management' fires are inevitable.

0900 THURSDAY 1 SEPTEMBER

LAND RECLAMATION: WHEN WILL THE ANIMALS RETURN?

J.D. Majer

Curtin University of Technology, Box U1987, Perth, W.A., 6001, Australia

Land which has been degraded by mining, or some other transient land-use, is sometimes rehabilitated in an attempt to restore the original biota. Plant recolonization is often monitored at intervals of time after rehabilitation but the fauna is seldom looked at. This paper looks at the long-term (>10 years) patterns and rates of fauna return on rehabilitated land and investigates the prospects for complete restoration of the original animal community.

Factors which may influence the rate and pattern of animal return include the climatic and geographic regions in which the degraded area occurs, the complexity of the original vegetation, the intrinsic properties of the animal community and the nature of the plant succession. In addition, the size and remoteness of the degraded area, whether fertilizer is applied or not, and the post-disturbance land-use all have an important influence on the rate and pattern of the animal community's succession.

0920 THURSDAY 1 SEPTEMBER

TWO HUNDRED YEARS OF DISTURBANCE : HOW HAS IT AIDED OUR UNDERSTANDING OF "SUCCESSION" IN AUSTRALIA?

Barry J. Fox

School of Biological Science, University of New South Wales, P.O. Box 1, Kensington, N.S.W., 2033

The impact of the European invasion of the Australian continent over the last two hundred years has produced many natural laboratories to examine the responses of natural systems to human disturbance. Response to exogenous disturbances such as mining, clearing or intensive grazing produce changes not encountered by the plants and animals in previous natural (endogenous) disturbances such as fire or grazing by native species. This paper reviews what has been learnt about succession from this Australian experience and examines how current research is contributing to an improved understanding of the mechanisms of succession. A 'habitat accommodation' model presents animal succession as a response to external changes in the continuing vegetation succession. Animals enter the succession when their specific habitat requirements are met and are replaced when conditions move outside their optimal range reducing their competitive ability. The existence of two components of the model, threshold levels in habitat requirements and the role of interspecific competition in the replacement of species, have both been demonstrated by transplants and manipulations in field experiments.

0940 THURSDAY 1 SEPTEMBER

SEED ECOLOGY IN RELATION TO RECLAMATION

D.T. Bell, S. Vlahos and S.M. Bellairs

Department of Botany, The University of Western Australia, Nedlands, W.A., 6009, Australia

Rehabilitation and reclamation of disturbed land in Western Australia is often accomplished, at least in part, through the transport of seed in topsoil and/or plant mulch. Seed storage in soils used to rehabilitate Darling Range bauxite mining spoils averages more that 700 per m^{-2}, but the species composition is limited. The potential contribution of bradysporous seed for bauxite reclamation at 7 seeds per m^{-2}, however, is so low as to be impractical. Bradysporous seed, however, provide a valuable source of plant individuals and species in gravel mining scar reclamation at Kulin (1121 seeds per m^{-2}) and for sand mining reclamation at Eneabba (305 seeds per m^{-2}).

Ecological principles of seed production, storage and germination in relation to mining rehabilitation are discussed.

1000 THURSDAY 1 SEPTEMBER

THE ROLE OF THE SEED BANK IN MINERAL SANDS REHABILITATION AT ENEABBA, W.A.

L.J. Carey and M. Jefferies

Associated Minerals Consolidated Limited, Eneabba, W.A., 6518

Mineral sands are being mined at the northern end of species rich Kwongan of world importance stretching from Mt Lesueur to Eneabba. The mine site at Eneabba is located approximately 270 km north of Perth in the Irwin District of the South West Botanical Province.

Areas disturbed for mining are rehabilitated progressively with the aim of regenerating the species rich ecosystem. Species return is accomplished from returned topsoil, mulch, sown native seed and nursery stock.

Investigations providing information for the management of the seed bank in this complex ecosystem will be discussed. Data on the response of the native species to the techniques employed will be presented.

1020 THURSDAY 1 SEPTEMBER

WEED MANAGEMENT AND REVEGETATION PROGRAMS

F.D. Panetta[1] and R.H. Groves[2]

[1]Department of Agriculture, Baron-Hay Court, South Perth, W.A., 6151, Australia
[2]CSIRO Division of Plant Industry, GPO Box 1600, Canberra, A.C.T., 2601, Australia

The magnitude of weed problems encountered in rehabilitation projects is largely a function of the availability of plant propagules. Areas which have been mined represent an extreme case where there can be a good degree of control over the composition of the soil seed bank. On the other hand, when degraded pasture is converted to a community comprised of native species, annual and perennial weeds often regenerate densely from soil-stored seed.

Using examples from a wide range of Australian environments, we consider the approaches which have been adopted to reduce interference from weeds. These include methods of site preparation which depress short-term recruitment of weeds, the introduction of mixtures of short-lived and more longevous species, and the judicious use of herbicides.

1110 THURSDAY 1 SEPTEMBER

SELECTING TREES FOR SALTLAND RECLAMATION

P.G. van der Moezel and D.T. Bell

Department of Botany, The University of Western Australia, Nedlands, W.A., 6009, Australia

The salinisation of previously productive land in Australia has been brought about by excessive clearing of native deep-rooted plants. As a result, watertables have risen bringing previously deeply-stored salt to the surface. Planting trees in secondary salinised areas may be one option for lowering groundwater levels around saline scalds and seepages.

To select trees which can grow in saline and often waterlogged soil, seedlings of *Acacia*, *Casuarina*, *Eucalyptus* and *Melaleuca* species were grown in a glasshouse under four treatment conditions: 1) non-saline drained control, 2) saline drained, 3) non-saline waterlogged, and 4) saline waterlogged. Salinities were increased at weekly intervals of 700 mS m^{-1} until most plants had died. The individual seedlings surviving in salt waterlogging at the end of the experiment have been selected for micropropagation at Murdoch University and CSIRO, Canberra.

Relative tolerances of a range of species and provenances and the anatomical, morphological and physiological mechanisms relating to the salinity and waterlogging stresses are discussed.

1130 THURSDAY 1 SEPTEMBER

REHABILITATION AGRONOMY - TECHNIQUES FOR REVEGETATING DEGRADED LAND

C.V. Malcolm

Resource Management Division, Department of Agriculture, Baron-Hay Court, South Perth, W.A., 6151, Australia

Revegetation of degraded soil is made difficult by salinity, crusting, dispersion, infertility, instability and climatic factors. When degradation has proceeded beyond the threshold where recovery occurs readily by destocking, it is necessary to use ecologically based revegetation methods. Rehabilitation agronomy involves site characterisation, selection of adapted species and ecotypes and development of establishment methods and management strategies. Successful revegetation of saline agricultural land in W. Australia has resulted in erosion control, ecological site improvement and production of forage at an economic level. The same principles of plant selection and establishment are giving promising results on degraded pastoral land and mine dumps. Selection of species and ecotypes with superior establishment ability and engineering of establishment niches to meet plant criteria for germination and survival are keys to success. The work has involved especially chenopodiaceous shrubs (e.g. Atriplex and Maireana spp).

1150 THURSDAY 1 SEPTEMBER

RE-ESTABLISHMENT OF A FUNCTIONAL FOREST ECOSYSTEM FOLLOWING BAUXITE MINING IN THE DARLING RANGE, W.A.

S.C. Ward, J.M. Koch, O.G. Nichols

Alcoa of Australia Limited, P.O. Box 252, Applecross, W.A., 6153, Australia

Alcoa of Australia Ltd. has mined and rehabilitated in the Darling Range for over 20 years. The aim of the rehabilitation programme is to establish a functional forest ecosystem which meets the designated land use objectives for the area.

Current research programmes are investigating the processes of nutrient accumulation, nutrient cycling and floral and faunal succession. Where a legume understorey has been established, nutrient accumulation rates in the young developing system are high and the above ground nutrient pools approach those of the jarrah forest. Weight and nutrient content of annual litter fall is comparable to that in the jarrah and other Australian dry sclerophyll forests with the exception of nitrogen (N). The amount of litterfall N approaches that of Australian wet sclerophyll forests.

In newly rehabilitated sites, plant species numbers and diversity increase rapidly. After 3-5 years there is a levelling off in these parameters due to interspecific competition. As the early dominating species senesce (6-10 yrs), there is a slow invasion by other jarrah forest species. The initial dominance then senescence of pioneer legume species is similar to that seen in the jarrah forest following hot fires. →

Detailed faunal studies have demonstrated which rehabilitation techniques favour the return of communities similar to those occurring in the jarrah forest. These techniques have been incorporated into rehabilitation prescriptions.

An understanding of these ecological processes and what affects them allows informed decisions to be made on the use of management tools such as fire. This is essential if rehabilitation is to meet long term objectives.

1210 THURSDAY 1 SEPTEMBER

"GREENING" OF STEELPLANT SITES

S.C. Thompson[1] and S. Makin[2]

[1]BHP Central Research Laboratories, P.O. Box 188, Wallsend, N.S.W., 2287

[2]BHP Slab and Plate Products Division, P.O. Box 1854, Wollongong, N.S.W., 2500

The Broken Hill Proprietary Company is rehabilitating industrial land at its Port Kembla and Newcastle steelworks. The projects aim to create vegetation covers on solid waste emplacement areas and unused sections of steelplant land in order to improve the amenity of the sites, to reduce dust emissions and monitor fallout.

Research projects have been initiated to investigate methods of creating "urban forests" in areas influenced by industrial fallout and solid wastes. The studies are aimed, partly, at evaluating a range of Australian plants for their reaction to industrial environments. The tolerant species could then be used widely in rehabilitating steelplant sites while the susceptible species which are affected by fallout could be used in potentially sensitive areas to detect pollution. In addition, the research programs are studying methods of ameliorating waste materials so that they will support plant growth and perform as whole or part substitutes for soil.

Plants grown in a soil substitute should not be affected by the problems often encountered in growing plants in soil such as weed competition and the presence of pathogens.

1400 THURSDAY 1 SEPTEMBER

CONSERVATION OF GENETIC RESOURCES IN AUSTRALIA'S FLORA AND FAUNA

S.D. Hopper and D.J. Coates

Department of Conservation and Land Management, Wildlife Research Centre, P.O. Box 51, Wanneroo, W.A., 6065

Conservation of the genetic resources of the Australian flora and fauna is advocated as wise management aimed at maximizing the options available to future generations for utilization, study and appreciation of the continent's biodiversity. As a natural resource, the flora and fauna already contribute substantially to the national economy in forestry, the pastoral industry, fisheries, tourism, bee keeping, wildflower harvesting and the kangaroo trade. Moreover, the values of natural vegetation to agricultural and urban existence through ecosystem services such as the provision of clean air and pure water, climatic control, soil conservation and soil salinity control are becoming apparent. The potential of the Australian flora and fauna as sources of food and chemicals useful to man and as a teaching resource has scarcely been realized.

Effective conservation of genetic resources depends upon an adequate data base and a knowledge of the processes that control and sustain inherited variation. For most of Australia's plants and animals, taxonomic descriptions and geographical information will remain the only data base available for conservation initiatives over the next century. It is a matter of national priority that taxonomic research and teaching continue at an accelerated rate. The application of population genetic studies to conservation is very much a new field. In this paper, recent genetic information relevant to reserve design, minimum viable population size and endangered species management will be reviewed. Given the pace of ongoing destruction on native vegetation, the search for general principles in gene resource conservation from a limited sample of the Australian flora and fauna is the key scientific challenge facing workers over the next century.

1430 THURSDAY 1 SEPTEMBER

ECOPOLITICS: ECOLOGISTS AND THE BATTLE FOR THE EARTH

W. Hare

Australian Conservation Foundation, 672B Glenferrie Road, Hawthorne, Vic, 3122

The natural world is being radically transformed by the forces of industrial civilization. Our forests, woodlands, deserts, rivers, oceans and mountains are being destroyed or modified on a scale and at a rate unprecedented in ecological history.

In the 200 years of European settlement, Australia's environment has been radically altered. We have lost many plant and animal species, half of our forests are gone, river systems suffer from salinity and our rangelands have been badly degraded. Current economic plans for the future of Australia promise little respite.

Ecological scientists have played a fundamental role in alerting the world to the environmental consequences of industrialism and population growth. However, the mere accumulation of knowledge is not on its own sufficient to bring about the kind of reforms to industrialism needed for the viable future of our planet.

Ecologists have a special responsibility to become actively involved in the debates and decision making over the future of the earth. Too often the debate is left to the advocates of virtually unfettered industrialism ('development') on the one side and to environmental groups on the other. This is often a one-sided battle - the relatively small forces available to organisations like the ACF arraigned against coalitions of industrial corporations, unions, economists and government.

0900 FRIDAY 2 SEPTEMBER SESSION I OPEN FORUM

POPULATION CHANGES IN ARID-ZONE LIZARDS: WHERE HAVE ALL MY CTENOTUS GONE?

Craig James

Zoology A08, University of Sydney, N.S.W., 2006

A three year mark-recapture study of 7 species of Ctenotus (Scincidae) in a spinifex grassland near Alice Springs has revealed dramatic variations in the populations through time. Lizards were pit-trapped for a minimum of 6 weeks each spring and autumn resulting in 2719 captures and 1476 recaptures of Ctenotus. Population dynamics for the most common species (C. quattuordecimlineatus) which contributed 28% of the total captures, are presented.

There were significant year to year variations in the adult populations present on a sub-site and in the proportion of mature females that were reproductive. Following a season of high reproductive output there were large numbers of juvenile lizards but mature adults had disappeared and did not reappear for the remainder of the study (12 months).

The season of high reproductive output was probably due to above average rainfall in the preceding winter. The failure to recapture most of the marked adults after this successful reproductive season suggests that many of the adults have either died or become inactive deep underground.

0900 FRIDAY 2 SEPTEMBER SESSION II OPEN FORUM

WHAT IS "AVAILABLE" PHOSPHORUS IN FOREST ECOSYSTEM?

Mark Adams

Department of Botany, The University of Western Australia

Phosphorus cycling in many Australian forest ecosystems is strongly conservative. Eucalypts characteristically withdraw much of the P content of leaves during leaf senesence. Nevertheless the amount of P cycled through litterfall is considerable in relation to the P-demand. Little, if any, P is lost from forest ecosystems; the P shed in litter is largely re-utilized. Indices of available-P in soils are usually based on extractants designed to remove inorganic-P.

Such tests have been adopted ad hoc from agriculture for use with soils from natural ecosystems. It is not surprising that correlations between plant productivity and these indices are often poor. More recently the soil pool of labile organic-P has been suggested as important in P-cycling and as a possible index of P-availability.

Data are presented from a number of Victorian, Tasmanian and West Australian forests which demonstrate (i) the relatively poor suitability of inorganic-P extractants as indices of P-availability (ii) how measures of labile organic-P may be preferable indices of available-P and (iii) some of the constituents of the labile organic-P pool and how they may be involved in plant uptake.

1920 FRIDAY 2 SEPTEMBER SESSION I OPEN FORUM

INCREASED BASKING IN FEMALE SKINKS: REDUCING COSTS OF REPRODUCTION?

Lin Schwarzkopf, Zoology A08, University of Sydney, N.S.W., 2006

Pregnancy may be a costly or risky undertaking for a female because there is an increased drain on energy resources, and because pregnancy may increase vulnerability to predation. How can females reduce these costs? A laboratory experiment showed that increased daily basking periods can significantly shorten gestation period in female water skinks (Eulamprus tympanum cool temperate form). Hence, viviparous reptiles may be able to decrease gestation time (and thus, costs of reproduction) by basking more than other, non-reproductive members of the population. In the field, female water skinks bask in significantly greater proportions than males at all times of their activity season, except early spring. Mean temperatures during basking were not significantly different among males, non-pregnant females and pregnant females, and were similar to mean activity temperatures reported in the literature for this species ($\bar{x}$ = 30.1°C). These observations suggest that, whereas females bask more than males, the increase in basking is not due solely to pregnancy but to other factors which may be related to reproduction.

9020 FRIDAY 2 SEPTEMBER SESSION II OPEN FORUM

EFFECTS OF PRESCRIBED BURNING ON N-CYCLING AND TREE GROWTH IN A SNOWGUM FOREST

H. Keith

Ecosystem Dynamics Group, RSBS, ANU, GPO Box 475, Canberra, 2601

The effects of repeated prescribed burning in eucalypt forests on the distribution and availability of nutrients are being investigated. Specific components of the N-cycle are being measured to determine the effects of N supply on forest growth processes and the possible long-term effects of changing the soil nutrient status due to different fire management practices. A series of field treatments in a snowgum forest are being used to identify how occurrence and frequency of fire affects the availability of soil N and to induce a large change in the N supply by fertilizer addition.

Sequential soil sampling and in situ incubations have been used to measure temporal changes in the pool of soil mineral N and to calculate rates of N mineralization and uptake by the vegetation. The results show that a low-intensity, prescribed burn induces an immediate three-fold increase in Mineral N in the surface (0-5 cm) soil; this persists for several months. The long-unburnt plots have higher rates of mineralization and uptake than those frequently burnt. N fertilization resulted in elevated levels of soil mineral N and greatly increased rates of mineralization and uptake. The relationship between N availability, uptake and utilization is being investigated by measuring the growth rates and N contents of various biomass components of the trees. Increments of tree basal area were greater on the fertilized plots and shoot growth in the canopy was more vigorous during the 1987/88 growing season. The →

concentration of N is higher in leaf and twig samples from the canopy in the fertilized plots and lower in the frequently-burnt plots. Other growth processes being monitored include the growth of tagged branches in the canopy, gas exchange parameters of the leaves and the recycling of nutrients through litterfall.

0940 FRIDAY 2 SEPTEMBER SESSION I OPEN FORUM

BIOGEOGRAPHY OF THE REPTILES OF THE DAMPIER ARCHIPELAGO : DETERMINISTIC ASSEMBLAGES

Garry W. Connell

Zoology Department, University of Western Australia, Nedlands, W.A., 6009

Reptile populations were censused on 10 semi-arid tropical islands in the Dampier Archipelago. Stochastic processes were found to be unimportant in determining the pattern of community structure with the 19 recorded species having highly non-random distributions.

Multivariate analyses of 30 physical and biotic variables revealed deterministic factors explaining a significant amount of the observed variation in community attributes. Area is the best predictor of species richness, diversity and eveness. However due to the high degree of covariation between area and habitat variables, area per se lacks priority over habitat diversity as the major influence on community structure.

0940 FRIDAY 2 SEPTEMBER SESSION II OPEN FORUM

NUTRIENT CYCLING STUDIES IN WET TROPICAL RAINFOREST

R.A. Congdon, J.L. Herbohn and C. Maycock

Botany Department and Australian Centre for Tropical Freshwater Research, James Cook University of North Queensland, Townsville, Qld, 4811, Australia

This paper will present preliminary results of studies comparing water and nutrient cycling in unlogged rainforest and an adjoining gap created by logging some 25 years ago. Throughfall, stemflow, bulk precipitation, litterfall and streamflow are being measured. Little difference has been found in total litterfall between the two sites but significantly higher accession rates of nitrogen and phosphorus were found at the unlogged site, due to higher concentrations in reproductive structures. The greatest stemflow contributions have been found from trees of intermediate girth (DBH = 10 to 30 cm). Allometric regression techniques are being used to estimate biomass and nutrient standing stocks of gap species.

1000 FRIDAY 2 SEPTEMBER SESSION I OPEN FORUM

INFLUENCE OF PITFALL AND DRIFT-FENCE DESIGN ON CAPTURE RATES OF SMALL VERTEBRATES IN SEMI-ARID HABITATS OF WESTERN AUSTRALIA

Gordon R. Friend[1,3], Graeme T. Smith[2], David S. Mitchell[1] and Chris R. Dickman[3]

[1]Department of Conservation and Land Management, Wildlife Research Centre, P.O. Box 51, Wanneroo, W.A., 6065
[2]CSIRO Division of Wildlife and Ecology, LMB No. 4, P.O., Midland, W.A., 6056
[3]Zoology Department, University of Western Australia, Nedlands, W.A., 6009

The influence of several attributes of pitfall/drift fence design on capture rates of small vertebrates was examined over 12 months in semi-arid habitats of Western Australia. Large 28 cm diameter pits captured significantly more animals than smaller 16 cm diameter pits. Amongst taxonomic groups, large lizards and geckos showed highly significant biases for large pits, frogs, small lizards, and snakes and legless lizards less so, while small mammals were caught equally often in both sizes. All faunal groups except geckos showed significant response to increasing fence length, but the optimal length per pit remains unclear. Faunal groups showed a dichotomy in responses to temporary versus permanent drift fences. Independent fenced pits produced significantly higher capture rates than those in a conventional driftline. Variations in species responses to different design attributes probably reflect differing modes of behaviour and activity.

1000 FRIDAY 2 SEPTEMBER SESSION II OPEN FORUM

INFERENCES ON RARITY IN *EUCALYPTUS PALIFORMIS* FROM A PHYLOGENY OF THE GREEN ASH GROUP OF EUCALYPTS, ESTIMATED USING ALLOZYME DATA

S. Prober[1], J.C. Bell[2] and G. Moran[2]

[1]Ecosystem Dynamics, R.S.B.S., A.N.U., G.P.O. Box 475, Canberra, A.C.T., 2601
[2]C.S.I.R.O. Division of Forestry and Forest Products, P.O. Box 4008, Queen Victoria Terrace, Canberra, A.C.T., 2600

Eucalyptus paliformis is a microendemic in the mountains of south eastern Australia, with a geographic range of only 6 km^2. As part of a study on causes of rarity in this species, a phylogeny of the 'green ash' group of eucalypts, to which *E. paliformis* belongs, was constructed using allozyme data. The estimated phylogeny is largely in agreement with one derived for the same group from morphological characters (Ladiges, unpubl. data), and suggests that *E. palliformis* is a sister species to *E. kybeanensis*, a species which occurs in all of the known stands of *E. paliformis*. A long 'branch length' on the phylogenetic tree indicates a clear separation of *E. paliformis* from even its closest relative, and suggests that *E. paliformis* has a long history relative to other species in the group. It therefore seems unlikely that *E. paliformis* is a recently evolved species, with an expanding range. We conclude that *E. paliformis* is probably stable, possibly relictual, and confined to a particular habitat.

1020 FRIDAY 2 SEPTEMBER SESSION I OPEN FORUM

SEASONAL CHANGES IN AGGRESSIVENESS OF WHITE-CHEEKED AND NEW HOLLAND HONEYEATERS: ARE THEY RELATED TO CHANGES IN NECTAR AVAILABILITY?

Doug P. Armstrong

School of Biological Sciences (A08), University of Sydney, Sydney, N.S.W., 2006

In heathland near Sydney, male White-cheeked and New Holland Honeyeaters occupy territories throughout their breeding season, which extends from autumn through spring. Floral nectar, which is a major component of these birds' diets, is apparently superabundant during winter. During autumn and spring, however, nectar may be in short supply, and bird exclusion experiments indicate that birds deplete nectar at those times. In 1987, territorial males were far more aggressive in autumn and spring than in winter, suggesting that aggressiveness could be at least partially a response to competition for nectar. To test this possibility in 1988, I have been monitoring behaviour of territorial males with access to ad libitum sugar water feeders near but not within their territories. These males used feeders extensively during autumn, and very rarely visited flowers on their territories. Preliminary results suggest a pronounced drop in aggressiveness from autumn to winter, suggesting that seasonal changes in aggressiveness may be unrelated to changes in nectar availability.

1020 FRIDAY 2 SEPTEMBER SESSION II OPEN FORUM

PRINCIPLES AND METHODS FOR THE REGENERATION OF WESTERN AUSTRALIA'S RANGELANDS

B.H.R. Ward and R.A. Shepherd

Rangeland Management Branch, Department of Agriculture, Carnarvon Regional Office, P.O. Box 522, Carnarvon, W.A., 6701

Surveys indicate that more than one third of the Gascoyne and Murchison catchment areas are affected by moderate to severe degradation. In some of these areas, improvement in rangeland condition by natural processes can be achieved through changes in management practices. For extensive areas, however, regeneration will depend on two main principles. These are, to facilitate an increase in soil moisture by decreasing runoff and increasing infiltration and to reintroduce plant species for revegetation.

Research into methods of regeneration have shown that cultivation substantially increases water infiltration and moisture storage. Soil conditions are also improved through processes such as salt leaching. These factors lead to an improved environment for plant germination and survival.

Plant selection work has also indicated that several chenopod shrub species are adapted to regenerating on a wide range of soil types, whereas others seem capable of regenerating on specific soils. A large number of these species have been established on a range of degraded soils by direct seeding.

1110 FRIDAY 2 SEPTEMBER SESSION I OPEN FORUM

THE DUGONG IN SHARK BAY: EXPANDING KNOWLEDGE OF AN UNIQUE HERBIVORE NICHE

Paul K. Anderson

Department of Biological Sciences, University of Calgary, Canada and Department of Botany, University of Western Australia

Large concentrations of dugongs graze a Halodule-Penicillus community in eastern Shark Bay in summer. The methods and early results of an intensive study of the Dugong-Halodule interaction are described.

1110 FRIDAY 2 SEPTEMBER SESSION II OPEN FORUM

ASPECTS OF NITROGEN CYCLING IN TWO DOMINANT MACROALGAE; THE KELP (ECKLONIA RADIATA) AND SARGASSUM SP.

Eric I. Paling

Department of Botany and Centre for Water Research, The University of Western Australia, Nedlands, W.A., 6009

The dominant reef macroalga in the Perth nearshore region is the kelp (Ecklonia radiata). In summer, on shallower reefs (generally less than 2 m), another phaeophyte Sargassum is common. Most of their production enters the food chain via detrital pathways as particulate or dissolved organic matter. The influence of nitrogen on kelp growth has been examined to further understand the mechanisms of nitrogen cycling in the coastal ecosystem. Examination of the uptake characteristics of kelp have shown that there are no significant differences between the uptake of ammonium and nitrate. In addition it appears that the uptake of both forms of nitrogen is concentration dependent (i.e. a diffusive process). This suggests that whichever form of inorganic nitrogen is in greater concentration will be the one utilized for growth. Sargassum also shows this pattern. Results of these short term experiments are supported by long term growth studies on kelp.

1130 FRIDAY 2 SEPTEMBER SESSION I OPEN FORUM

INBREEDING AND COMPETITION: PROBLEMS FOR THE CONSERVATION OF MARSUPIALS ON OFFSHORE ISLANDS?

Chris R. Dickman and Antony, J. Lynam

Department of Zoology, The University of Western Australia, Nedlands, W.A., 6009, Australia

The dibbler, Parantechinus apicalis, is a rare dasyurid marsupial, almost extinct on mainland Australia but common on two small offshore islands. This study evaluates the conservation status of the island populations with respect to potential problems of inbreeding and competition from introduced mice, Mus musculus. The maximum population size of P. apicalis on the smaller island (5.4 ha) is ≅50; on the larger (25.9 ha) ≅200; both populations have been isolated from the mainland for ≅500 years. Inbreeding is suggested by reduced heterozygosity compared with mainland P. apicalis and by observations of incestuous matings. However, the populations show no consistent sign of morphological asymmetry, reduced fecundity or low juvenile survival and thus little evidence of inbreeding depression. Controlled removals of mice have not affected the P. apicalis populations, suggesting that competition is unimportant. The results show that P. apicalis is tolerant of inbreeding and invasion and emphasise the value of islands for conservation.

1130 FRIDAY 2 SEPTEMBER SESSION II OPEN FORUM

MACROALGAL SUCCESSION IN THE PEEL-HARVEY ESTUARINE SYSTEM

Paul Lavery

Department of Botany and Centre for Water Research, The University of Western Australia, Nedlands, W.A., 6009

Since the late 1960s, increasing levels of nitrogen and phosphorus have been entering the Peel-Harvey Estuarine system. As a result large blooms of macroalgae have occurred in Peel Inlet in nuisance proportions. In response to this problem long-term monitoring began in the late 1970s. Since then marked changes in macroalgal biomass, species composition and dominance have been recorded.

This presentation will discuss the changes in macroalgal biomass and species composition in the Peel-Harvey system between 1978-87.

Until 1978-79 Cladophora montagneana was the dominant macroalgae with standing crops approaching 50 000 t dry weight. By November 1979 however, only 5 000 t was present. Since that time Cladophora has never constituted a major component of the macroalgal biomass.

Following the decline of Cladophora, Chaetomorpha linum became the dominant alga with an estimated peak biomass of 30 000 t in 1980. By 1984 Ulva rigida was co-dominant with C. linum and Enteromorpha spp while during 1985 U. rigida became dominant. Since then C. linum has again become the dominant species.

1150 FRIDAY 2 SEPTEMBER SESSION I OPEN FORUM

NW COASTAL ISLANDS - MANAGEMENT OF A VALUABLE RESOURCE

K.D. Morris

Department of Conservation and Land Management, W.A. Wildlife Research Centre, P.O. Box 51, Wanneroo, W.A., 6065

Over 100 islands lie off the NW coast of Western Australia. Because of their significant conservation values many of these are nature reserves. These values include supporting population of mammals now extinct or rare on the mainland, providing nesting sites for seabirds and marine turtles, and supporting diverse and undisturbed floral assemblages. Some islands also have archeological and historic values. With the development of the iron ore and hydrocarbon industries in the Pilbara over the last 25 years many of the islands are now also valued for recreational activities and industrial purposes. The management of these islands by CALM is aimed at preserving their conservation values through a range of operational activities such as feral animal control, imposition of access and lease conditions on island users, and public education. These aspects will be discussed in this paper.

1150 FRIDAY 2 SEPTEMBER SESSION II OPEN FORUM

PATTERNS IN SPINIFEX GRASSLAND, GREAT SANDY DESERT

E.M. Goble-Garratt and D.T. Bell

Botany Department, University of Western Australia

Two scales of distribution pattern exhibited by the spinifex grasslands in the south-western Great Sandy Desert were analysed in a number of ways. Sandridge or dunefield vegetation has often been investigated in the context of the cyclic or repeating pattern in floristic composition from the crests to the swales of the dunes. Changes in species turnover have been recorded as forming a continuum or as being essentially discontinuous. A two phase pattern was evident in the area studied and this topographically-related floristic pattern remained consistent in newly burnt areas.

The spatial distribution of individuals in an ecological population may be classified as being random, clumped or regular. Regular spacing within plant populations has been cited as evidence of competition for a limited resource. In this study, microtopography, soil type and age were found to affect seedling establishment and growth patterns in the spinifex populations.

1210 FRIDAY 2 SEPTEMBER SESSION I OPEN FORUM

PREY HANDLING TIME AND PREY CAPTURE SUCCESS IN THREE SYMPATRIC SMALL DASYURIDS

M.C. Calver, J.S. Bradley and D.R. King

Regressions of handling time on prey weight were determined for the dasyurids Sminthopsis hirtipes, S. ooldea and Ningaui spp. preying on grasshoppers and cockroaches in the laboratory. In all cases, a simple linear regression fitted the relationships better than logarithmic models. The slopes of the regression lines were steeper for grasshopper prey than cockroach prey in all species, and for each prey type the slopes for the predators were ranked in order of predator weight. Capture efficiency, defined as the proportion of successful attacks, did not vary significantly between predator species and prey types, and all predators showed declining capture efficiencies with increasing prey size. Niche separation in these dasyurids does not appear to be based on different optimal prey sizes for each species.

1210 FRIDAY 2 SEPTEMBER SESSION II OPEN FORUM

RESPONSES OF NATIVE PLANTS TO HERBICIDES

J. Dodd and J.R. Peirce

Weed Science Branch, W.A., Department of Agriculture, Baron-Hay Court, South Perth, W.A., 6151, Australia

Thirty five species of native perennials from 22 families showed tolerance of herbicides (diuron, bromacil, ethidimuron, glyphosate, hexazinone, karbutiliate, picloram +2,4-D) used in trials on the control of plant regrowth along the vermin barrier fence. Ten were species of Myrtaceae, of which seven were melaleucas (M. adnata, M. cordata, M. lateriflora, M. scabra, M. sheathiana, M. uncinata and M. sp.). Of the remainder, four species were Chenopodiaceae (Maireana, 2 spp; Atriplex 2 spp), two were Goodeniaceae, while the rest were the sole representatives of their respective families. The presence of tolerant species would influence the future composition of regrowth treated with any of these herbicides. Some of the species might be of value for planting on roadsides and rehabilitation sites where herbicides are required for weed control. The herbicides that were most effective for controlling regrowth also damaged non-target species growing up to 40 m from the treated plots. Tree and mallee eucalypts were the most frequently damaged species. Several species of large shrubs, viz Acacia (2 spp), Allocasuarina (2 spp), Daviesia, Grevillea, Hakea and Melaleuca (1 sp each) were also affected. The causes and implications of this off-target damage will be discussed.

1400 FRIDAY 2 SEPTEMBER SESSION I OPEN FORUM

THE ROLE OF HARVESTER AND FORAGER TERMITES IN AN AUSTRALIAN SAVANNA

M. Hodda

Ecosystem Dynamics Group, RSBS, ANU, GPO Box 475, Canberra, 2061

The population of grass harvesting and litter foraging termites from an area within Kakadu National Park, Northern Territory, are described. The distribution of mound building harvesters and foragers is associated with broad vegetation types, the abundance of certain grasses and the presence or absence of feral buffalo. However, harvesters and foragers are influenced differently. Harvester termites and buffalo may be competing for forage during the dry season. A simple model of the ecosystem suggests that fire and termites may also be "competing" for grass material during the dry season. This may have important implications for the ecosystem because material consumed by termites can be recycled whereas burned material may be lost.

1400 FRIDAY 2 SEPTEMBER SESSION II OPEN FORUM

GEOGRAPHIC INFORMATION AND MODELLING SYSTEMS: THE PRACTITIONER'S PANECEA OR SCIENCE SEDUCED?

J.A. Beck

Curtin University of Technology, School of Computing Science, GPO Box U1987, Perth, 6001

Over the last decade, decision making practices of land managers have increased considerably in scope and complexity. For example, today's land manager is responsible lawfully for the consequences of his actions or inactions. To choose between alternative strategies, management ideally relies on science to predict the likely outcome of each strategy. The best of our current scientific knowledge and resource information must be available to managers in a form that they can interpret and apply, readily and correctly. Geographic Information and Modelling Systems can effectively bridge the communication gap between science and management.

Computerized Geographic Information and Modelling Systems have been developed in Australia to support the decision making processes of land resource managers. Many of these systems have been received with scepticism by the manager and scientist alike. Land managers are often critical of this "unfriendly" technology, and scientists often believe that the prediction and information bases of a system are inadequate. Systems and the management strategies thereof, can be developed specifically to overcome these problems.

1420 FRIDAY 2 SEPTEMBER SESSION I OPEN FORUM

PIPING OF TROPICAL EUCALYPTS BY TERMITES: PREDATION OR MUTUALISM?

Braithwaite, R.W.

CSIRO Division of Wildlife and Rangelands Research, Tropical Ecosystems Research Centre, Darwin, N.T., 5789, Australia

In tropical Australia, we examined D.H. Janzen's hypothesis that tree hollows are part of a mutualistic system for nutrient acquisition rather than the consequence of predation by xylophagous organisms opportunistically utilized by larger animal species. In Kakadu National Park, 7-60% of trees (>10 cm DBHOB) in different forest types had piped trunks. Consistent with Janzen's hypothesis, the incidence of piping was strongly negatively correlated with total soil phosphorus and nitrogen within and between vegetation types. Trees of Families Myrtaceae (particularly Eucalyptus spp.), Euphorbiacae and Caesalpiniaceae were most commonly piped. Most of the piping is done by the termite Coptotermes acinaciformis and the main nutrient contributors are birds: a treecreeper and six parrot species. The advantage of the putative mutualistic strategy outweighs the obvious disadvantages (c. 1% annual mortality due to fires felling trees by successively burning into fire scars; aggressive predation of trees by an uncommon species of termite), because the most common tree species are also the most piped.

1420 FRIDAY 2 SEPTEMBER SESSION II OPEN FORUM

COMPETITION AND POLLINATION

Robert J. Whelan and Ross L. Goldingay

Biology Department, University of Wollongong, Wollongong, N.S.W., 2500

Co-occurring, congeneric plant species may be expected to compete for the services of pollinators but the occurrence of interspecific competition in nature is difficult to detect. This study centered on four co-occurring Banksia species in eastern New South Wales. Three species were found to overlap substantially in flowering time and to share potential pollinators: mammals and honeyeaters. Pollinators were shown to be needed for fruit set in all species tested so far. Pollen-supplementation experiments demonstrated that all three species sometimes suffer pollen limitation of fruit set, so pollinators can be a limiting resource. For Banksia ericifolia (the species with the most abundant flowering), pollination appeared to be a limiting resource only once in four years - at the peak of flowering in the best flowering year. Circumstantial evidence suggests a competitive interaction between two species, Banksia spinulosa and B. ericifolia but a field experiment in 1987, removing all B. ericifolia inflorescences from replicated sites, produced equivocal results. Pollinator activity at B. spinulosa increased with the removal of the putative competitor but no increase in fruit set was detected.

1440 FRIDAY 2 SEPTEMBER SESSION I OPEN FORUM

THE EFFECTS OF NEIGHBOURING SPONGES ON THE RATES OF SEXUAL AND ASEXUAL REPRODUCTION IN A COLONIAL MARINE INVERTEBRATE

Laura Stocker

Zoology Department, University of Sydney, N.S.W., 2006

The effects of neighbouring sponges on rates of fission, fusion, and larval production in the subtidal colonial ascidian Didemnum moselyi were investigated. The study was done in 2-6 m of water in a kelp forest growing on a rocky subtidal reef in Port Jackson, Sydney. Didemnum moselyi forms colonies less than 10 mm diameter which are constantly undergoing fission and fusion. There are a number of models in the literature about colonial organisms from which different predictions can be made about rates of fusion and of asexual and sexual propagation, in circumstances where spatial resources are limited or various sources of mortality are present. Using direct experiment and histological analysis, I tested these predictions in relation to Didemnum and a species of sponge that commonly borders it.

1440 FRIDAY 2 SEPTEMBER SESSION II OPEN FORUM

THE EFFECT OF HERBIVORY ON THE DISTRIBUTION OF EUCALYPTUS PAUCIFLORA IN THE BRINDABELLA RANGE, SE AUSTRALIA

J.E. Williams

Ecosystem Dynamics Group, Research School of Biological Sciences, The Australian National University, G.P.O. Box 475, Canberra, A.C.T. 2601, Australia

This study addressed the hypothesis that herbivory plays an important role in controlling the lower altitudinal distribution of Eucalyptus pauciflora in the Brindabella Range, A.C.T. In this area E. pauciflora is replaced downslope by E. dives and E. dalrympleana occurs at low frequency in both communities. Data on the mean levels of leaf damage for the lignotuberous seedlings of these eucalypts were not consistent with this hypothesis. E. dalrympleana seedlings showed significantly lower levels of damage (7.4-9.4%) compared with the other species irrespective of altitude. There was no significant difference in mean levels of leaf damage between E. pauciflora (13.9-20.2%) and E. dives (19.2-20.7%). These results, amongst others, suggest that herbivory is unlikely to be an important factor influencing the distribution of E. pauciflora.

1500 FRIDAY 2 SEPTEMBER SESSION I OPEN FORUM

IMPROVING THE TARGET SPECIFICITY OF DINGO BAITING

M.C. Calver and Janet Gardner

External Studies, Murdoch University

The potential hazard of 1080 baiting for dingoes on 15 species of non-target mammals in the pastoral areas of Western Australia was assessed by comparing projected doses of 1080 (based on consumption of unpoisoned bait) with the minimum lethal dose of 1080 for each species. These figures suggested that 9 species were potentially at risk from factory baits, while only 4 species were potentially endangered by meat baits. The approach estimated hazard in a "worst possible case" scenario, eliminating the need to consider a plethora of complicating variables in other cases. Consequently, the assessments of risk made might prove excessive, but they are not conservative.

Further laboratory experiments with two native and two introduced species showed that individuals of all species reduced consumption of poisoned relative to unpoisoned bait, although in some cases this did not prevent animals from being poisoned fatally.

1500 FRIDAY 2 SEPTEMBER SESSION II OPEN FORUM

FIRE MANAGEMENT AND FIRE ECOLOGY : A MANAGER'S PERSPECTIVE

Noel Preece

Conservation Commission of the Northern Territory, P.O. Box 1046, Alice Springs, N.T.

A fire management manual for central Australian parks and reserves has been developed over the past four years. It arose from a need to set standards and provide guidelines for fire management in this part of the arid zone.

Problems encountered in the development of the manual included insufficient information on arid zone fire management, little appropriate management expertise, insufficient time availability, a rapidly evolving fire ecology scene for the arid zone of the N.T., and strongly divergent views on relevance of ecological information from other parts of the country.

Many of the practical problems have been overcome, but much more work needs to be done on fire ecology for the arid zone. The third and likely publishable edition of the manual will be finalised shortly.

The manual is apparently the only one of its kind for the arid and semi-arid zones of Australia. As such it is a starting point for professional fire management in the arid zone.

SYMPOSIUM POSTER

CREATION OF WETLANDS AFTER SAND MINING, CAPEL, WESTERN AUSTRALIA

Jane M. Chambers

Department of Botany and Centre for Water Research. The University of Western Australia, Nedlands, W.A. 6009

This project arose through the aim of the mining company Associated Minerals Consolidated to develop ponds, resulting from mineral sand mining, as wetlands supporting a diversity of waterbirds in essentially natural surroundings. These wetlands will be of interest to the general public and for further wetland research.

Preliminary investigations into the water quality of the ponds highlights four aspects which would limit the productivity of the system 1) variable and generally very low pH (∿4); 2) very high ammonia concentration (>50,000µg l^{-1} NH_4-N); 3) low concentrations of available phosphorus (0-15µg l^{-1} PO_4-P); and 4) relatively high concentrations of iron, manganese and sulphate.

Investigations are therefore being carried out into the effects of modifying the pH and adding phosphate to the water column, with the aim of defining conditions which will enable the ecosystem to support food webs. Intact cores from the ponds which contain both the water column and underlying sediment are being used to study phytoplankton growth, nutrient dynamics, and nutrient exchange between the water column and the sediment. The effect of pH and phosphorus addition on algal growth is being studied further in culture experiments, using treated water inoculated with an algal assemblage from the ponds.

SYMPOSIUM POSTER

SELECTION OF *ERAGROSTIS CURVULA* ECOTYPES FOR REVEGETATION OF DISTURBED AREAS IN SOUTH AFRICA

B.L. Dawson

PU-NTC Research Institute for Reclamation Ecology, P.O. Box 352, Brackenfell, 7560 ReP of South Africa

Accessions of the *Eragrostis curvula* complex were evaluated in an attempt to identify those more suitable for the revegetation of disturbed areas than the commercially available Ermelo variety.

The selection criteria included growth form attributes, performance aspects, as well as persistence. Accessions were ranked on the basis of the combined scores for each attribute. Forty eight of the eighty four accessions, primarily of the "*robusta*" and "*conferta*" types, proved to be superior to the Ermelo ("*curvula*" type) variety.

Six of the accessions, each representing a different morphological type within the *E. curvula* complex, were selected, and seed production and implementation is underway.

SYMPOSIUM POSTER

REHABILITATION OF ABANDONED ASBESTOS DUMPS IN SOUTHERN AFRICA

B.L. Dawson

PU-NTC Research Institute for Reclamation Ecology, P.O. Box 352, Brackenfell, 7560 ReP of South Africa

Asbestos waste dumps, abandoned in an un-rehabilitated state following early asbestos mining operations, are being revegetated using extra-ordinary measures due to the proximity of many of these dumps to rural populations with free-ranging domestic livestock.

The ability of the waste material to support vegetation is evaluated. The waste is covered with soil if necessary. A dense cover of suitable local indigenous species is then planted to prevent human and domestic stock access. Suitable species, having an impenetrable habit or forming a thick ground cover and unpalatable to domestic stock, are identified during surveys of natural colonisation of the dumps as well as of the adjacent natural vegetation.

Adjacent areas are chemically stabilised, and toe-dams constructed to impound run-off.

SYMPOSIUM POSTER

GERMINATION OF TWO SALT TOLERANT GRASSES FOR SALINE AREAS UNDER IRRIGATION

Bronwyn A. Myers, Wendy C. Morgan and David I. Couper

Institute for Irrigation and Salinity Research, Ferguson Road, Tatura, 3616, Victoria

In the irrigated areas of northern Victoria, approximately 90,000 ha of land is affected by salinity. The summer-active grass Diplachne fusca and the winter-active grass Puccinellia ciliata are salt-tolerant and have considerable agronomic potential. One of the major difficulties with the cultivation of these grasses is germination under saline conditions. Fresh seed of D. fusca exhibits dormancy which may be broken by dry storage for about 12 months or scarification. The temperature optima of the two species coincides with that typically experienced at the commencement of their growing seasons; 23 to 31°C for D. fusca and 21 to 26°C for P. ciliata. The decline in germination percentage with increasing salinity for both species was similar to that reported for many halophytic and glycophytic species; at the respective optimum temperatures for the two species, a 50% reduction occurred at an osmotic potential of about -0.5 MPa (6,000 ppm NaCl). For most saline sites, prior leaching with good quality water would be necessary to ensure successful establishment from seed.

SYMPOSIUM POSTER

POST-EUROPEAN VEGETATION CHANGE IN THE PILLIGA SCRUB

E.H. Norris

National Herbarium of New South Wales, Royal Botanic Gardens, Sydney, N.S.W., 2000, Australia

The state forests of the Pilliga Scrub comprise a mosaic of cypress pine, box, and ironbark forests and woodlands with a shrubby understorey, and broom plains dominated by Melaleuca uncinata. Prior to European settlement early reports indicate that the vegetation comprised an open woodland with a savannah understorey.

Post-settlement changes included the introduction of grazing animals and a reduction in burning of the forests. During the 1880s a change from cattle to sheep grazing, together with deliberate burning of the grasses, was combined with several years of severe drought. The following wet years saw a massive regeneration of cypress pine and other woody plants.

Several timber reserves had been declared before the turn of the century and by 1910, when most of the graziers had abandoned the area, further national forests were gazetted. The present day forests constitute the largest single mass of dedicated state forest remaining in N.S.W. and have existed in their present form for only a few decades.

OPEN FORUM POSTER

A PROPOSAL FOR THE DEVELOPMENT OF A GEOGRAPHIC INFORMATION AND MODELLING SYSTEM TO SUPPORT FIRE AND LAND MANAGEMENT IN WESTERN AUSTRALIA

J.A. Beck

Curtin University of Technology, School of Computing Science, GPO Box U1987, Perth, 6001

Many fire regimes, imposed and maintained artificially under current policies of the Department of Conservation and Land Management in Western Australia, have been criticized and questioned by conservationists, academics and the public. Concerns have arisen about potential ecological damage stemming from the prescribe burning activities of the Department. Alternatively, the Department considers prescribe burning a necessary practice to afford private, public and community assets protection from fire. The development of fire management strategies requires a basis that is ecologically sound while adhering to the financial constraints and legal obligations that are imposed upon today's land management practices.

Geographic Information and Modelling Systems available in eastern Australia are being evaluated currently for their application to support decision making, which is ecologically based, for land and fire management in WA. Several computerized installations of the "PREPLAN" concept, which was first conceived by the National Parks and Wildlife Service of New South Wales, will be demonstrated. The development of such a system for WA could facilitate the strategic planning of fire and land management regimes that consider explicity the potential damaging influence of management activities or wildfire, on flora and fauna conservation values, timber production values and other ecological or recreation values, without compromising the capacity of the Department to afford these resources protection.

OPEN FORUM POSTER

VERTEBRATE FAUNA OF THE DAMPIER ARCHIPELAGO

Garry W. Connell and Keith D. Morris

Department of Conservation and Land Management, W.A. Wildlife Research Centre, P.O. Box 51, Wanneroo, W.A., 6065

The Dampier Archipelago is comprised of a series of semi-arid tropical islands formed from partly inundated hills and ridges rising above the level of the submarine plain. The archipelago contains a diverse vertebrate fauna of 11 mammal, 92 bird, 37 terrestrial reptile, 4 marine turtle and 2 frog species. Thirty percent of the vertebrate species known from the Pilbara region occur on the islands.

The high species richness of the archipelago biota is due to the physical and habitat diversity, representative of the range country of the Pilbara, and the islands isolation from the mainland with subsequent lack of disturbance since european settlement.

OPEN FORUM POSTER

PIONEER SPECIES OF THE W.A. GOLDFIELDS

J.E.D. Fox, T.K. Bywaters and J.M. Osborne

School of Biology, Curtin University of Technology, G.P.O. Box U1987, Perth, W.A., 6001

The opportunity now exists to both restore and improve the land potential of disturbed semi-arid zones of Western Australia. In the W.A. goldfields, on overburden waste dumps, attainment of an early successful plant cover is a realistic rehabilitation objective.

This poster lists arid region pioneer species that are able to provide a good, cost effective, and low maintenance plant cover on the altered and often hostile disturbed surface materials. The choice of recoloniser species is based on local surveys and seed availability, combined with an assessment of the floristic spectrum of naturally occurring communities.

OPEN FORUM POSTER

STRUCTURE OF BATS GUILDS IN MANGROVES: ENVIRONMENTAL DISTURBANCES AND DETERMINISM

N.L. McKenzie and A.N. Start

Department of Conservation and Land Management, Wildlife Research Centre, PO Box 51, Wanneroo, W.A., 6065

We examined the species structure of assemblages to obligate insectivorous bats that forage in stands of mangrove. The potential foraging niche of each bat species was represented in terms of its flight morphology, and its realized foraging niche estimated from field observations of foraging microhabitats. Differences in flight morphologies of species could be related to their foraging microhabitats in the mangal.

Compared with random subsets drawn from the pool of potential colonizers, the bat assemblages observed in relatively stable mangrove stands had a deterministic structure; a single axis related to locomotor morphology accounted for the separation of all guild members. In contrast, bat assemblages in mangrove stands that are more subject to environmental disturbances had a less deterministic structure.

OPEN FORUM POSTER

STUDENT INVOLVEMENT IN HEATHLAND REHABILITATION: A CASE STUDY

J.M. Osborne and J.E.D. Fox

School of Biology, Curtin University of Technology, G.P.O., Box U1987, Perth, W.A., 6001

Applied rehabilitation studies on the northern sandplains (W.A.) mineral sand mining sites provide valuable avenues through which biology students are able to gain relevant, practical training. Moreover, the information resulting from the research benefits the sponsoring company, Associated Minerals Consolidated.

Undergraduate and postgraduate studies carried out at Eneabba (W.A.) since 1982 have encompassed many facets of rehabilitation including the following:

- seed quality testing, viability assessments, and presowing seed treatment trials
- field investigations establishing the influences of sowing times, burial depths and fertilizer rates on seedling establishment
- assessments of invertebrate and vertebrate recolonisation of a former sandmine, with unmined control site comparisons
- vegetative propagation glasshouse trials of heath species from Eneabba, including *Verticordia* and *Adenanthos* species
- nutrient amendment glasshouse trials for selected heathland *Banksia* species.

ABDULHADI	ROCHADI	MR	BOTANY DEPARTMENT	UNIVERSITY OF QUEENSLAND
ADAMS	MARK	DR	BOTANY DEPARTMENT	UNI.OF WESTERN AUSTRALIA
ADAMS	ROBYN	DR	DEPARTMENT OF SCIENCE	VICTORIA COLLEGE
ALBONE	PAUL	MR	C.A.L.M.	MT. PLEASANT
ALFORD	JENI	MISS	C.A.L.M.	WOODVALE
ALLAN	JOHN	MR	CANNING RESOURCES PTY LTD	WEST PERTH
ALTHAM	KEVIN	MR	GERALDTON MID-WEST	DEVELOPMENT AUTHORITY
ANDERSEN	ALAN	DR	WILDLIFE AND ECOLOGY	C.S.I.R.O. WINNELLIE
ANDERSON	PAUL	DR	BIOLOGICAL SCIENCES	UNIVERSITY OF CALGARY
ARMSTRONG	DOUG	MR	ZOOLOGY	UNIV. OF SYDNEY
ASHTON	DAVE	DR	BOTANY DEPARTMENT	MELBOURNE UNIVERSITY
ATKINS	LYN	MRS	WILDLIFE AND ECOLOGY	C.S.I.R.O. HELENA VALLEY
AULD	TONY	DR	N.P.W.S.	N.S.W.
BAKER	LYNN	MS	A.N.P.W.S.	YULARA
BALE	COLIN	DR	TECH. & FURTHER EDUCATION	ARMIDALE N.S.W
BARSON	MICHELE	DR	BUREAU OF RURAL RESOURCES	DEPT. OF PRIMARY INDUSTR
BAYNES	ALEX	DR	PALAENTOLOGY DEPT	W.A. MUSEUM
BEARD	JOHN	DR	VEG. SURVEY OF W.A.	APPLECROSS
BEARD	PAMELA	MRS		APPLECROSS
BECK	JUDI	MS	COMPUTING SCIENCE	CURTIN UNIVERSITY
BEESTON	GREG	MR	DEPARTMENT OF AGRICULTURE	WESTERN AUSTRALIA
BELL	DAVID	DR	BOTANY DEPARTMENT	UNI. OF WESTERN AUSTRALI
BELLAIRS	SEAN	MR	BOTANY DEPARTMENT	UNI. OF WESTERN AUSTRALI
BELLGARD	STAN	MR	C.A.L.M.	DWELLINGUP
BERRY	PADDY	DR	NATURAL SCIENCES	W.A. MUSEUM
BLUHDORN	DAVID	MR	A.E.S.	GRIFFITH UNIVERSITY
BLYTH	JOHN	MR	C.A.L.M.	CRAWLEY
BORNMAN	ANGELA	MS		BRIDGETOWN
BRAITHWAITE	DICK	DR	WILDLIFE AND ECOLOGY	C.S.I.R.O. WINNELLIE
BRIDGEWATER	PETER	DR	DEPT.OF ENVIRONMENT	CANBERRA
BROOKS	DENIS	MR	ASSOCIATED MINERALS CONS.	NEDLANDS
BROWN	SANDRA	PROF	DEPARTMENTOF FORESTRY	UNIVERSITY OF ILLINOIS
BURBIDGE	ALLAN	DR	C.A.L.M.	WOODVALE
BURKE	STEVEN	MR	CONS.FORESTS & LANDS	VICTORIA
BURROWS	NEIL	MR	C.A.L.M	WOODVALE
CALE	PETER	MR	ZOOLOGY DEPARTMENT	UNI.OF WESTERN AUSTRALIA
CALVER	MIKE	DR	EXTERNAL STUDIES	MURDOCH UNIVERSITY
CARDALE	SYLVIA	DR		MITCHELL COLLEGE
CARR	GEOFF	MR	ECOLOGICAL HORTICULTURE	VICTORIA
CAVANA	MATT	MR	C.A.L.M.	MT. PLEASANT
CHAMBERS	JANE	MS	BOTANY DEPARTMENT	UNI. OF WESTERN AUSTRALI
CLARK	ROBIN	DR	DIVISION OF WATER RES.	C.S.I.R.O. CANBERRA
CLAY	ROGER	DR	WILDLIFE & PARK MGMT.	S.A. COLLEGE
CLOUGH	PETER	MR	MINISTERIAL OFFICER	GERALDTON
COATES	DAVID	DR	C.A.L.M.	WOODVALE
COHEN	BERNICE	MS	N.P.W.S.	SOUTH AUSTRALIA
CONGDON	BOB	DR	BOTANY DEPARTMENT	JAMES COOK UNIVERSITY
CONNEL	GARY	MR	ZOOLOGY DEPARTMENT	UNI. OF WESTERN AUSTRAL
COWLING	RICHARD	DR	BOTANY DEPARTMENT	UNI. OF CAPETOWN S.AF
CURRY	PETER	MR	DEPARTMENT OF AGRICULTURE	WESTERN AUSTRALIA
DAVEY	STUART	MR	DEPARTMENT OF FORESTRY	A.N.U.
DAWSON	BRIAN	MR	RECLAMATION ECOLOGY	PU-NTC RES. INST. S.AF.
DE MUNK	FRED	MR	APPLIED SCIENCES	PHILLIP INSTITUTE
DELL	JOHN	MR	BIOGEOGRAPHY AND ECOLOGY	W.A. MUSEUM
DICKMAN	CHRIS	DR	ZOOLOGY DEPARTMENT	UNI. OF WESTERN AUSTRAL
DODD	JONATHAN	DR	DEPARTMENT OF AGRICULTURE	WESTERN AUSTRALIA
DOLVA	GUN	MS	ZOOLOGY DEPARTMENT	UNI. OF WESTERN AUSTRAL
FAIRWEATHER	PETER	DR	ENV. AND URBAN STUDIES	MACQUARIE UNIVERSITY
FOX	BARRY	DR	BIOLOGICAL SCIENCES	UNI. OF N.S.W.
FOX	MARILYN	DR	NATIONAL HERBARIUM	N.S.W.
FRIEDEL	MARGARET	DR	WILDLIFE AND ECOLOGY	C.S.I.R.O. ALICE SPRING

FRIEND	GORDON	DR	C.A.L.M.	WOODVALE
FRIEND	TONY	DR	C.A.L.M.	WOODVALE
FROEND	RAY	MR	BOTANY DEPARTMENT	UNI. OF WESTERN AUSTRAL
GARDENER	CHRIS	DR	TROPICAL CROPS & PASTURES	C.S.I.R.O. TOWNSVILLE
GILLEN	JAKE	MR	GEOGRAPHY	UNI.OF ADELAIDE
GOBLE-GARRATT	DINKY	MS	HERBARIUM	WESTERN AUSTRALIA
GOLDNEY	DAVID	DR	APPLIED SCIENCES	MITCHELL COLLEGE
GRIFFIN	TED	MR	E.A. GRIFFIN & ASSOC.	PERTH
GROVES	RICHARD	DR	PLANT INDUSTRY	C.S.I.R.O. CANBERRA
HALSE	STUART	DR	C.A.L.M.	WOODVALE
HARE	BILL	MR	A.C.F.	MELBOURNE
HARVEY	JUDITH	MS	C.A.L.M.	WOODVALE
HATCHER	BRUCE	DR	HATCHER RESEARCH ASSOC.	PERTH
HEYLIGERS	PETRUS	DR		CANBERRA
HIBBERD	JOHN	DR	N.P.W.S.	N.S.W
HILLMAN	KAREN	DR	BOTANY DEPARTMENT	UNI. OF WESTERN AUSTRAL
HOBBS	RICHARD	DR	WILDLIFE AND ECOLOGY	C.S.I.R.O. HELENA VALLE
HODDA	MIKE	MR	R.S.B.S.	A.N.U.
HOPKINS	ANGAS	MR	C.A.L.M.	WOODVALE
HOPPER	STEVE	DR	C.A.L.M.	WOODVALE
HOW	RIC	DR	BIOGEOGRAPHY AND ECOLOGY	W.A. MUSEUM
HOWELL	JOCELYN	MS	NATIONAL HERBARIUM	N.S.W.
HUMPHREYS	BILL	DR	BIOGEOGRAPHY AND ECOLOGY	W.A. MUSEUM
JAMES	CRAIG	MR	ZOOLOGY	UNIV. OF SYDNEY
JEFFERIES	MARK	MR	ASSOCIATED MINERALS CONS.	ENEABBA
JIANG	WANG GAO	MR	ZOOLOGY DEPARTMENT	YUNNAN UNIVERSITY CHIN/
JORDON	GREG	MR	BOTANY DEPARTMENT	UNI. OF TASMANIA
KEIGHERY	GREG	MR	C.A.L.M.	WOODVALE
KEITH	HEATHER	MS	R.S.B.S.	A.N.U.
KING	DENNIS	DR	A.P.B.	WESTERN AUSTRALIA
KINNEAR	ADRIANNE	DR	SCIENCE DEPARTMENT	W.A.C.A.E. CHURCHLANDS
KINNEAR	JACK	DR	C.A.L.M.	WOODVALE
KOCH	JOHN	DR	ENVIRONMENTAL DEPARTMENT	ALCOA
LADD	PHILIP	DR	BIOLOGY & ENV. SCIENCE	MURDOCH UNIVERSITY
LAIDLAW	SCOTT	MR	BIOLOGY AND HEALTH	DEAKIN UNIVERSITY
LAKE	SAM	DR	DEPARTMENT OF ZOOLOGY	MONASH UNIVERSITY
LAMONT	BYRON	DR	SCHOOL OF BIOLOGY	CURTIN UNIVERSITY
LANDSBERG	JILL	DR	FORESTRY & FOREST PROD.	C.S.I.R.O. CANBERRA
LAVERY	PAUL	MR	BOTANY DEPARTMENT	UNI. OF WESTERN AUSTRA
LESSLIE	ROB	MR	GEOGRAPHY	UNI. OF ADELAIDE
LINDSAY	DAVE	MR	HAMERSLEY IRON	PARABURDOO
LONGMORE	MAUREEN	DR	GEOGRAPHY	UNI. OF ADELAIDE
LUKATELICH	ROD	DR	BOTANY DEPARTMENT	UNI. OF WESTERN AUSTRA
MAIN	BARBARA	DR	ZOOLOGY DEPARTMENT	UNI. OF WESTERN AUSTRA
MAIN	BERT	PROF	ZOOLOGY DEPARTMENT	UNI. OF WESTERN AUSTRA
MAJER	JON	DR	SCHOOL OF BIOLOGY	CURTIN UNIVERSITY
MALCOLM	CLIVE	MR	DEPARTMENT OF AGRICULTURE	WESTERN AUSTRALIA
MASTERS	PIP	MS	ZOOLOGY	UNI. OF SYDNEY
MATTISKE	LIBBY	DR	E.M. MATTISKE & ASSOC.	KALAMUNDA
MATTISKE	TREVOR	MR		
MCCOMB	ARTHUR	A/PR	BOTANY DEPARTMENT	UNI. OF WESTERN AUSTRA
MCDOUGALL	KEITH	MR	N.P.W.S.	VICTORIA
MCKELLAR	RICHARD	MR	ENVIR.& PLANNING CONSULT.	NANNUP
MCKENZIE	NORM	MR	C.A.L.M.	WOODVALE
MCNAMARA	KEIRAN	MR	C.A.L.M.	CRAWLEY
MERCER	GEOFF	MR	C.A.L.M.	GERALDTON
MITCHELL	DAVID	MR	C.A.L.M.	WOODVALE
MOORE	ANDREW	MR	R.S.B.S.	A.N.U.
MORGAN	GETHIN	MR	LANDWATER MANAGEMENT	ARMIDALE
MORRIS	KEITH	MR	C.A.L.M.	WOODVALE
MORSE	KATE	MS	ANTHROPOLOGY	W.A. MUSEUM

MORTON	STEVE	DR	WILDLIFE AND ECOLOGY	C.S.I.R.O. ALICE SPRINGS
MUSTON	ROSLYN	DR	BIOLOGY	UNI. OF WOLLONGONG
MYERS	BRONWYN	DR	AGRIC. & RURAL AFFAIRS	IRIG. & SALIN. RESEARCH
NARDI	KIM	MR	C.A.L.M.	GERALDTON
NESBITT	BRADLEY	MR	A.N.P.W.S.	YULARA
NEWELL	GRAEME	MR	BIOLOGICAL SCIENCES	DEAKIN UNIVERSITY
NORBURY	GRANT	DR	A.P.B.	CARNARVON
NORRIS	LIZ	MS	NATIONAL HERBARIUM	N.S.W.
NORTON	TONY	DR	C.R.E.S.	A.N.U.
NULSEN	BOB	DR	DEPARTMENT OF AGRICULTURE	WESTERN AUSTRALIA
O'BRIEN	MICHAEL	DR	AUSTRALIAN HERITAGE COMM.	CANBERRA
O'NEILL	TONI	MS	GEOGRAPHY	UNI. OF WOLLONGONG
PALING	ERIC	MR	BOTANY DEPARTMENT	UNI. OF WESTERN AUSTRALI
PANETTA	DANE	DR	DEPARTMENT OF AGRICULTURE	WESTERN AUSTRALIA
PHILLIPS	PERDITA	MS	ENVIRONMENTAL SCIENCES	MURDOCH UNIVERSITY
PICKARD	JOHN	DR	WESTERN LANDS COMMISSION	N.S.W.
PREECE	NOEL	MR	C.C.N.T.	ALICE SPRINGS
PRINCE	BOB	DR	C.A.L.M.	WOODVALE
PROBER	SUZANNE	MS	R.S.B.S.	A.N.U.
RECHER	HARRY	DR	ECOSYSTEM MANAGEMENT	UNI. OF NEW ENGLAND
ROLFE	JIM	MR	C.A.L.M.	WOODVALE
SANDELL	PETER	MR	C.A.L.M.	MT. PLEASANT
SAUNDERS	DENIS	DR	WILDLIFE AND ECOLOGY	C.S.I.R.O. HELENA VALLEY
SCHWARZKOPH	LIN	MS	ZOOLOGY	UNI. OF SYDNEY
SHORT	JEFF	MR	WILDLIFE AND ECOLOGY	C.S.I.R.O. HELENA VALLEY
SIMMONS	DIANNE	DR	DEPARTMENT OF SCIENCE	VICTORIA COLLEGE
SLATYER	JUNE	MRS		CANBERRA
SLATYER	RALPH	PROF	R.S.B.S.	A.N.U.
SMITH	ADAM	MR	OLYMPIC DAM PROJECT	S.A.
SMITH	VANESSA	MS	C.A.L.M.	MT. PLEASANT
SQUIRES	VIC	DR	NATURAL RESOURCES	ROSEWORTHY AG. COLLEGE
STAFFORD-SMITH	MARK	DR	WILDLIFE AND ECOLOGY	C.S.I.R.O. ALICE SPRINGS
START	TONY	DR	C.A.L.M.	WOODVALE
STOCKER	LAURA	MS	ZOOLOGY	UNI. OF SYDNEY
TAYLOR	JAN	DR		DALKEITH
TAYLOR	JENNY	MS		UNI. OF SYDNEY
TAYLOR	SANDY	DR	GEOGRAPHY	UNI. OF ADELAIDE
THOMAS	LESLEY	MS		MURDOCH UNIVERSITY
THOMPSON	STUART	MR	CENTRAL RESEARCH LABS	B.H.P. WALLSEND
VAN DER MOEZEL	PAUL	DR	BOTANY DEPARTMENT	UNI. OF WESTERN AUSTRAL
VAN DER SOMMEN	FRANK	MR	LAND RESOURCES MANAGEMENT	ROSEWORTHY AG. COLLEGE
VAN OOSTERZEE	PENNY	MS	DESERT DISCOVERY	ALICE SPRINGS
VAN WYK	JACK	PROF	PU-NTC RESEARCH INST.	POTCHEFSTROON UNIV. S.A
WALLACE	KEN	MR	C.A.L.M.	NARROGIN
WALSH	FIONA	MS	BOTANY DEPARTMENT	UNI. OF WESTERN AUSTRAL
WARD	BRETT	MR	DEPARTMENT OF AGRICULTURE	CARNARVON
WARD	SAM	DR	ENVIRONMENTAL DEPARTMENT	ALCOA
WARDELL-JOHNSON	GRANT	MR	C.A.L.M.	MANJIMUP
WERREN	GARRY	MR	A.D.F.A.	UNI. COLL. UNI. N.S.W.
WHELAN	ROB	DR	BIOLOGY	UNI. OF WOLLONGONG
WILLIAMS	ANDY	MR	C.A.L.M.	WOODVALE
WILLIAMS	DICK	DR	BOTANY DEPARTMENT	MONASH UNIVERSITY
WILLIAMS	JANN	MS	R.S.B.S.	A.N.U.
WILLIAMSON	JIM	MR	C.A.L.M.	MT.PLEASANT
WILLS	RAY	MR	BOTANY DEPARTMENT	UNI. OF WESTERN AUSTRAL
WILSON	ALLAN	DR	WILDLIFE AND ECOLOGY	C.S.I.R.O. DENILIQUIN
WILSON	BARBARA	MS	BIOLOGICAL SCIENCES	DEAKIN UNIVERSITY
WILSON	BARRY	DR	C.A.L.M.	CRAWLEY
WILSON	CHRISTINE	MRS		DENILIQUIN
WILSON	ROD	MR	W.A.MUSEUM	GERALDTON
WOODS	BILL	MR	DEPARTMENT OF AGRICULTURE	WESTERN AUSTRALIA
WRIGHT	GUY	MR	ANTHROPOLOGY	UNI.OF WESTERN AUSTRAL