MANGROVES

Papers presented to a Workshop convened by
CSIRO Division of Land Resources Management
and WA Department of Conservation and Environment
and held at CSIRO, Floreat Park, WA, on
August 14, 1980.

WORKSHOP ON MANGROVES

On 14 August, 1980, a workshop held at the CSIRO Division of Land Resources Management aimed to bring together those studying or interested in mangrove ecosystems of Western Australia. The objective was to acquaint each other of current studies, to identify needs for further research, and to discuss means of working together to meet these needs.

Some thirty persons attended the meeting. Participants were invited to prepare a brief outline of their interests or research activities in this field.

Although no formal record was kept of the full and searching discussions, it was felt that the individual submissions together with the Rapporteur's Report, should be circulated as a record of what we believe has been a useful and important step towards a better understanding of a vital but highly vulnerable coastal resource.

FRANK HONEY
GRAHAM CHITTLEBOROUGH

CONVENERS

WORKSHOP ON MANGROVES - 14 AUGUST, 1980

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W.A. MANGROVE WORKSHOP - AUGUST 14, 1980

Rapporteur's Report

Perhaps the most pleasing results of this inaugural meeting of Western Australian mangrove workers were the realizations that not only a core of knowledge is currently available but that a sincere sense of cooperation has been established. The mangroves are recognised as important to the State from the engineering, biological and environmental aspects and perhaps the most significant physical factors in controlling the mangrove trees are the tidal regimes, the sedimentation (accretion or erosion) the ground water (fresh or salt) and the exposure to wave energy; it was also recognised that the adgacent areas in front of the mangroves (the tidal flats) and behind them (the salt flats) are in fact very important to the mangrove system.

Topics dealt with by the speakers or in the titles of the submitted notes included:

a) identification, distribution and community structure of the mangrove species
b) methods of conducting intensive and extensive surveys of the mangrove system (by Landsat, aerial photography or quadrat sampling on the ground).
c) sedimentation and hydrological-chemical processes in and around the mangroves
d) productivity of the mangroves (such as by blue green algae, or bacteria) and their value to nearshore coastal waters (to banana prawns or net fisheries)
e) taxonomy, distribution, zonation and abundance of animals associated with the mangroves (such as bats, birds, molluscs and crustacea)
and f) physical role of mangroves in the maintenance of shorelines, creeks and harbours and in the biological conservation of primary habitats for fauna and flora.

The control and management of mangroves in some other countries is quite stringent; for instance the U.S.A. has a "no loss" policy whereby reclaimed or damaged mangroves must be replaced by living mangrove stands of similar extent. As a result propagation studies of mangroves have provided information on growth and maintenance of mangroves. It appears that the influence of terrestrial inputs is as great or even greater than that from the sea; however the ultimate stability requires an understanding of both marine and terrestrial processes as well as the degree of interplay between them.

The use of Landsat by CSIRO in Western Australia to assess and identify the suggested 16 soil/landscape coastal units for the north coast should provide a much needed coastal classification. The hydrologic properties of these soil units varies widely from non-absorbent qualities (short term run-off flow across the coast) to absorbent structures that hold rainwater and slowly release it

to the coastal regions over a long period of time; these methods of fresh-ground water flows are most relevant to mangrove "health". The Western Australian mangroves are regarded as "arid mangroves" since they are largely backed by salt flats and lack the "wet mangrove" species of the Queensland coast (for instance).

Some of the more specific points to clearly emerge from the meeting were as follows:

1. Standard terminology should be adopted as soon as possible by all workers at this early stage of W.A. mangrove study.

2. The benthic molluscs and crustacea associated with mangroves clearly indicate vertical zones from the tidal flats in front of the mangroves to the salt marsh behind. Sediment size of the substrate and tidal height are correlated with these zones.

3. Nitrogen fixation occurs continuously via the bacteria within the fore flats and on mangrove roots and irregularly via blue green algae on the salt marshes behind; the blue green algae are dependent on fresh water and produce,after periods of rainfall, the highest productivity rates.

4. Evidence for an increase in the productivity of a mangrove-lined area is provided at Mangrove Bay, (west side of North West Cape) where the figures for biomass were highest in those transects closest to the narrow mouth of the bay; the parallel transects ran from the shore to the edge of the barrier reef.

5. Regions of development by man such as those along the Pilbara coast are clearly areas where research and data recording will continue to be needed to judge coastal changes, using the existing base line data that are being currently amassed by industry. The monitoring of changes (should they occur) is primarily motivated by engineering motives (siltation in harbours, barriers against storm surge in cyclones) and in the public interest.

6. Other important aspects of the coastal mangrove system are for fisheries (net and handline fishing and banana prawn nursery grounds are in the mangrove creeks) and as primary habitats for vertebrate animals (some species of birds and bats).

7. Integration of efforts and the synthesis of results obtained by the various research and industrial agencies can and should be encouraged; perhaps specific areas can be agreed to after the Landsat interpretation of the suggested 16 coastal landform units has been made.

R.W. GEORGE
2/9/1980

CLASSIFICATION AND KEY TO MANGROVE ASSOCIATIONS IN W.A., BROOME TO BUNBURY

P. B. Bridgewater

School of Environmental and Life Sciences
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HOW TO USE THE KEY

(1) Ensure that the area you are in is reasonably uniform (i.e. not a steep bank, which may be covered by a number of associations, and not an area obviously transitional).

(2) Working in an area of not less than 20 sq m, or more than 100 sq m, list the species present. The area can be square, circular or linear, depending on the landform. For example, along creeks the communities often occur in narrow bands, so there a linear strip of 20 x 1 m would be used.

(3) Once you have established the species present, the key can be utilised.

(4) Should the key not "work", it may mean you are in a transitional area, or an association not included in the classification. I would be pleased to hear details of any sites which do not "work".

KEY TO MANGROVE ASSOCIATIONS, BROOME TO BUNBURY

1) Avicennia marina present ... 2

" " absent ... 10

2) Aegiceras corniculatum present ... Aegricetetum

" " absent ... 3

3) Camptostemon schultzii present ... 4

" " absent ... 5

4) Both Ceriops tagal and Bruguiera exaristata present

... Ceriopo - Bruguieretum osbornietosum

neither or only one of the above species present.

... Camptostemo - Avicennietum

5) Ceriops tagal present ... 6

" " absent ... 7

6) Brugiera exaristata present ... Ceriopo - Bruguieretum camptotstemetosum

" " absent ... Avicennio - Ceriopetum

7) Sarcocornia quinqueflora present ... Avicennio - Sarcocornietum

" " absent ... 8

8) Rhizophora stylosa present ... Avicennio rhizophorietum

" " absent ... 9

9) Avicennia > 1 m high ... Avicennietum

" < 1 m high, Halosarcia halocnemoides present ... Halosarcio - Avicennietum

10) Ceriops tagal present ... 11

" " absent ... 12

11) Excoecaria agallocha present ... Ceriopetum excoecarietosum

" " absent ... Ceriopetum

12) Aegiceras corniculatum	present	...	Aegiceretum
Aegialitis annulata	present	...	Aegialitetum
Rhizophora stylosa	present	...	Rhizophoretum

CLASSIFICATION OF WESTERN AUSTRALIAN MANGROVE ASSOCIATIONS

1. Aegialitetum - Aegialition

   Identifying species - Aegialitis annulata

2. Aegiceretum - Aegicerion

   Identifying species - Aegiceras corniculatum

3. Rhizophoretum - Rhizophorion

   Identifying species - Rhizophora stylosa

4. Avicennio - Rhiziophoretum

   Identifying species - Avicennia marina
   - Rhizophora stylosa

5. Avicennietum

   Identifying species - Avicennia marina

6. Avicennio - Sarcocomietum - Avicennion

   Identifying species - Avicennia marina
   - Sarcocornia quinqueflora

7. Halosarcio - Avicennietum

   Identifying species - Halosarcia halocnemoides
   - Avicennia marina

8. Avicennio - Ceriopetum

   Identifying species - Avicennia marina
   - Ceriops tagal

9. Ceriopo - Bruguieretum

   Identifying species - Bruguiera exaristata
   Ceriops tagal
   Avicennia marina

   osbornietosum - Bruguierion

   Identifying species - Osbornia octodontata

   camptostemetosum

   Identifying species - Camptostemon schultzii

10. Camptostemo - Avicennietum

    Identifying species - Camptostemon schultzii
    Avicennia marina

11. Ceriopetum - Ceriopion

Identifying species - Ceriops tagal excoecarietosum

Identifying species - Excocecaria agallocha typicum

Ceriops tagal

AUSTRALIAN INSTITUTE OF MARINE SCIENCE

Townsville

Summary of programmes relating to mangroves

Coastal land forms and mangrove swamp stratigraphy

Objectives: To explain the origin and development of modern mangrove swamps in the Australian tropics.

Comments: During 1979, a coring programme was initiated in the mangrove swamps of Missionary Bay to explore their origins and character in recent geologic time and also to develop a better understanding of existing low-lying coastal land forms. This work now incorporates studies of dune stratigraphy and may be regarded as a long-term project. Survey information essential to the programme is provided by the staff of Commonwealth Survey Office.

The research described above is also providing information on sea level change in the GBR province. In a close link with AIMS, Dr. J. Chappell of A.N.U. is pursuing sea level work in the Princess Charlotte Bay area as well as in areas of the GBR. The investigations are long-term in nature.

Mangroves

Objectives: To establish and explain the range of expression of tidal forests in the Australasian region, to investigate their productivity and the manner in which this is influenced by environment and biological adaption, and to determine the processes which yield a supply of food to the dependent biota and the efficiency of their operation.

1. Vegetational analysis

   Research Personnel: Dr. J. Bunt, Dr. K. Boto, Dr. W. Williams (Consultant).

   Collaborations: Professor B. Tomlinson, Harvard; Dr. R. Primack, Boston U.; Dr. B.Jackes, JCU.; Dr. L. Webb, CSIRO; Department of Environment and Conservation, PNG; UNESCO.

   Comments: In tropical Queensland, a minimum of over 30 mangrove species are of common occurrence. The diversity of forest types is wide. Considerable advance has been made at AIMS in their characterization but a good deal of work remains to be done. This requires field study in a variety of estuaries on Cape York Peninsula as well as in the Gulf of Papua which is the likely immediate source of the mangroves of eastern Australia. Over the next three years, attention will be paid to the identification of the various

environmental characters which govern forest expression. The work will require attention to the taxonomy and biology of individual species for which current information is adequate. These investigations are seen as a point of departure for ecosystem studies encompassing the dependent biota. Topographic mapping and other ground and aerial surveys conducted for the programme by the Commonwealth Government Survey Office are pivotal to the work in ecology. Continued support is anticipated.

2. Primary Productivity

Research Personnel: Dr. T.J. Andrews, Dr. J. Bunt, Dr. K. Boto, Dr. B. Clough, Dr. W. Williams (Consultant).

Comments: Notwithstanding extensive measurements of litter fall in the mangroves of this region, accurate data on rates of net forest primary production are still lacking. A survey method for guiding estimates has been developed within AIMS and has proven useful but is considered less than adequate for incisive ecosystem analysis. Accordingly, attempts will be made over the coming few years to apply micrometeorological methods for obtaining more precise estimates of canopy photosynthesis. Litter fall studies will be continued with individual species since this approach has proven extremely useful in determining the manner in which photosynthate is apportioned among tissues such as leaves, flowers, reproductive parts, etc.

At the same time, it is planned also to make direct measurements of trunk growth and, if possible, to find an acceptable means of establishing rates of root production. The latter measurements must include the production of root exudates as well as root tissue.

Preliminary evidence indicates that soluble organics entering estuaries from mangrove substrates may be of considerable trophodynamic significance locally. Leaves and other large particulate litter, on the other hand, are subject to immediate tidal export. The fate of those materials and the manner in which they become available to dependent consumers requires investigation.

3. Mangrove Physiology

Research Personnel: Dr. T.J. Andrews, Dr. B. Clough

Collaborations: Dr. I. Cowan, Dr. G. Farquhar and Miss M. Kimball (A.N.U.); Dr. T. Steinke (U of Durban).

Comments: Early in the mangrove studies programme, work was undertaken for the development of a mobile gas exchange laboratory for the study *in situ* of mangrove photosynthetic physiology. Now complete and computer-operated, this system has been deployed in Missionary Bay where it has been applied principally in studies of *Rhizophora stylosa*, one of the most common mangrove species in northern Queensland. These investigations have been intrinsically important but also

valuable in identifying basic physiological and environmental controls on rates of primary production. The work will be continued with *R. stylosa* and other species and will depend on "glass house" studies as well as observations directly in the field. Limited attention has been paid to exploring the manner in which substrate temperature and salinity influence root metabolism and, in turn, the photosynthetic activities of the leaves. The gas exhange system offers excellent opportunities for collaborative research.

4. Sediment Chemistry

Research Personnel: Dr. K. Boto

Collaborations: Dr. W. Patrick and Dr. R. Buresh, Wetlands Research Labs, Louisiana State U.

Comments: Investigations of sediment chemistry are intimately related to and, in fact, an integral part of the overall mangrove ecology project. The studies are aimed at the chemical and also the physical characterization of mangrove sediments, and in particular, relate to the kinetics of cycling of primary nutrients influencing the growth of mangrove forests. The work is concentrated in Missionary Bay but also extends to estuaries along Cape York Peninsula where vegetational characterization is in progress. At present, emphasis is being given to the use of ^{15}N tracers in following the cycling of nitrogen. The studies are long-term in nature.

5. Mangrove trophodynamics

Research Personnel: Dr. I. Kneipp, AIMS Postdoctoral Fellow.

Collaboration: Dr. S. Simberloff, Florida State U.

Comments: Staffing restrictions have prevented full development of this important component of the mangrove ecosystem programme. Excellent opportunities exist for collaborative research. In this regard, Simberloff has made a preliminary but substantial study of the insect fauna of the mangrove canopy. The CSIRO Division of Entomology is examining his collection. Subsequently, Kneipp has bugun a study of the population biology and trophodynamics of sesarmid crabs in a programme which is expected to continue for two years. Attempts are being made to attract other investigators with interests in animal ecology.

GEOLOGICAL STUDIES IN MANGROVE ECOSYSTEMS

R.G. Brown Geology Department
University of Western Australia

Geological studies of sedimentary processes in mangrove ecosystems of Western Australia have been carried out in the Gascoyne River delta near Carnarvon, in Lake MacLeod, Exmouth Gulf, Port Hedland and in King Sound near Derby. Objectives of the studies have varied but most investigations have examined the biogenic influences of the mangrove ecosystems on sedimentation patterns and geochemical effects arising from groundwater processes. The investigations have specifically sought to identify elements of the ecosystem that generate skeletal detritus and those that create bioturbation in the sediment column. Most have attempted to determine the stratigraphic record of the environmental changes that preceded the present environmental patterns.

In the Gascoyne Delta, a Ph.D project by D.P. Johnson examined patterns of mangrove sedimentation and their relation to a red-bed deltaic sequence and a major carbonate-bank deposit. Elements of the mangrove biota were documented.

Associations between mangrove sedimentation and evaporitic sediments are being assessed in Lake MacLeod by B.W. Logan and associates. Development of evaporitic sediment in mangrove-related sediments at Exmouth Gulf formed a major part of an investigation of gypsum deposits by R.A. Caldwell. In both cases, groundwater characteristics have been a major target of the investigations.

Sedimentation studies in Exmouth Gulf by R.G. Brown and associates have included detailed investigations mainly in mangrove belts along the tidal flats around the southern end of the gulf. A comprehensive review of the stratigraphic distribution of mangrove-related sediment units formed part of an Honours project by N.J. Murray concentrated on biotic influences on sedimentation in Gales Bay. A summary of tidal-flat sedimentation in Giralia Bay by R.G. Brown formed the basis for a field excursion as part of the 25th International Geological Congress in 1976. Further work in Exmouth Gulf is planned for 1980-81.

A project on tidal flat sedimentation in King Sound by V.S. Semeniuk involved detailed studies of the mangrove ecosystem near Derby. Several aspects of the mangrove biota were documented and a pattern of environmental changes was established from the stratigraphic record.

Relevant papers and reports:

Brown, R.G., 1976, Tidal flat sedimentation and stratigraphy, Exmouth Gulf: Field Note Supplement 4 to *25th International Geological Congress Excursion Guide 37A*. 17pp.

Brown, R.G., 1977, Stratigraphic distribution of diagenetic features in mangrove tidal flats of Exmouth Gulf, W.A. *Abstr. 2nd Aust. Geol. Conv., Monash Univ.*, Geological Society of Australia.

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Caldwell, R.A., 1976, Holocene gypsum deposits of the Bullara Sunkland, Carnarvon Basin, Western Australia: Ph.D dissertation, Univ. of W.A., 123p.

Clifton, P., 1974, Tidal flat sedimentation and Pleistocene geology, The Bay of Rest, Exmouth Gulf, Western Australia: B.Sc. Hons thesis, Univ. of W.A., 64p.

Johnson, D.P., 1974, Sedimentation in the Gascoyne river delta: Ph.D dissertation, Univ. of W.A., 141p.

Logan, B.W., Brown, R.G., and Quilty, P.G., 1976, Carbonate Sediments of the West Coast of Western Australia. *25th International Geological Congress Excursion Guide 37A*, 99p.

Murray, N.J., 1976, Biotic Influences on Sedimentation, Gales Bay Tidal Flat, Exmouth Gulf, Western Australia: B.Sc. Hons. thesis, Univ. of W.A., 52p.

Semenium, V.S., 1978, Kenneally, K.F., and Wilson, P.G., 1978, Mangroves of Western Australia: West. Aust. Naturalists Club Handbook No. 12.

MANGROVES AND DEVELOPMENT

R.G. Chittleborough

Marine Studies Branch
Department of Conservation and Environment

Urban, industrial and port developments at times remove sections of mangrove communities. In some cases these are conscious decisions; other losses are from indirect effects. With increasing development on the northwest coast, decision makers are being faced increasingly with questions concerning the roles and values of mangroves.

How important are mangrove communities to present (and future) users of the coast?

Where development in a particular area necessitates the removal of mangroves, what proportion should be retained in order to sustain their benefits?

What long-term impact will a particular type of development have on adjacent mangrove communities?

Can better planning of a development avoid these indirect effects?

The newly formed Marine Studies Branch must consider such questions when advising government on environmental aspects of a particular development. Clearly the Branch cannot carry out studies of the breadth or depth needed to put these problems into proper perspective. Hence our interest in assessing what research is being carried out and what furthur inputs may be necessary.

SUMMARY OF RESEARCH CARRIED OUT IN MANGROVE SWAMPS OF TOWNSVILLE

Ms Toni Crossland

Department of Biology
Western Australian Institute of Technology

Nitrogen fixation in mangrove sediments assayed by the acetylene reduction technique.

Five sites in the mangrove swamp and adjacent salt marsh have been monitored over a period of four years for the following:-

(1) seasonal variation of N_2 fixation

(2) temperature (at three levels)

(3) salinity (soil and water)

(4) pH and rainfall

The sites are separated on the basis of soil type, vegetation cover and daily tidal influence. Some work has been carried out on mineral composition of the different soil types and isolation of the N_2 fixing organisms (bacteria and blue green algae).

Little emphasis has been placed on taxonomy of the mangroves although all plants in the five areas were identified.

INVENTORY OF AUSTRALIAN MANGROVES

Robert W. Galloway Division of Land Use Research
CSIRO, Canberra

In the course of a recently-completed inventory of Australian mangroves I noticed that they tend to cut out to the south where mean water temperatures at the warmest month are close to 22°C. I intend to investigate this relationship more closely and have several temperature recorders on order which will be established at appropriate sites in south eastern Australia. I have also collected some data from State Fishery Departments on inshore water temperatures as well as some information from colleagues in New Zealand and so far all points to about the figure I have in mind. My ultimate reason for investigation is to use fossil mangrove evidence (e.g. pollen from the continental shelf) as a guide to former water temperatures. I would be pleased if someone in W.A. showed an interest in taking part in my proposed study of water temperatures at the poleward limit of mangroves; I do not intend to extend my own observations beyond Ceduna in S.A.

Participants in the workshop may also be interested to know that I have been able to demonstrate that rings in Avicennia marina at Port Macquarie, N.S.W., are annual and I feel sure that the trees there are up to several centuries old. My interest in this topic arises from a belief that mangroves can be used as a guide to coastal evolution.

THE TAXONOMY, DISTRIBUTION AND ECOLOGY OF CRABS, PARTICULARLY THE FIDDLER CRABS (UCA) ASSOCIATED WITH WESTERN AUSTRALIAN MANGROVES AND ADJACENT SALT MARSHES.

R. W. George and D. S. Jones, Western Australian Museum, Perth.

Collections and observations from Shark Bay, Exmouth Gulf (a prime study area has been selected at the Bay of Rest), Onslow, Dampier, Cape Lambert, Port Hedland, Broome (another study area), Derby and Wyndham. Collections have also been extended into Northern Territory and Queensland.

A manuscript entitled "The Fiddler crabs (Uca) of Western Australia and Northern Territory" has been accepted for publication in the Records of the Western Australian Museum as a Supplement.

A manuscript giving the results of observations on sediment particle size and zonation of the 8 species of Ocypodid crabs in the Bay of Rest is being prepared for publication.

The zonation of crab species can be correlated with tidal height and a study is in progress to compare the effects of mesotidal ranges at the Bay of Rest (3.0 metre range) with that of macrotidal ranges at Broome (10.0 metre range).

Future Interests : To obtain an understanding of the ways in which :

a. the effects of wave, wind and tidal action control and sort the sediment particles;

b. the fresh water input to the mangrove system (either by run off or via ground water) is modified by the wave or tidal action; and

c. these environmental influences correlate with the observed vertical zonation and geographical distribution of the crabs associated with the mangrove and salt marsh systems.

CORRELATION OF DISTRIBUTION OF MANGROVES WITH COASTAL AND NEAR HINTERLAND MORPHOLOGY

F.R. Honey and E. Bettenay
CSIRO Division of Land Resources Management
Perth, West Australia

Mangroves are readily distinguished on Landsat imagery and with computer analysis of the Landsat data for several areas of the N.W. coast it has been shown that it is possible to discriminate the two major species Avicennia marina and Rhizophera stylosa. Areas which have been studied in detail using Landsat data include Exmouth Gulf, Port Hedland, Dampier and Cambridge Gulf. During these studies some associations between onshore and offshore coastal features, and the extent and type of mangroves were noted.

The project being commenced by LRM on the mangroves will attempt to establish any correlations between the presence of mangroves, speciation and the onshore and offshore features, including soils, landform, geology, drainage systems, area of salt marshes and slope of the nearshore sead bed. Much of this information can be extracted from existing soils and landforms maps (Atlas of Australian Soils), geological maps and Landsat imagery. As the information available from maps or extracted from Landsat is very broad, more detailed mapping will be necessary in some areas using aerial photography and transects through the mangrove belts and neighbouring areas.

Twenty areas of approximately 10 x 30 km have been selected on Landsat imagery between Exmouth Gulf and King Sound. The Landsat data for these areas will be analysed and maps prepared showing presence and major species of mangroves. The information on bathymetry will be extracted from available charts, or derived from the Landsat data. Information on onshore features will be extracted from existing maps, aerial photographs, or from ground traverses. Following extraction of the data, an attempt to determine any correlations will be made using canonical analysis..

The population dynamics of the Avicennia marina population at Bunbury, W.A.

Angas Hopkins, W.A. Wildlife Research Centre, P.O. Box 51, Wanneroo, W.A. 6065.

The two populations of Avicennia marina in the Leschenault Inlet are the southern most in Western Australia by over 500 km and are probably relectual. The inlet has been disturbed quite substantially in recent years by activities related to the new port development; these disturbances include the construction of a causeway across the mouth of the inlet through Anglesea Island. The remaining portion of Anglesea Island and the surrounding mudflats have been proposed for a Nature Reserve. If this reserve is created it will be necessary to understand the dynamics of the Aviennia population to establish a case for manipulation if necessary.

The island has been pegged on a grid system related to the Australian Map Grid and nine belt transects (10 m wide) have been marked out across it. All Avicennia individuals within seven of these transects have been numbered, measured (Girth at base, GBH and height of each stem, total number of stems and reproductive status of trees 1.2 m tall, plus diam. at base, height and number of leaf pans for seedlings). Sampling will be continued to completion later this year.

Data so collected will provide a measure of present population structure and will be a baseline for the assessment of change following future resampling.

The conservation of Major Plant Communities in Australia.

1. The Mangrove Communities.

Angas Hopkins W.A. Wildlife Research Centre, P.O. Box 51, Wanneroo, W.A. 6065.

Since the publication of the original report on plant conservation in Australia (Specht, Roe and Boughton, 1974. Aust. J. Bot. Suppl. No. 7), the CONCOM Working Group on Endangered Flora has undertaken to revise sections of this report using more up-to-date sources of information. The first report (Hartley and Leigh, 1979 Australian Plants at Risk. Aust. Nat. Pks. Wildl. Serv. Occ. Pap. No. 3) deals with the conservation status of species. This study is the first of a series on the conservation of plant communities.

Information is being compiled on:

1. The distribution of mangrove species in Australia using herbarium records, existing published and unpublished data.

2. The distribution of mangrove communities around the Australian coastline.

3. The reserves in each State containing mangroves, the approximate area of mangroves and the status of the reserve.

It is hoped to use this information to determine the following:

4. The adequacy of reservation of mangrove communities.

5. The general locations best suited for future reserves.

6. The locations of populations of mangrove species in need of special conservation attention.

Data are still being compiled.

SELECTION OF AERIAL PHOTOGRAPHIC TECHNIQUES FOR MANGROVE INVESTIGATIONS

Hugh Jones Environmental Superintendent
Mt. Newman Mining Co. Pty. Limited

Mt. Newman Mining Company has investigated a number of different aerial photographic techniques for use in evaluating mangrove stands in the Port Hedland area. The following is a resume of the historical progression through the various types of aerial photography with notes relating to the relative advantages and disadvantages in the techniques employed.

A study of the aerial photography originally done for the Port Hedland area prior to 1975 showed that the photography was usually taken at too high an altitude for detailed appraisal of the mangrove stands. It was decided in 1975 to fly at a lower level and the altitude eventually selected was 1,250' giving standard photography at the scale of 1:2,500. This scale was selected because it was felt that individual trees could be reasonably effectively identified while at the same time giving the aircraft sufficient altitude so that it would not be grossly effected by ground turbulence.

Three different types of photography were evaluated, namely black and white monochrome, ordinary coloured photography and infrared or false colour photography. Because of literature published on the use of infrared photography, this type of photography was selected and examples are displayed. Using this photography it was possible to differentiate between various mangrove species, to identify areas of dead mangroves and to identify any unvegetated areas.

This photography taken in August 1975 was flown late in the morning so that the sun angle would not produce an irregular infrared response. Unfortunately this also resulted in flying under near high tide conditions which in retrospect was a disadvantage.

The Company next flew the Port Hedland area for environmental purposes in May 1977 when ordinary colour photography was selected as the medium. This second set of photography was flown at the same altitude as the 1975 photography and on the same flight lines. It is possible to select photographs from those two sets of photography to produce sterographic pairs. This enables very easy comparison between aerial distribution of any specific features over that two year differential. The 1977 photography was flown under almost low tide conditions and this has resulted in considerably more data being available with regard creek erosion, root exposure, etc.

The true colour photography is easier to interpret to the casual observer than infrared photography and because of the very marked colour differential between the various mangrove species, it is just as easy to differentiate species distribution on the true colour as on the false colour. It is easier to differentiate between dead and non-dead trees on the infrared photography.

Among the practical advantages of using the ordinary colour photography are the avoidance of obtaining U.S. Defence Department permission to import the film from the United States, the avoidance from having to store the infrared film under ice and the avoidance of the inevitable extra cost involved in infrared photography.

Just after completing the 1977 colour photography it was decided to draw up a mosaic showing the distribution of the various plant communities. The technique eventually arrived at was to utilise alternative photographs in each run and join them together on a cloth backing, the photographs being suitably inscribed. In this way the advantages of the sterograph pairs is retained while it is easy to lay out a mosaic covering any part of the Port Hedland area.

During the flying of the 1977 photography, which was done as part of a multiple company aerial photography requirement, the contractor ran short of the correct film stock and as an interim arrangement, covered part of the area of 5,000' giving a scale as 1:10,000. The contractor then enlarged these individual prints to a scale of 1:2,500. These prints were almost as good in quality as the photography flown at 1,250' and as a result all future pnotography will be flown at 5,000' and enlarged in this manner thereby gaining a significant cost advantage.

At various stages we have experimented using oblique aerial photography and have found it excellent for qualitative assessments, particularly if twin cameras are used, one loaded with infrared and one with ordinary colour. However, the difficulties of exactly locating the photograph and more importantly of obtaining new idential photographic cover in successive years means that this type of photography is of limited value in quantitative assessments.

BATS OF MANGROVE COMMUNITIES IN W.A.

N.L. McKenzie W.A. Wildlife Research Centre
Department of Fisheries and Wildlife

AIMS: (i) Inventory the bats occurring in each main block of mangroves along the W.A. coastline.

(ii) By combining the results from blocks within each of the main biogeographical regions defined by Semeniuk et al., to recognise characteristic bat faunas.

(iii) By correlation of the environmental situation and observed behaviour of each bat species with the flight characteristics of its wings (aspect ratio calculations based on wing bone measures) to look at the species structure of bat communities in mangroves. In effect I am trying to separate the species within each such community in terms of ecological niche parameters related to differences in the functional requirements of their food hunting.

At least nine species of birds are restricted to mangrove communities - are there any W.A. bats so restricted? In the last four years as opportunity presented I have visited 16 of the main mangrove blocks between Cambridge and Exmouth Gulf in Western Australia. Of 17 bat species recorded so far in or over mangrove communities, 15 are also known to occur in terrestrial environments of adjacent regions of W.A., although one tropical species (Nyctophilus arnhemensis) ranges further south in mangal than it does in terrestrial environments. Two bat species (Tadarida loriae and Pipistrellus tenuis) are known only from mangrove communities and nearby coastal environments. However, both of these occupy terrestrial environments in very high rainfall areas elsewhere in Northern Australia (N.T. and Queensland).

There are about 750 bird species in Australia compared with about 60 bat species; bird habitat requirements can be expected to average more specific and specialised (narrower niches). One would expect bat habitat requirements to be more flexible and fewer, if any, species to be restricted to a single community of plants.

Monitoring by Cliffs Robe River Iron Associates

C. Morris — Environmental Officer
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Wapet House
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Cliffs Robe River Iron Associates have been actively engaged in monitoring the coastline, in the vicinity of Cape Lambert, as part of its overall environmental management programme.

Accordingly, paired sets of oblique photographs have been prepared, using colour and false colour infra-red film. An initial run was flown during 1977 along the vicinity of Cape Lambert coastline and repeated in 1979. Further runs are to be made in 1980/81.

A set of low tide colour and false colour infra-red mosaics of the Cape Lambert mangroves and coast have been prepared from runs flown in 1977.

Ground checks have been made based on anomalies recorded in photographs, and a continuous monitoring programme includes water acidity transects and other field surveys.

PILBARA MANGROVES AND INDUSTRIAL DEVELOPMENT

Chas. Nicholson, Environmental Officer,
DEPARTMENT OF CONSERVATION AND ENVIRONMENT

There is an urgent need to gather information on the Pilbara mangroves in order to plan development projects with minimal impact on the coastline and its immediate resources.

Unless carefully planned, the number and size of existing and proposed port and industrial developments along the Pilbara coast will make this the most stressed section of mangroves along our coasts.

The main concentrations of developments are in the Port Hedland and the Mermaid Sound-Nickol Bay regions, although there are already few areas to which people do not have access for recreation.

Port Hedland - Existing

- Mt. Newman Mining - iron ore
- Goldsworthy Mining - iron ore
- Leslie Salt - 6 Mile Creek, Beebingarra creek evaporators
- Port Hedland Port Authority - general shipping and harbour developments

- Potential

- Additional iron ore exporter
- Steel mill
- Naval facility
- Major thermal power station
- Petrochemicals

Cape Lambert - Existing

- Cliffs Robe River Iron Associates - iron ore and pellets

- Potential

- Additional iron ore exporter

Point Samson - Existing

- Commercial fishing base

- Potential

- Johns Creek Fishing Harbour

Dampier/Burrup Peninsula - Existing

- Hamersley Iron - iron ore and pellets
- Dampier Salt

- Potential

- NW Shelf Gas Project LNG and LPG (Woodside) under construction
- Steel mill
- Petrochemicals
- Additional LNG or general industrial usage and ports

Ronsard Island - Potential

- Iron ore export port

Dixon Island - Potential

- Iron ore export port
- Steel or chemical industries
- Major thermal power station (at Bougner Point)

Legendre Island - Potential

- Deep water port

Onslow - Existing

- Minor fishing and supply base Beadon Creek

Implications of such developments on the coastal and mangrove systems include:-

(1)	Mechanical effects	- drainage pattern alterations - landfill - causeways - dredging
(2)	Effluent effects	- bitterns disposal (salt evaporators) - cooling water discharges - chemicals - sediments and dust
(3)	People pressures	- recreational boating - net fishing and crabbing - rubbish dumping

Mangroves have several important roles in the Pilbara:-

(1)	Mechanical	- protection of coast from cyclonic storm surges and river floods, - sediment trapping to protect tidal channel banks, e.g. Port Hedland Harbour
(2)	Biological	- nutrients - habitat/shelter
(3)	Recreational	- fishing, crabbing
(4)	Aesthetic	- greenery in an otherwise parched land.

Against these, mangroves suffer the following disadvantages:

(1) Industrial planners tend to see mangroves and associated tidal flats near port sites as convenient landfill sites for creation of portside industrial land. The Pilbara Study (1974) plans for complete landfill of Port Hedland harbour mangals.

(2) Local authorities see mangroves as convenient rubbish tip sites, e.g. Port Hedland - Four Mile Creek.

(3) Some sections of the public regard mangroves as smelly sandfly infested swamps interfering with access to water based recreation, e.g. Cossack waterfront.

Recognising the value of mangrove systems, the Environmental Protection Authority recommended "that any further development, which might cause the destruction of mangroves, be subject to approval by and under the supervision of the EPA." (Conservation Reserves for Western Australia, 1975; recommendation 8.7.).

Research workers from both State and tertiary institutions could well coordinate their research with that being carried out by companies operating on the coast. This can be done by conducting research (a) in locations already or potentially subject to pressure (together with appropriate control locations), and (b) on mangrove stress agents such as the mechanical, effluent, or people pressures listed above. Such cooperation would be beneficial to both parties, leading to a better understanding of mangrove systems and aiding decision on industrial operations.

The Environmental Officer, Pilbara, is resident in the region and has some resources which may assist researchers:

- local knowledge
- local contacts
- coastal airphotos, Cape Preston to Spit Point 1:25,000 scale
- locations of mangroves under stress
- limited time for guided tours or adminstrative assistance in planning visits to the region.

Contact by writing: P.O. Box 276
KARRATHA 6714
telephoning: 091 852103
calling at: Room 10 PWD Building
Welcome Road
KARRATHA

MANGROVES - PRAWN FISHERIES

J. Penn Western Australian Marine Research Laboratories
Department of Fisheries and Wildlife

Mangroves are of interest and importance to Western Australian penaeid prawn fisheries in relation to Banana prawn nursery areas. Banana prawns (Penaeus merguiensis) are the only commercially significant prawns in W.A. that utilise mangrove tidal creeks for nursery areas. The area of interest is therefore from Onslow to Port Hedland and the Kimberley coast - with Nickol Bay being of major importance.

At present little penaeid research is being carried out in the mangrove areas, apart from a general interest in the Nickol Bay - Dampier fishery and its survival in the face of increasing industrial development in that area.

DISTRIBUTION OF MANGROVE MOLLUSCS IN WESTERN AUSTRALIA

F.E. Wells W.A. Museum

During the last four years I have been examining distributional features of molluscs in a variety of habitats in Western Australia, including mangroves. The work is aimed at understanding the mechanisms governing the distribution of molluscs on both large (10^3 km) and small scales (10^2 m). Two studies have been undertaken in mangroves in the Admiralty Gulf, Kimberleys, and the Bay of Rest, Exmouth Gulf. The Admiralty Gulf study relates the intertidal distribution of molluscs to zonation patterns of trees. The Bay of Rest study examines the distributions of the mudwhelks Terebralia sulcata and T. palustris in relation to shore height and sediment grain size.

Further work will be undertaken as time and funding permit.

Wells, F.E. (In press). A comparative study of the distributions of the mudwhelks Terebralia sulcata (Born) and T. palustris (Linnaeus) in a mangrove swamp in northwestern Australia. Malacol. Rev.

Wells, F.E. and Slack-Smith, S.M. (In press). Zonation of molluscs in a mangrove swamp in the Kimberley, Western Australia. Rec. West. Aust. Mus.