SOUTH COAST TERRESTRIAL AND MARINE RESERVE INTEGRATION STUDY

A collaborative project between CALM Marine Conservation Branch and South Coast Region

Project No: N713 - National Reserves System Cooperative Program
Environment Australia

BIOLOGICAL VERIFICATION OF THE MAJOR BENTHIC HABITATS OF THE SOUTH COAST (MONDRAIN ISLAND - ALBANY): 10-21 FEBRUARY 1997

Field Programme Report: MRIP/SC - 2/97

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- Mike Steber, DOLA Remote Sensing Applications Centre, Perth.
- Officers and crew of the STS Leeuwin.
- Participants in the Recherche Archipelago Eco-Adventure Voyage.

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SUMMARY

This report presents details of a field survey to be undertaken aboard the vessel STS Leeuwin, from 10-21 February 1997, to provide biological verification of the major benthic habitats for the nearshore waters of the south coast of Western Australia from Mondrain Island in the Recherche Archipelago to Albany.

This field survey is being carried out as part of the South Coast Terrestrial and Marine Reserve Integration Study, which is being coordinated by the Marine Conservation Branch (MCB) of the Department of Conservation and Land Management (CALM) as part of the MCB's Marine Reserve Implementation Programme (MRIP). The South Coast project is being conducted in collaboration with CALM's South Coast Region in Albany.

The objectives of the field survey are to provide additional data on major benthic community types and to improve the accuracy of habitat classification of the existing benthic habitat maps. The methods to be used will be the opportunistic collection of video footage of benthic communities and direct in-water observations of the visually dominant species. In addition, surface water temperatures will be recorded to coincide with NOAA-AVHRR satellite overpasses, to assist with ground-truthing of sea-surface temperature (SST) images. Surface seawater samples will also be taken twice daily and subsequently analysed for salinity after the survey.

Further details of the benthic communities in the area between Starvation Boat Harbour and Groper Bluff will assist in planning of the sampling methodology and selection of sampling sites for a systematic marine biological survey of the coastal waters adjacent to the Fitzgerald Biosphere Reserve, which will be carried out from 7-21 March 1997. These data will be an important contribution to the information base for proposed marine reserve areas along the south coast, identified in the Wilson Report, being compiled as part of the South Coast Terrestrial and Marine Reserve Integration Study.

1. INTRODUCTION

1.1 General background

This report presents details of a field survey to be undertaken aboard the vessel STS Leeuwin, from 10-21 February 1997, to provide biological verification of the major benthic habitats for the waters off the south coast of Western Australia from Mondrain Island in the Recherche Archipelago to Albany. This survey is being undertaken as part of one of the Leeuwin Ocean Adventure eco-tourism voyages.

The terrestrial environment of the south coast region of Western Australia is known to have exceptionally high conservation values and, in recognition of these natural attributes, the Western Australian Department of Conservation and Land Management (CALM) has established a system of terrestrial reserves along this coastline. By contrast little is known about the conservation values of the marine environment, although high levels of marine biodiversity and endemism has been reported from other parts of Australia's temperate marine environment (Edyvane, 1996).

A recently published statewide review of the marine environment of Western Australia, entitled "*A Representative Marine Reserve System for Western Australia* - Report of the Marine Parks and Reserves Selection Working Group, 1994" (CALM, 1994: known as the Wilson Report) identified a number of marine areas, offshore from existing terrestrial reserves, along the south coast that were considered as suitable candidates for possible incorporation into the state system of representative marine reserves (Figures 1,2 & 3).

Under the *New Horizons in Marine Management* strategy released in November 1994 (Appendix I), the State Government requires biological, economic, usage and cultural assessments to be made of areas to be considered for marine reserve status under the CALM Act before the Notice of Intent (NOI) is issued. This revised process has been designed to reduce the level of user concern normally resulting from the release of the NOI for public comment. The data layers provide the basic information for a consultative process resulting in the determination of preliminary boundaries and zonings so that current users have a clear appreciation of how the proposed marine reserve will affect their current and future activities from the outset.

The CALM Act (1984) allows for the establishment of multiple-use marine reserves for the purposes of conservation of marine flora and fauna and public recreation. Commercial activities, such as fishing, aquaculture and petroleum exploration and production, are also acceptable within specific zones of multiple-use marine reserves. Commercial and recreational fisheries in marine reserves are managed by the Fisheries Department. The CALM Act specifies the statutory process for the reservation of marine reserves, including a public planning process for the development of management zoning schemes that allow for the spatial separation of incompatible activities in a marine park. In anticipation of this process the major marine resources and current uses of areas recommended for reservation in the Wilson Report, are being identified and mapped in a Geographical Information System (GIS) by CALM's Marine Conservation Branch (MCB) as part of the Marine Reserve Implementation Programme (MRIP).

This field survey is being carried out as part of the South Coast Terrestrial and Marine Reserve Integration Study, funded by Environment Australia under the National Reserves System Cooperative Programme (Project No: N713), which is being conducted by the Marine Conservation Branch in collaboration with CALM's South Coast Region. The project will contribute to a regional classification of the proposed marine reserve areas along the south coast, identified in the Wilson Report, according to ecological, economic and cultural criteria. The project will also provide recommendations that will facilitate the integrated management of adjacent terrestrial and marine reserves and will ensure that the potential impacts of terrestrial and estuarine ecosystems upon their marine counterparts are understood prior to the creation of any marine reserves. Further information on the benthic communities in the area between Starvation Boat Harbour and Groper Bluff will assist in design of the sampling methodology and in the selection of sampling sites for a systematic marine biological survey of the coastal waters adjacent to the Fitzgerald Biosphere Reserve, which will be carried out from 7-21 March 1997.

In addition, surface seawater temperatures will be recorded to coincide with NOAA-AVHRR (Advanced Very High Resolution Radiometer) satellite overpasses, to assist with ground-truthing of sea-surface temperature (SST) images. Twice daily surface seawater samples will also be taken and analysed for salinity after the survey.

1.2 Objectives

The objectives of this field programme are as follows:

Primary objective

- To provide additional data on major benthic community types and to improve the accuracy of habitat classification of the existing benthic habitat maps.

Secondary objective

- The opportunistic collection of sea-surface temperature and salinity data to assist in the investigation of broad-scale oceanographic patterns along the south coast.

2. METHODS

Benthic habitat classification, compiled by Dr Hugh Kirkman, CSIRO Division of Fisheries and Oceanography, has been obtained for the south coast from Albany to the Recherche Archipelago. Full details of the mapping project are given in Appendix II. The relevant digital data sets has been sourced through the Coastal Resource Atlas at the Western Australian Department of Transport (DOT), and transferred to the marine GIS currently being established at the MCB office in Fremantle. Benthic habitat maps have been generated for the area being covered during this STS Leeuwin voyage.

To facilitate biological verification of these benthic habitat maps video footage of the major benthic community types (e.g. seagrass meadows, limestone reef etc.) and the visually dominant flora and fauna in coastal waters between Mondrain Island (34°08'S 122°14'E) in the Recherche Archipelago and Albany (35°03'S 117°53'E) will be opportunistically recorded using a manually deployed drop-down underwater camera system. The existing benthic habitat maps will serve as an indication of bottom type expected at any particular location. The video camera will be lowered over the side of the STS Leeuwin during periods when the vessel is stationary, sea-state and weather conditions permitting. Several minutes of video footage of the seabed will be recorded at each of these sites. Date, time and site number will be recorded on each section of footage, and water depth and GPS coordinates for the location will be recorded on the standardised habitat data sheets. Direct observations of habitat may also be made at shallower sites with divers on SCUBA or snorkelling. All habitat data and related observations will be recorded on the habitat data sheets. An example of a habitat data sheet and guidelines for completing these sheets are included as Appendix III. Operating instructions for the underwater camera system are included as Appendix IV.

At each of the video sites a sea-surface temperature measurement will be taken from a bucket sample using a digital thermometer (a standard scientific thermometer has also been supplied as a backup). These readings must be taken within 60 seconds of a bucket sample of seawater being brought onboard the vessel and the data will be recorded on the standardised salinity-temperature data sheets (Appendix V). In addition, two surface seawater bottled samples will be taken per day in clean glass sample bottles. The water samples will be taken at selected drop-down video sites and obtained by quickly filling a sample bottle from the bucket of seawater, and the bottle number will be recorded in the appropriate section of the salinity-temperature data sheet. The sample bottles and caps used to collect these salinity samples must be thoroughly pre-washed in sea-water from the site just prior to sampling. The salinity of these water samples will subsequently be analysed back in Perth.

Sea-surface temperature measurements will also be taken during the periods of NOAA-AVHRR satellite overpasses as an aid to interpretations of satellite imagery of sea-surface temperature and water colour signals which can be used as a proxy for broad-scale surface water circulation patterns. The times (Western Standard Time) at which NOAA-AVHRR satellites begin their passes over Western Australia have been obtained from the Department of Land Administration (Remote Sensing Applications Centre, contact Mr Mike Steber) and this information has been reproduced in Appendix VI (see column 6). The last column (i.e., Column 11) of the data sheets in Appendix VI shows the time that will be taken by the satellite to cover the entire area of Western Australia. Sea-surface temperature data will be collected during the period that the satellite passes over Western Australia. The physical data set will be forwarded to Mr Alan Pearce (CSIRO, Division of Oceanography) for use in the calibration of selected NOAA-AVHRR SST images.

3. EQUIPMENT

3.1 Underwater camera system

- Cunard Technologies (contact: Mr Mark Harris, tel: 09-458 4022 fax: 358 2105) Remote Monitoring Camera System, comprised of:
  - Camera control unit with colour monitor and VHS video recorder
  - 100m submersible umbilical
  - Colour camera unit (2)
  - Underwater light unit
- Operating instructions for camera system (Appendix IV).
- 180 min VHS video tapes (10).
- Habitat data sheets.
- CALM benthic habitat maps.

3.2 Sea-surface salinity-temperature measurements

- Digital LCD thermometer.
- Standard scientific thermometer.
- Salinity/temperature data sheets.
- Glass water sample bottles (20)

4. FIELD PROGRAMME

The field survey is planned to span a total of 10 days from 10-21 February 1997, as the STS Leeuwin sails between Esperance (departs 10 February), Mondrain Island in the Recherche Archipelago, and Albany (arrives 21 February). CALM personnel (Peter Collins, Kevin Ellard, Malcolm Grant and Alan Danks) will be joining the vessel for different days during this period. Opportunistic collection of video footage, benthic habitat observations and sea-surface salinity-temperature samples and measurements will be carried out whenever feasible at various locations governed by factors such as weather conditions and sea-state, the vessel's planned route and itinerary, other activities planned for the eco-adventure voyage and additional logistical considerations.

5. SAFETY

All safety procedures relating to navigation and associated vessel activities, and the personal safety of officers, crew and passengers of the STS Leeuwin during this field survey are the primary responsibility of the master of the vessel. Alterations to field procedures based on safety aspects related to weather conditions and sea-state are the responsibility of the master of the vessel. Decisions to modify the methods of the field survey will be made by the vessel's master in consultation with CALM officers onboard. CALM officers onboard the vessel during the field survey are responsible for ensuring that all field work undertaken by CALM staff, including CALM volunteers, is conducted according to CALM's departmental safety procedures and protocols.

6. REFERENCES

CALM, 1994. A Representative Marine Reserve System for Western Australia. Report of the Marine Parks and Reserves Selection Working Group. Department of Conservation and Land Management, Perth.

Edyvane,K. 1996. The role of marine protected areas in temperate ecosystem management. In: *Developing Australia's representative system of marine protected areas: Criteria and guidelines for identification and selection* (ed. R. Thackway). Proceedings of a technical meeting held at the South Australian Aquatic Sciences Centre, West Beach, Adelaide, 22-23 April 1996. Department of the Environment, Sport and Territories: Canberra.

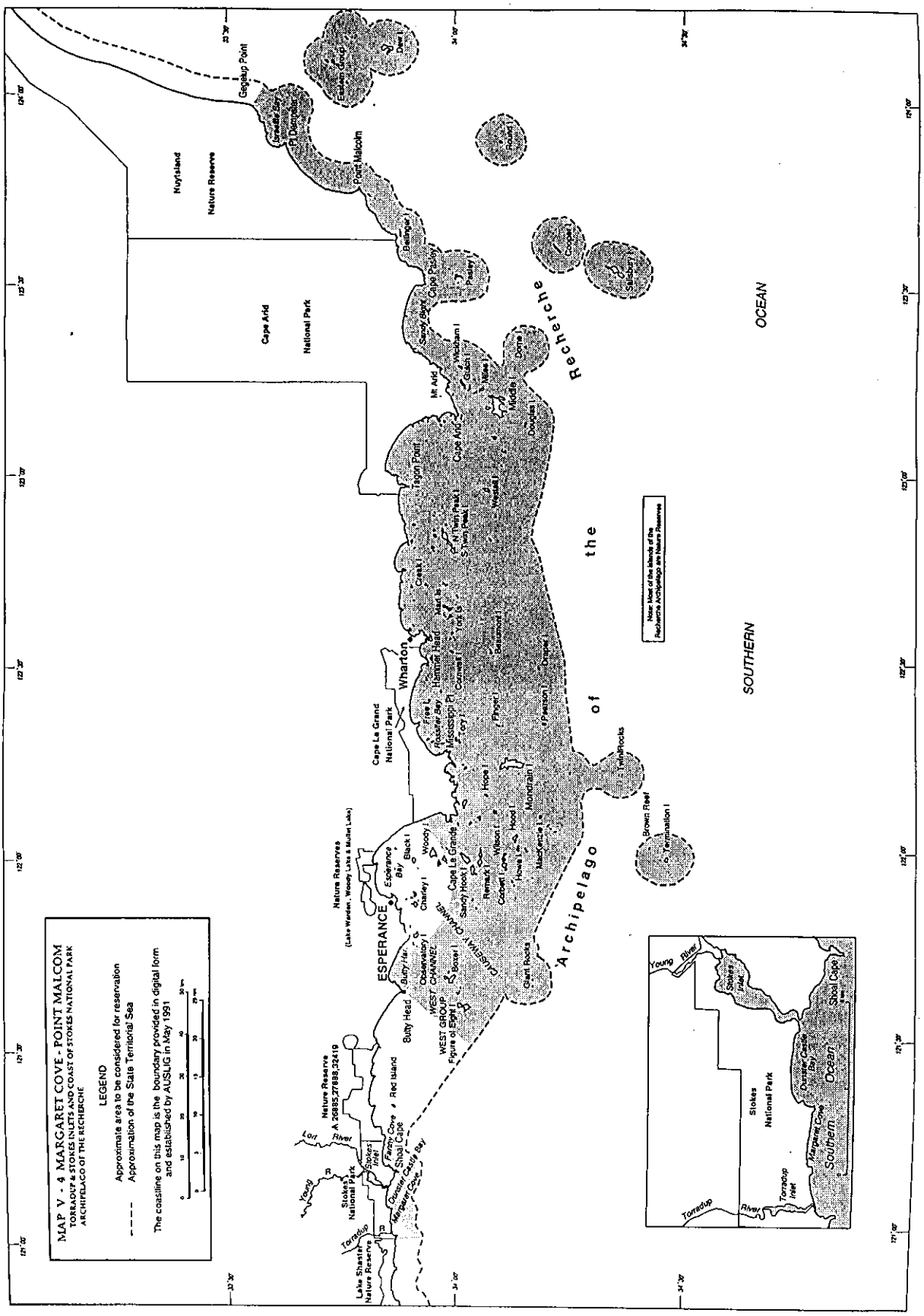


Figure 1: Proposed marine reserves in the Archipelago of the Recherche and adjacent to Stokes National Park

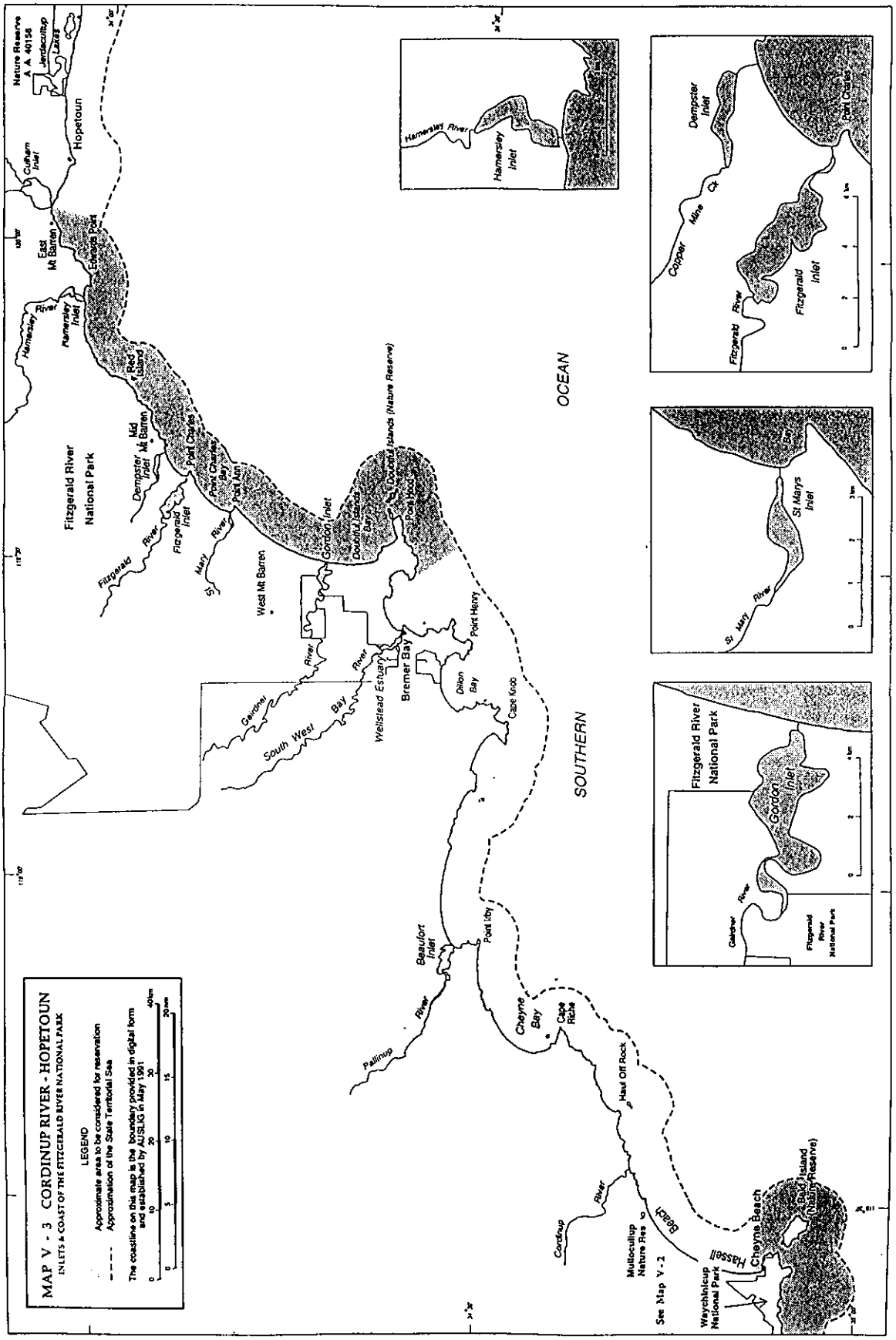


Figure 2: Proposed marine reserves adjacent to Fitzgerald River and Waychinicup National Parks.

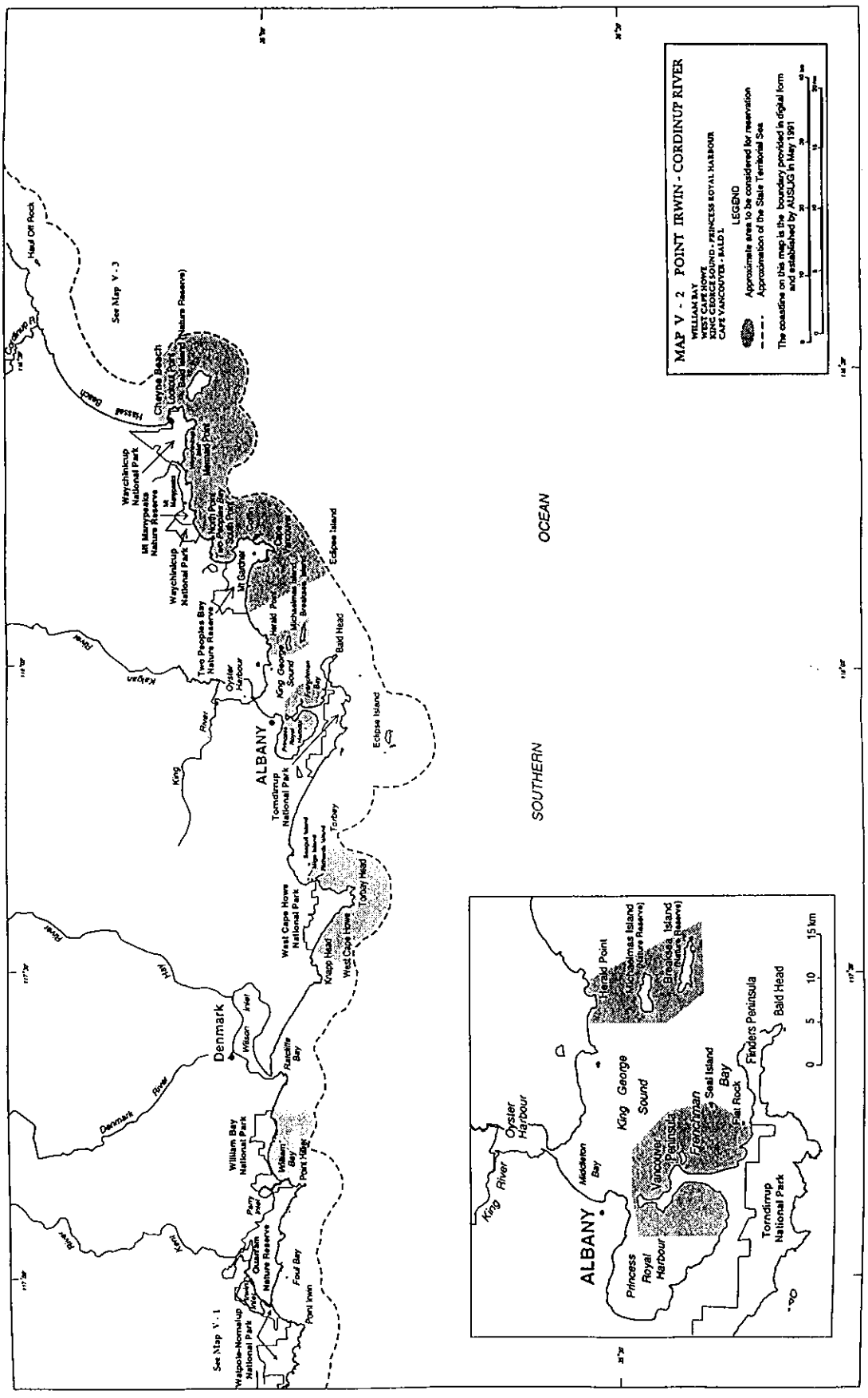


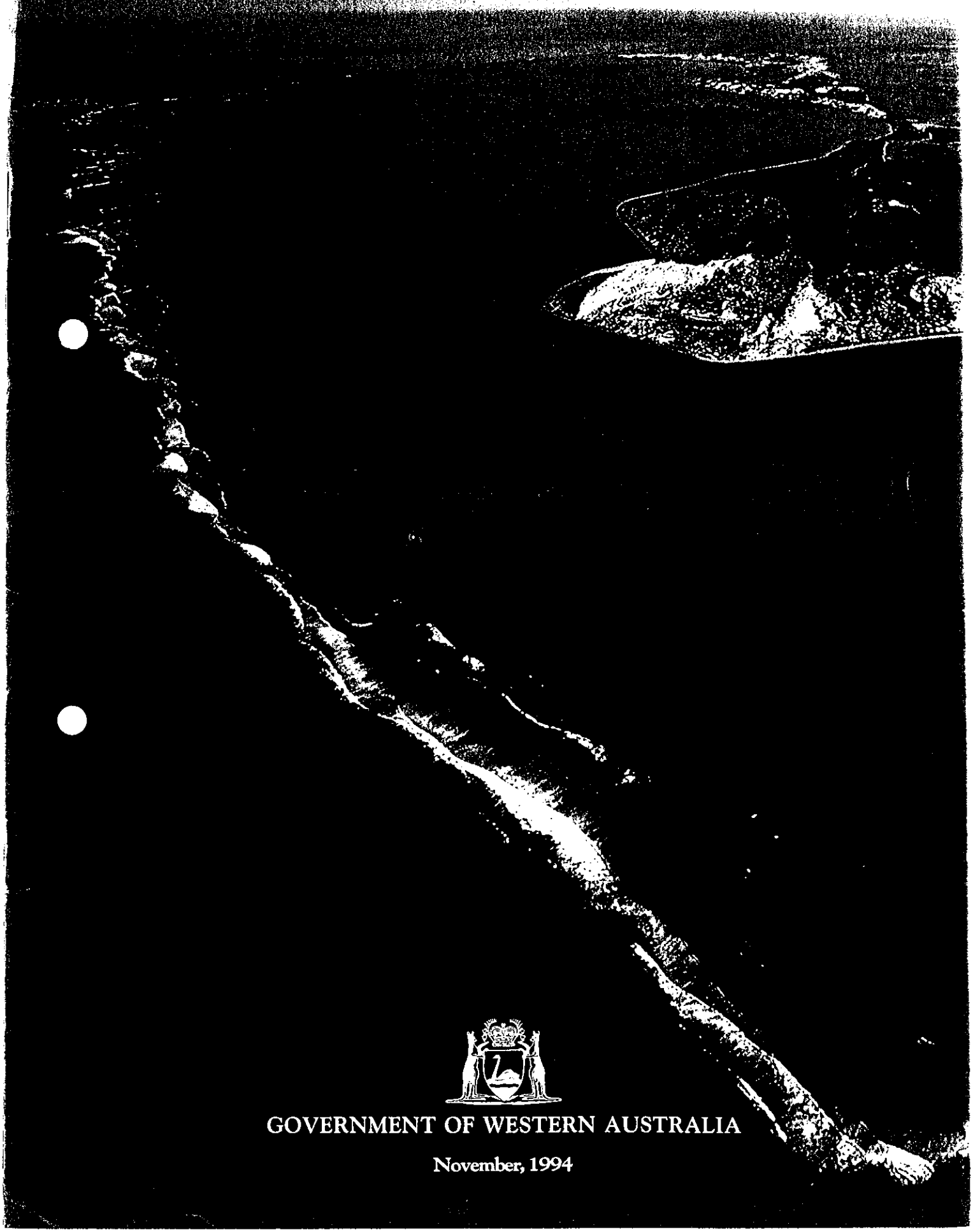
Figure 3: Proposed marine reserves along the coast from Cheyne Beach to Albany.

APPENDIX I

New Horizons in Marine Management Strategy Document

State Government of Western Australia.

NEW HORIZONS IN MARINE



GOVERNMENT OF WESTERN AUSTRALIA

November, 1994

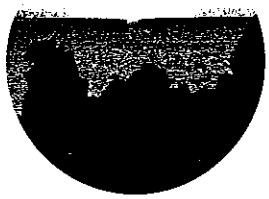
Foreword by the Premier *and the* Minister for the Environment

Western Australia's coast is big in every sense of the word. Stretching 12 500 km, it encompasses a rich diversity of marine environments from ancient river deltas to mangroves, coral reefs, islands, sandy beaches and sheer cliffs. Our coast is habitat for a range of plant and animal life that challenges the imagination.

Most Western Australians live or work near the coast. Nearly all of us spend at least some part of our holidays enjoying its beauty. Western Australians treasure our coast and the bounty it holds. Our marine environment also is a major part of our tourism industry, attracting many thousands of visitors from elsewhere in Australia and overseas.

But as well as the amazingly beautiful and diverse natural landscapes and life forms, parts of our coast are rich in natural resources such as petroleum, minerals and fish which contribute to our economic growth and well-being.

'The strategy enables us to have development that meets the needs of the present generation without compromising future generations' enjoyment of the unique features of our marine environment.'



The Government's guiding principle is the wise use of resources. We are committed to the conservation of our environment and the ecologically sustainable use of our natural resources.

In July 1994, the Government released the State's first comprehensive strategy for conserving the marine environment. It lays the foundation for an exceptional level of protection for our sensitive marine ecosystems. As a demonstration of the Government's commitment, the strategy expressly excludes drilling in Ningaloo Marine Park for petroleum exploration and production.

The strategy strikes a balance which:

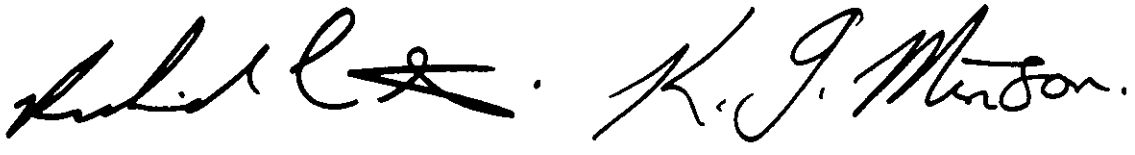
- Reinforces Western Australia's high environmental protection and management standards.
- Provides clear access guidelines for the exploration industries.
- Removes uncertainty and minimises the potential for conflict between conservation and resources development.

The strategy enables us to have development that meets the needs of the present generation without compromising future generations' enjoyment of the unique features of our marine environment.

In particular, the strategy reinforces the concept of multiple use of our marine environment.

Western Australia is blessed with some of the world's best coastal and marine environments. We have a responsibility to conserve it if we are to continue to enjoy all the benefits it offers.

New Horizons in Marine Management is a step in meeting that responsibility.



Richard Court
PREMIER

Kevin Minson
MINISTER FOR THE ENVIRONMENT

A most remarkable coast

NEW HORIZONS IN MARINE MANAGEMENT

The key elements:

A Marine Parks Authority in which marine conservation reserves will be vested.

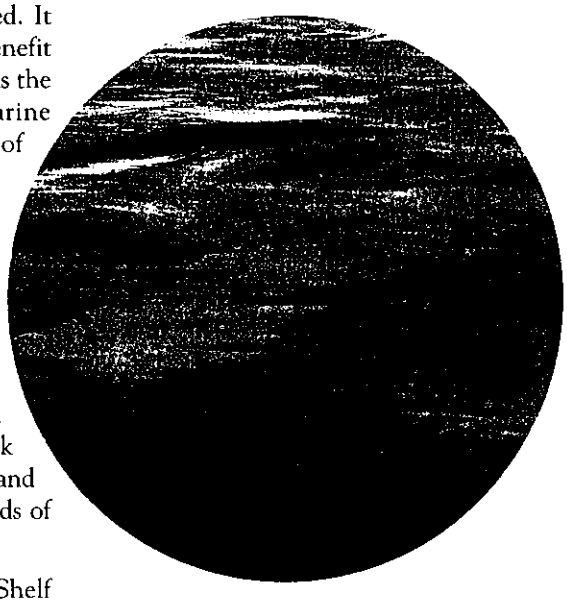
A three-tiered approach to marine conservation reserve categories.

Access guidelines for petroleum explorers and developers in marine conservation reserves.

No drilling for petroleum in Ningaloo Marine Park.

Release of a report on a comprehensive marine reserve system for Western Australia.

Western Australia's coastline, extending 12 500 km from the Kimberley to the Great Australian Bight, is a myriad of habitats and landscapes. It is home for a remarkable array of marine fauna such as corals, crocodiles, dugong, turtles, migratory whales, sealions, penguins and great white sharks. The flora includes the world's biggest seagrass meadows. Most of the marine life is virtually untouched. It may harbour compounds of untold benefit to humankind. Marine features such as the stromatolites in Hamelin Pool Marine Nature Reserve in Shark Bay are of international significance.



The seas are rich in natural living resources such as lobsters, scallops, prawns and fish that are the economic base of many coastal communities. The giant whale sharks off North West Cape, the friendly dolphins at Monkey Mia in Shark Bay, and migrating humpback and southern right whales off Perth and our south coast attract many thousands of tourists each year.

The seabeds under the North West Shelf have been found to contain rich deposits of petroleum, which includes crude oil and natural gas. More recently, in the Kimberley, diamonds are being found in offshore sediments.

Our tropical marine life belongs to a huge region stretching from the east coast of Africa to Polynesia in the central Pacific, and from Japan to the northern Australian coasts.

The temperate marine environment is part of the Southern Australian Region extending across the continent's south coast.

WA's marine richness is enhanced by a stretch of coastline between North West Cape and Cape Leeuwin that marks the transition between these two distinct marine environments. The warm Leeuwin Current, sourced from the tropics, is another distinct feature of the WA coast and brings tropical species well south, such as the corals growing around the Abrolhos Islands and Rottnest Island.

More expertise, more resources

A key part of the New Horizons in Marine Management strategy will be the new Marine Parks Authority. It will open the way for more specialised management of our marine conservation areas.

The expected increase in the number of marine conservation reserves warrants a separate vesting authority whose members are experienced in marine issues.

The new authority will have representation from a wide range of interest groups. These include:

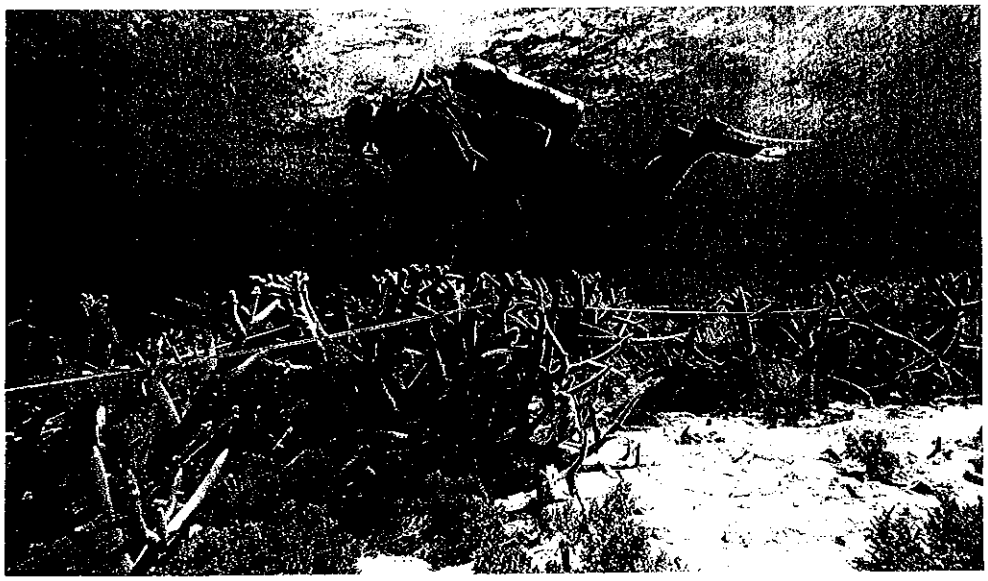
- Conservation
- Commercial fishing
- Recreational fishing
- Other water-based recreation groups
- Tourism
- Marine science
- The petroleum industry
- Community representatives
- State Government

The Conservation and Land Management Act is being amended to give legal backing to the new authority.

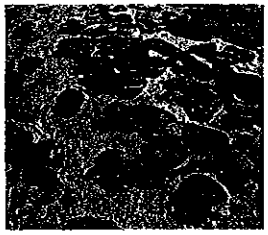
Good science

The Government will appoint a special scientific advisory committee to advise the Marine Parks Authority. It will comprise marine scientists from the non-government sector, research institutions, the WA Museum, Fisheries Department and the Department of Conservation and Land Management (CALM).

CALM will set up a specialist Marine Branch - to include marine scientists - to support the new authority. CALM will continue to be responsible for overall management of marine conservation reserves.



A conservation system for many uses



'Expanding the system of marine conservation reserves is part of the Government's aim to ensure there is a balance among the various uses of marine areas.'

The marine conservation reserve system has two primary aims:

- To preserve representative ecosystems; and
- To provide for management of the various uses of marine reserves.

A major part of the New Horizons in Marine Management strategy is to develop a marine conservation system so that the management of biological and recreational resources takes into account the essential and occasionally competitive activities of commercial and recreational fishing, tourism, passive recreation, scientific study and petroleum exploration and production.

Expanding the system of marine conservation reserves is part of the Government's aim to ensure there is a balance among the various uses of marine areas.

The major change is the creation of a new category of marine conservation reserve to be called a Marine Management Area.

The existing marine nature reserves and marine parks categories will continue. As a result, the categories will be:

MARINE NATURE RESERVES

These reserves are created for conservation and scientific research. Although low-impact tourism may be permitted, no fishing (recreational and commercial) nor petroleum drilling or production will be allowed. Currently there is only one Marine Nature Reserve in WA - Hamelin Pool in Shark Bay which has among the finest examples of stromatolites or "living fossils" found anywhere on Earth.

MARINE PARKS

Western Australia has six Marine Parks - Ningaloo, Marmion, Shoalwater Islands, Rowley Shoals, Swan Estuary and Shark Bay. As well, the waters around Rottnest Island are reserved under the Rottnest Island Authority Act. Parks such as these will continue to be created to protect natural features and aesthetic values while at the same time enabling public recreation. Commercial and recreational fishing also will be permitted.

Under the Marine Parks system, four zones will be created:

- **Sanctuary Zones** are "look but don't take" areas managed solely for nature conservation and low-impact tourism.
- **Recreation Zones** provide for recreation including recreational fishing (subject to bag limits and other conservation measures).
- **Special Purpose Zones** are managed for a particular priority use or issue. This could be protection of habitat, a seasonal event such as whale-watching or a particular type of commercial fishing. All uses compatible with the priority use or seasonal event will be allowed in these zones.
- **General Use Zones** make up the rest of Marine Parks not included in sanctuary, recreation or special purpose zones. Conservation of natural resources in General Use Zones still remains the priority but activities such as sustainable commercial fishing and petroleum exploration and production are allowed where they will not affect sensitive marine habitats.

  Petroleum drilling will be excluded from marine nature reserves and from sanctuary and recreation zones in marine parks, but will be provided for elsewhere in marine parks in appropriate zones, subject to Environmental Protection Authority assessment.

MARINE MANAGEMENT AREAS

These areas will be selected primarily on the basis of their biological and recreational values but will recognise their potential for supporting commercial activities such as petroleum production and commercial fishing - subject to environmental impact assessments for activities referrable under the Environmental Protection Act.

Another Government initiative is to create Fish Habitat Protection Areas under the Fish Resources Management Act to protect fish in specific areas.

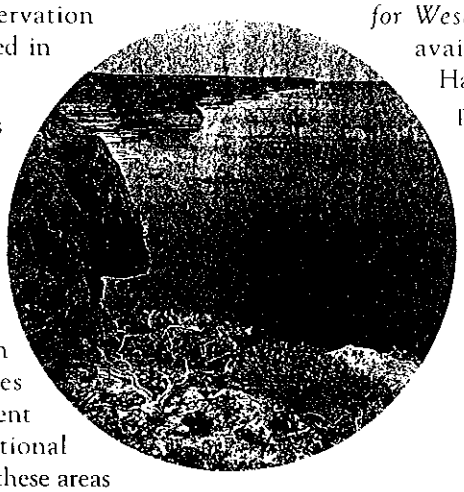
However, the principal thrust of the marine conservation effort will be to have one comprehensive system under the Conservation and Land Management Act.

A blueprint for the future

The New Horizons in Marine Management strategy embraces a commitment to a high level of public participation in determining future marine conservation areas.

As part of that public consultation process, the Government has released a report of a scientific working group into a representative marine reserve system for Western Australia.

The working group was chaired by the former Director of Nature Conservation with CALM, Dr Barry Wilson, and included some of the State's most eminent marine scientists. They spent seven years considering the State's 12 500 km of coastline from the Kimberley to the Great Australian Bight. The report is the most significant marine conservation reserves document released in Australia.



The working group has identified about 70 areas that represent the distinct coastal types around WA's coastline. The working group has listed these as areas to be considered for incorporation into the marine reserves network. Further assessment of the biological, recreational and commercial values of these areas will be part of the process in setting aside future marine conservation areas.

In line with its policy for conservation of the environment and sustainable economic development, the Government is seeking public comment on the report over the next few months. As part of that process, a series of meetings will be held to brief and receive comment from local communities and a range of user, interest and industry groups.

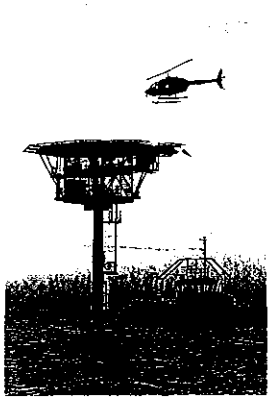
The Government is further committed to full and open consultation before an area is dedicated as any one of the three categories of marine conservation reserve. Before additional marine conservation reserves are created, a biological, mineral and petroleum resource assessment for the areas will be carried out under a time frame agreed between the Ministers for the Environment and Mines. The assessments will be completed before a reserve category is declared. Proposed Marine Management Areas will not be subject to this requirement.

All marine conservation reserve proposals will be subject to a two-month public comment period before a final decision by Government. The decision in each case will be up to both Houses of Parliament. Further, zoning for marine parks will continue to be developed as part of the management planning process and will include a public review period.

Copies of the working group report - *A Representative Marine Reserve System for Western Australia* - are available from CALM, Hayman Road, Como, phone (09) 334 0333 and CALM Regional and District Offices.

'The Government is further committed to full and open consultation before an area is dedicated as any one of the three categories of marine conservation reserve.'

Achieving a balance for natural resources



The New Horizons in Marine Management strategy is a balanced approach for conservation of the marine environment while encouraging commercial activities such as petroleum exploration and production, as well as fishing and tourism.

PETROLEUM

This balanced approach means that some areas are set aside purely for nature conservation from which drilling for petroleum is expressly excluded. Petroleum drilling and production may be permitted in multiple-use zones so long as these activities are approved through the assessment processes under the Environmental Protection Act.

The chart shows the various levels of petroleum activity allowed in each of the categories of marine conservation reserves.

The Government's policy on petroleum exploration and development in marine conservation reserves is:

- Petroleum drilling and production will be prohibited in Marine Nature Reserves, both Sanctuary and Recreation Zones of Marine Parks and in Special Purpose Zones of Marine Parks where such activity would be incompatible with the conservation purpose of the Zone.
- Petroleum drilling and production will be permitted in parts of General Use and Special Purpose Zones of Marine Parks subject to assessment by the Environmental Protection Act process.
- Petroleum drilling and production can be undertaken in Marine Management Areas subject to the Environmental Protection Act process.
- Before the Minister for the Environment creates any marine reserve or management zone within a reserve that would preclude petroleum exploration and development activities, he will obtain the consent of the Minister for Mines.
- A depth limit of 200 metres below the seabed will apply to all marine conservation reserves.

GRANTING TENEMENTS

Petroleum tenements may be granted to overlap existing marine conservation reserves or proposed marine conservation reserves endorsed by State Cabinet. However, petroleum drilling in these reserves will be allowed only in Marine Management Areas or in General Use and Special Purpose Zones of Marine Parks.

SEISMIC SURVEYS

Marine Management Areas and Marine Parks will be accessible for low-impact seismic surveys subject to environmental impact assessment processes agreed by the Environment Protection Authority in consultation with the Fisheries Department, and operational constraints imposed by CALM.

Seismic surveys may be permitted to extend into marine conservation reserve areas that are not available for drilling, to complete data collection for resource targets that are either outside or accessible from outside the reserve.

MINERALS

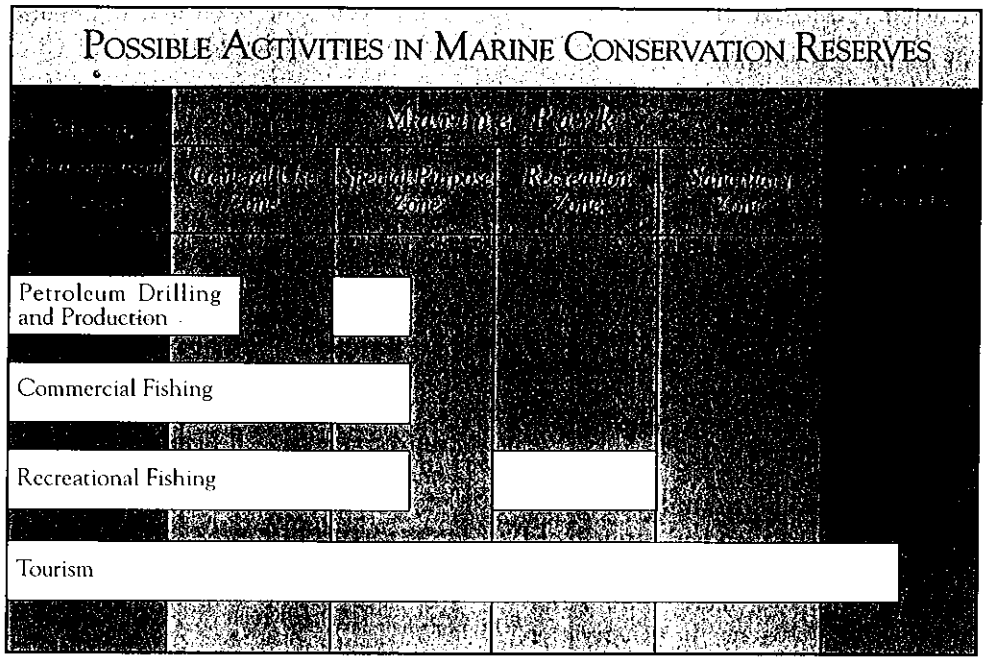
The Government has established a process to prepare guidelines for access for mineral exploration and development in marine conservation reserves.

FISHING

In line with the Government's multiple-use policy in marine conservation reserves, commercial and recreational fishing will be provided for in Marine Management Areas and in Marine Parks in General Use Zones, and in Special Purpose Zones where they are compatible with the purpose of the zone.

Commercial fishing will not be permitted in Recreation Zones of Marine Parks and no fishing will be permitted in Marine Nature Reserves and in Sanctuary Zones of Marine Parks. Fishing in marine conservation reserves will continue to be managed under fisheries legislation.

POSSIBLE ACTIVITIES IN MARINE CONSERVATION RESERVES

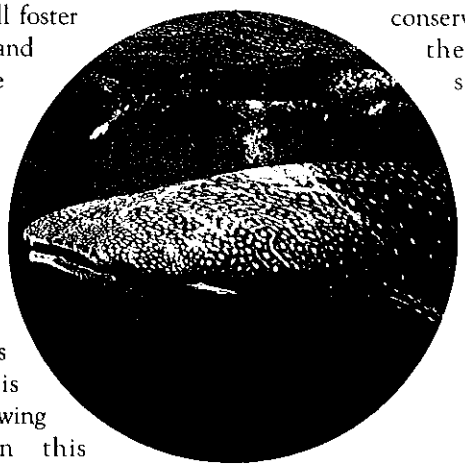


TOURISM

The Government recognises that tourism, particularly nature-based tourism, is a rapidly developing industry. Nature-based tourism will make a major contribution to protecting the State's unique ecosystems, especially those found along our coastline. Providing high quality experiences of the environment will foster greater understanding and sympathy for the environment.

To this end, the Government has released a discussion paper - *Towards a Nature Based Tourism Strategy for Western Australia* - as part of its commitment to this emerging industry. Following public comment on this discussion paper and consultation with industry and other interested people, a strategy will be finalised which will put Western Australia's nature-based tourism industry on a firm footing to compete in the competitive international tourism market. Copies of the discussion paper are available from the WA Tourism Commission, phone (09) 220 1700.

The New Horizons in Marine Management strategy recognises the relationship between the marine conservation reserve system and the tourism industry. Appropriate tourism development will be encouraged to maximise the opportunity for visitors to enjoy marine conservation reserves while at the same time ensuring such development does not threaten the highest conservation values or conflict with other uses in particular zones.



NINGALOO REEF - A STATE ICON

The Ningaloo Reef is as spectacular as it is ancient. The coral formations making up the reef have created an underwater wonderland habitat for more than 460 species of fish and marine mammals.

Among them is the massive whale shark, up to 18 metres long and weighing up to 40 tonnes. Ningaloo is one of the few places in the world where visitors can swim alongside these giants. Marine mammals such as dolphins, humpback whales and dugong also inhabit the reef.

The reef has long been popular with holidaymakers and recreational fishers but as its popularity grows, so too does the pressure on this fragile environment.

Ningaloo Marine Park was created to protect this remarkable marine environment. The Park stretches from Bundegi Reef in Exmouth Gulf, around North West Cape then 260 km southwards to incorporate Ningaloo Reef. In all, it covers 2240 square km of the State's tropical waters.

The Government's commitment to the conservation of this unique marine environment under the New Horizons in Marine Management strategy means that drilling and production of petroleum is not allowed in Ningaloo Marine Park.

The role of Government agencies

MARINE PARKS AUTHORITY

All marine conservation reserves will be vested in the Marine Parks Authority which will be established under the Conservation and Land Management Act.

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

CALM will manage all marine conservation reserves vested in the Marine Parks Authority. The Department also is responsible for preparing and implementing management plans for each conservation reserve.

CALM's responsibilities include nature conservation, recreation and nature-based tourism, management planning, wildlife research and management, information and education programs in conservation and recreation, and liaison with interest groups including local and international organisations. CALM will ensure integrated management of marine reserves with adjoining mainland and island conservation reserves.

FISHERIES DEPARTMENT

Fishing and aquaculture are under the jurisdiction of the Fisheries Department. In the case of any conflict between the purposes of a Marine Park and provisions within the Fisheries Act relating to commercial or recreational fishing, the Fisheries Act has precedence.

TRANSPORT DEPARTMENT

The Transport Department is responsible for all boating regulations including licensing, safety standards, marker buoys, moorings and jetties.

DEPARTMENT OF MINERALS AND ENERGY

Mining and petroleum exploration is carried out under several Acts administered by the Department of Minerals and Energy. The Minister for the Environment also must obtain the consent of the Minister for Mines before creating any marine reserve or management zone within a reserve that would exclude mineral and petroleum exploration and development.

ENVIRONMENTAL PROTECTION AUTHORITY

The Environmental Protection Act sets out specific guidelines for assessing mineral and petroleum exploration and production and for other developments such as tourist resorts. The EPA process must be followed before any exploration, production or development begins. The EPA is assisted by the Department of Environmental Protection in administering this process.

APPENDIX II

Mapping Australia's Underwater Features

Dr Hugh Kirkman, CSIRO Division of Fisheries,
Marmion Marine Laboratories, WA.

MAPPING AUSTRALIA'S UNDERWATER FEATURES

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ABSTRACT

Australia's coastline was first mapped at the beginning of the 19th century. Now the underwater features are being mapped with extensive ground truth, satellite technology and computer mapping and digitising techniques. Landsat TM imagery is processed to enhance underwater features. The enhanced imagery is then taken into the field for strategic ground truth verification of features seen in the imagery. GPS position fixing is used to find a position of interest or to position a site where verification takes place. Once an image has been verified the ground truth points are placed on an outline of the coast and these points placed on the image. Eight categories of habitat are used in the map but these may vary depending on where in Australia the mapping is done. The features are traced onto the image and digitised and the map presented, at 1:100,000 on Arc Info. The success of this project relies on the collaboration and cooperation of State Government departments, so far, most of South Australia and Western Australia from Exmouth Gulf to the border of South Australia has been completed, the Victorian government has bought the satellite images and preliminary interpretations have been done. New South Wales has bought the first of about ten images and Tasmania has made a commitment to assist in mapping that state. The aim is to complete all of Australia within three years.

OBJECTIVE

To prepare a map at a scale of 1:100,000 of underwater features of the Australian coastline and separate those features into categories that can be used for coastal management and making decisions on choices of marine protected areas.

BACKGROUND

The underwater features of the Australian coastline are poorly known apart from areas around centres of population. Underwater features are seagrass meadows, reefs of different morphology and geology, unvegetated sand and, in the tropics, coral reefs, coral debris and muddy deltaic areas. There are a number of reasons that underwater features should be mapped.

- Selection of Marine and Estuarine Protected Areas (MEPA's). Once the features of the offshore coast have been mapped and an estimate of the biodiversity made, decision makers have an informative baseline upon which to choose bioregions or areas of biological similarity and hence select marine parks or reserves.
- Assist with decisions concerning coastal development - where to put marinas, harbours, effluent outfalls and exploratory. mining. Seagrass meadows are particularly vulnerable to above ambient nutrient concentrations caused by effluent discharges. Coral reefs are also affected by high sediment concentrations caused by land clearing. If the extent of these biological features is known decision makers can protect them or decide to sacrifice parts of them.
- Location of vulnerable areas if an oil spill occurs. Reefs and coral reefs are particularly vulnerable to oil pollution, if these habitats are well defined the clean up of oil can concentrate around these areas and limited resources can be deployed at strategic places to reduce impact.
- Assist with decisions as to the location of mariculture development. Aquaculture cages release nutrients into the sea and shade the underlying substrate. The positioning of these cages should be planned to have as little impact as possible on the benthic biota.
- Assist with locating where heavy machinery can approach the water/land interface for pollution clean-up and military purposes. Cliffs, exposed beaches and shallow offshore reefs are places that are difficult to approach for clean-up whereas shallow estuaries and gently sloping beaches are more suitable.
- Assist with coastal management. Once an atlas of resources has been prepared, strategic monitoring will help detect changes to the various ecosystems that have been distinguished.

METHODS

The maps are being prepared at a scale of 1:100,000 using the blue band or band 1 of the Landsat TM satellite. The key to mapping these areas is obtaining satellite imagery that has penetrated the water and then enhancing the raw imagery so that the best is made of the benthic features in the scene. The high water clarity in southern Australia has allowed us to identify features to 50m depth, but in many cases because of poor light penetration, this depth is much reduced. Completed maps, therefore, do not have an offshore limit, but rather a line exists at the extremity of what can be seen through the water by the Landsat TM imagery.

Each image is selected from microfiche reproductions provided by the Australian Centre of Remote Sensing (ACRES), a division of the Australian Land Information Group (AUSLIG) situated in Canberra, as being on a cloud-free day and with a sun elevation above 45°. Because of the sun elevation restriction, only images taken between mid-October and April are chosen. The weather pattern for the previous three days is then examined from the Bureau of Meterology data to determine if storms or strong wind might have disturbed sediment in the target area. Even with these constraints it is difficult, because of water turbidity, to find a suitable image.

Once an image has been acquired it is rectified to level 9, ie rectified to the AUSLIG topographic map at a scale of 1:100,000, with Australian Map Grid positions and checks at every 10km on the photographic image. The position of any feature can then be determined for later field ground truthing. The photographic image is laminated in plastic so that it is waterproof for field work. The discernible underwater features are traced on the image, and these are verified in the field.

The ground truthing of the images, to verify the presence of underwater features, is a major operation on a scale as large as the coastline of Australia. In southern Western Australia and in South Australia this has been done from ocean going vessels capable of spending extended time at sea. In the case of Western Australia, a shark fishing vessel was chartered from Esperance on two occasions. On the first cruise from 9 - 13 March 1994 we concentrated on deep water features and the islands of the Archipelago of the Recherche. On the second cruise from 6 - 13 April. 1994 we moved along the coast from Two Peoples Bay near Albany to the western end of the cliffs of the Great Australian Bight. In South Australia all ground truth was accomplished from the research Vessel "Ngerin" courtesy of the South Australian Research and Development Institute (SARDI) on five cruises. The first, from 16 - 29 June 1994, of these was from the Head of the Bight to Ellison and the second, from 9 - 19 October 1994, was to Kangaroo Island and the adjoining mainland. Spencer Gulf, the east coast to Portland in Victoria and the Eyre Peninsula were the remaining cruises.

Ground truthing was done by either "bounce" diving, hanging a video camera from the ship or by using a small grab. For the "bounce" diving part of the work, the crews take small inflatable dinghies to predetermined places of interest along the coast. These places are chosen on their representativeness of other areas or as being unusual in shape or position on the image. Before going into the water, an estimate of the bottom type expected is recorded on data sheets for each ground truth site. At the chosen site a GPS position is recorded and the field worker makes a dive, usually with scuba, to determine what is on the bottom. If a seagrass habitat is encountered a handful of seagrass with roots and rhizomes and fruiting parts, if available, is taken and the depth, density of seagrass, species and other observations are recorded on a field slate. If a reef is encountered, the depth and type of reef is recorded and the dominant seaweeds collected and returned for later pressing. If unvegetated sand is encountered, the diver may abort the dive and record "bare" on the field slate.

The bottom types are divided into eight categories: dense seagrass, medium seagrass,. sparse seagrass, patchy seagrass, bare sand, flat platform reef, heavy limestone reef and granite reef. Dense seagrass is seagrass that completely covers the bottom, medium seagrass is a density where two fingers held together can be placed between shoots and sparse is the density of seagrass where a hand can be placed between shoots. Flat platform reef is flat reef that is easily covered in mobile sand and therefore does not have a heavy growth of large seaweeds. In Western Australia this category often had *Scaberia or Dictyopteris* growing on it. Limestone reef has a cover of kelp *(Ecklonia radiata)* or other large brown seaweeds and granite reef also has kelp but has a smoother surface and has steeper edges.

The video camera and grab are usually used from the mother ship which, while the inflatables are engaged closer to the shore in shallower water, will be steaming to chosen sites where it may not be necessary to dive, is too deep or is thought to be unvegetated sand. At these sites a GPS position is recorded and the video or grab deployed. If scenes or samples of interest are found, a diver may collect a sample from the bottom.

Once the inflatables return to the mother ship, the data from the field slates are recorded on data sheets, and field note book, specimen plants are pressed and labelled and the actual bottom type compared with the estimated one.

After the cruise, the position of every ground truth site is plotted onto an AUSLIG, 1:100,000 outline of the coast as a number related to the data sheets and as a colour related to the category of bottom detected. Information from the field

The coast outline is then laid over the satellite image (they are at the same scale) and a pin is pushed through at each ground truth point. The category of the bottom type is noted on the satellite image and the tracings are revised using the ground truth data. The satellite images with their tracings are then digitised and put into Arc lnfo for presentation as a map. Each of the completed maps is accompanied by a statement as to the quality of the mapping. The quality control comes from a comparison of the expected bottom type compared to the actual bottom type. Currently the ground truth estimate of a particular area is about 80% accurate.

REQUIREMENTS FROM COLLABORATORS

A close liaison and co-operation with state government departments has been of vital importance to the whole project. Table 1 lists the collaborators in this project.

ORGANISATION	DEPARTMENT
Western Australian Government	Land Administration
	Fisheries
	Transport
	Environmental Protection
	Conservation and Land Management
South Australian Government	SA Research and Development Institute
	Environment and Natural Resources
Victorian Government	Fisheries Research Institute
	National Parks
NSW Government	National Parks and Wildlife Service
	Fisheries
Tasmanian Government	Fisheries
	National Parks and Wildlife
CSIRO	Division of Fisheries
	Division of Wildlife and Ecology
Royal Australian Navy	Hydrographers
AGSO	Marine Geology

CSIRO does not have a large budget for this work, however with the collaboration and co-operation of a number of State Departments the mapping in South Australia, Victoria and Western Australia has progressed quickly and economically. The state departments provided the satellite imagery (band 1 only) which was chosen by CSIRO from the catalogue at ACRES. The State Departments provided technical help in enhancing the imagery and producing a photograph with AMG and 10 km grid. The tracings were digitised and map produced by State Departments which provided the maps in digitised form to the CSIRO Division of Wildlife and Ecology for the CAMRIS GIS. The completed maps are owned by CSIRO and the state.

CURRENT STATUS

The southern coasts of Australia are in the process of being mapped. Arc Info maps have been prepared from Perth to the cliffs of the Great Australian Bight. The underwater features of the coast from Perth to Exmouth Gulf and from the cliffs of the GAB to Portland in Victoria are in preparation. Other areas of the Australian coastline eg. GBR, Moreton Bay, the estuaries of NSW and the Gulf of Carpentaria, have been mapped for various organisations for different purposes at different scales, but most of these maps can be brought to the scale required for this project and their categories made compatible with those of this project and then put into the underwater features data base.

The coast of Victoria has been mapped from satellite imagery but ground truth has been done only for Port Phillip Heads to Wilson's Promontory. For NSW satellite imagery seems inappropriate so that aerial photos are being scanned from which the maps will be prepared. The ground truth for the Tasmanian coast will be done during two cruises in February and April 1997.

It is anticipated that during 1996/97 the current study will be extended to the ground truth of the Victorian coast, and Tasmania. The NSW government has shown some commitment to mapping its coastlines.

The northern parts of Australia are a different matter as far as obtaining satellite images with sufficient water penetration. The water in northern Australia generally contains enough sediment to prevent light penetration beyond a metre. This sediment comes from seasonal rivers and the very large tides of the Kimberley to Darwin coast and the Gladstone to Rockhampton coast of Queensland.

Although the plant communities will not be as deep as in southern areas of the continent because of the lower light reaching benthic plants, it is just as important to map the reefs and substratum here as elsewhere. It is planned to use a series of transects to determine the composition of the benthic habitats. These transects would be at right angles to the coast and to a distance where, either a continuous substrate is obvious or it is believed that further data would be of limited use. This form of mapping requires much more field work and relies on a statistically sound number of samples ie transects, being taken. Further collaboration with the RAN, WA Dept of CALM, CSIRO Division of Marine Research at Cleveland through a FRDC Grant and Australian Customs Service will be anticipated.

END PRODUCT

Completed mapping is in an Arc lnfo format on disc or on hard copy at a scale of 1;100,000. These maps are available to State Government Departments and institutions that have given assistance in preparing the maps.

MIILESTONES

Oral Presentations:
CZP meeting. Oct 1994
ANZECC committee meeting Nov 1994
Vic Govt Departments Nov 1994
Perth Dive Academy Dec 1994
Underwater World June 1995

Written Reports
CZP Report Oct 1994
Ecos article Autumn 1995
South Australian Fisheries article May 1995

Kirkman, H. and Kuo, J. 1996. Seagrasses of the southern coast of Westem Australia. Proceedings of the International Workshop on the Biology and Ecology of Seagrasses. Rottnest Island. Eds. Kuo, Kirkman, Phillips and Walker.

Hamdorf, I. and Kirkman, H. 1995. Status of Australian Seagrass. Issue Paper Fisheries Pollution and Marine Environment Committee 32pp.

Kirkman, H. In press. State of Environment Report on Seagrasses. National State of the Environment Reporting System. Commonwealth Environment Protection Agency. 43 pp.

Kirkman, H. In press. Baseline and monitoring methods for seagrass meadows. Journal of Environmental Management.

Presentations
Plenary Talk at the International Symposium of Remote Sensing, Seattle Washington. Held in Septernber 1995.
Talk at Estuarine Research Foundation Biannual International Meeting. Corpus Christi, Texas Nov 12-19.

Committee Responsibilities due to this project.
Advisory Committee of Western Australian Land Information System (WALIS)
Visiting Committee Department of Geography, The University of Western Australia

APPENDIX III

Habitat Data Sheet

CALM Marine Conservation Branch

HABITAT DATA SHEET

Project	SOUTH COAST TERRESTRIAL AND MARINE RESERVE INTEGRATION STUDY				**Field Survey**		FEBRUARY 1997
Site No.		**Site Name**		**Date**		**Recorder**	
Vessel	MV Sealion		**Time**		**Weather**		
Sea			**Water depth (m)**		**Water visibility (m)**		
GPS Latitude			**GPS Longitude**		**Differential**		
° ’S			° ’E		**Yes**	☐	**No** ☐
Site location							

Habitat Description

Dominant Species

Sea-grass	
Macro-algae	
Coral	
Fish	
Invertebrates	

Other Features

Impact or Activity

Video reference	MRIP/SC/ /#	**Aerial reference**	/WA /RUN /
Slide reference		**Print reference**	

Habitat Data Sheet Guidelines

To assist with the standardisation of data recording and survey methodologies used in field surveys by CALM's Marine Conservation Branch the following is a brief explanation of the terms and methodologies to be used in the attached habitat data sheet.

Site No: All sites visited were designated a site number. Each site number should begin with SC (denoting South Coast) and ends in a number or number/letter combination. It is anticipated that these site numbers will remain with these locations in all future CALM studies and are therefore key designators for any other information or records kept relating to each site.

Site Name: Most sites have been given a name, chosen either as one that is formally recognised (such as a chart location) or a name introduced by the study team to enable quick identification.

Date and Time: This is the date and time at which the data at the site were collected.

Recorder: This is the name of the person who was primarily responsible for the recording of original notes.

Vessel Name: Name of survey vessel.

Weather: The percent cloud cover and wind speed (km/hr) and direction (degrees) were estimated.

Sea: The sea state was described as calm (no wind, calm sea), slight (breeze was influencing surface water), moderate (wind was generating wind waves up to 1 metre) or rough (windy with wind waves greater than 1 metre).

Water Depth: Depths are approximate and were read off an echo sounder.

Water Visibility: This is an estimation of horizontal in-water visibility at the time of observation.

GPS Lat and GPS Long: The GPS coordinates of a site are recorded as degrees, minutes, seconds and decimals of a second. The GPS **must be** setup to use the AGD 66 or AGD 84 datum.

Differential: If a differential GPS was used then 'yes' is noted. GPS readings utilising a differential system allowed for position fixing described by latitude and longitude to within about 3 m or less.

Location of site with ref. to lat/long: On occasions observations were made after swimming some distance from the position of the anchored vessel. Hence, a note of the actual location of the observations and/or visual recordings that were made is given with respect to the latitude and longitude of the anchored vessel.

Habitat description: This is a general note of the habitat type and its percentage cover. As cover can vary within the general vicinity of a site the described percentage cover can have an error of approximately 20%.

Dominant Species: This is a list of the most common or readily observed species of marine life at the site. It reflects what an observer might expect to see when visiting the site in the future. Taxa are usually described to genus .

Other Habitat Notes: Features of interest at or nearby the site are noted.

Activity or Impact Noted: Signs of activity or impacts that were observed at the site are noted.

Video reference: Video image taken of the site is referred to as:

SCTMRIS/SC 10-150297/TAPE#2

SCTMRIS is the project descriptor (South Coast Terrestrial and Marine Reserve Integration Study)
SC 10 is the site number
150297 is the date

Photo reference and Slide reference: A photograph or slide image taken of the site is referred to as:

SCTMRIS/SC10-150297/01p where:

SCTMRIS is the project descriptor

01 is the photo or slide number
p refers to ‘photo’ (alternatively *s* refers to ‘slide’)

Aerial reference: Aerial photographs of the site are referred to as:

5001/WA 2958/RUN43/20.2.91 where:

5001 is the photograph number
WA 2958 is the series number
RUN 43 is the flight run number
20.2.91 is the date that the photograph was taken

APPENDIX IV

Underwater Camera System Operating Instructions

Cunard Technologies, Welshpool, WA.

1.0 Introduction

The Cunard Technologies Remote Monitoring Camera System includes:

- CCC6 - Cunard Camera Controller V6
- CT-952 Colour Camera
- 150m Submersible Umbilical
- Deep_Sea 150W@120V Light

• The Cunard Camera Controller V6 allows control of the following functions:

- Camera ON/OFF
- Focus Far and Near
- Zoom In and OUT
- Time, Date and one Text line overlay
- Light ON/OFF, Variable Intensity and RCD Circuit Breaker.

The Controller has 14" colour monitor with all major functions accessible at the front panel and/or via remote controller. For external video signal processing a 'Video Out' BNC socket is mounted to the front panel of the CCC6.

• The Cunard Technologies CT-952 U/W Colour Video Camera is purpose built for underwater applications where a highly reliable camera is needed. The Video Unit of the camera is based on the very popular SONY XC999 high resolution colour video camera.

The camera is resistant to vibration and shock, yet provides a high colour picture resolution of min 460 TV lines. The Camera is a one piece package contained in 316 stainless steel pressure housing.
The CT-952 is fitted with a 7mm remote focus auto iris lens.

• The 150m long umbilical connects the control console with the camera and light. One end is terminated with 14pin Cannon multipin connector whereas the other end is terminated with underwater connectors with 1m pigtail Y-spliced for light.

• The 'Deep Sea' Light is suitable for underwater use to a depth of 500m sea water. It is fitted with 150W@120V bulbs. The lights' intensity is adjustable from the Control Console by turning 'Light Intensity' knob on the front panel.

3.0 Camera Setting-up Procedures

The setting-up procedures are concerned with a change in the length of umbilical cable between the surface control unit and the camera and instances when the circuit board is replaced. Attempts to align the video unit should not be undertaken unless the service engineer is fully conversant with this type of camera procedure. If in doubt, contact Cunard Technologies directly.

3.1 Long Line compensation

It is necessary to compensate for signal attenuation in the co-axial line of the umbilical cable caused by high-frequency and low-frequency losses.
Compensation for high-frequency losses match 6dB loss per 100m at 10Mhz and is selected by three DIP switches SW4 to SW6 (see Appendix 5.5) on the video interface board for cables of 100, 200, 400 and more metres. For intermediate lengths the nearest setting should be adopted. For umbilical length less than 100 metres no compensation is required.
To compensate for low-frequency losses in the umbilical cable the preset control VR1 on the interface board is adjusted until the sync portion of video signal is approximately 400mV at the camera output. Ensure that the surface end of the umbilical is terminated to 75 ohm impedance.

4.0 Time, Date and Text Line Adjustments

4.1 Front Panel Key Controls

POWER	:	- Power on/off
+⇑	:	- To position the overlayed screen upwards - To change DATE and TIME - To select character
–⇓	:	- To position the overlayed screen downwards - To change DATE and TIME - To select character
⇐	:	- To position the overlayed screen to the left - To step blinking text character backward
⇒	:	- To position the overlayed screen to the right
DATE&TIME	:	- To select DITE&TIME adjustment mode (4seconds)
TEXT	:	- To select TEXT adjustment mode (4 seconds)
TEXT OFF	:	- To switch text line on and off
SET	:	-To complete setting and move blinking character forward.

4.2 DATE & TIME and TEXT Adjustment ...

1. With the Video Camera connected to a Camera Controller and powered up, the video picture will be displayed on a Monitor.

2. Switch on ON-SCREEN DISPLAY by pushing the OSD ON/OFF Button.

3. With power to the ON-SCREEN DISPLAY, the system will firs clear its internal memory and about 3 seconds later will display the DATE, TIME and the 24 character TEXT line.

   eg **01-JAN-95** **00:00:01** at the top line

   000000000000000000000000 at the bottom line.

The unit has internal NiCad batteries to maintain the DATE, TIME and TEXT memory and to keep it current while power to the unit has been isolated. The batteries will maintain the current date, time and text for approximately 12 weeks. When the battery run down, the unit will need to be powered up and run for about 24 hours to recharge the battery.

4. To change the position of DATE, TIME and TEXT on the screen use the white and yellow buttons on the key pad which are marked : ⇑ ⇓ and ⇐ ⇒

5. To change or correct the DATE and TIME, the red button on the key pad marked **DATE&TIME** is to be used. Push the button and hold it down until the DAY starts to flash. With the DAY flashing use the white buttons marked "+" and "-" to either increase or decrease the DAY. When the correct DAY is displayed, push the black button marked SET and the DAY figure will be fixed and the MONTH figure will start to flash.

   The above steps should be followed and continued in sequence until the MINUTES of Time have been set. The SECONDS will be automatically set to "zero" at the end of the correction process.

6. To change or correct the 24 character text line, the red on the key pad button marked TEXT is to be used. Push the button and hold it down until the first character of the text line starts to flash. With the character flashing use the white buttons marked "+" and "-" to change the character. When the desired character is displayed, push the black button marked "SET" and the character will be fixed and the next character to the right will start to flash.

   The above steps should be followed and continued in sequence until the last (24th) character has been set. To return to a previous position in the character line use the yellow button marked "⇐". To end character adjustment use the black button marked "SET" and holding it down for a few seconds.

   The screen has now been updated and is displayed in the desired format.

5.0 Fault Finding

The fault finding procedures are designed to help the Service Engineer locate the area of the camera system in which the fault has occurred. In the event that the fault is traced to the video unit the complete system should be returned to Cunard Technologies or their accredited agent. Before attempting to locate a fault the Service Engineer must assure himself that a genuine fault condition exists and the alleged fault is not simply a misinterpretation of the operating procedures by the user.

4.1 No Composite Video Signal From the Camera

Refer to the block diagram and the component overlay drawings in the appendix. Check fuses F1 and F2 on the interface board for continuity. If the fuses are intact, check 22V supply from the rear bulkhead connector (connector CN1 pin 9). If this supply is present check the +12V dc output of U1 (at connector CN1 pin 6). A regulated output not equal to 12V (+/- 5%) indicates damaged components in the power supply circuit. In this case the regulator U1 is most likely damaged.
In the event that all voltages are correct, use an oscilloscope to determine whether there is a composite video signal on the interface board from the video unit (at connector CN2 pin 2). No signal at this point indicates that the video unit or the automatic iris lens is faulty and the camera should be returned to Cunard Technologies or their accredited agent.

4.2 Automatic Iris Fails to Operate

If the picture on the monitor screen flares (becomes bright and indistinct) when the scene illumination is increased measure the video signal at connector CN2 pin 2 (of the interface board) to determine whether there is a change in the video signal with the change in scene illumination. If it does change suspect the automatic iris, but if it does not change suspect the video unit. In the former instance replace the lens assembly and in the latter instance return the camera to Cunard Technologies or their accredited agent.

4.3 Camera Fails to Respond to the FOCUS Signals

Determine whether approximately 12 volt signal appears at console connector pins 3 and 4 when the focus signals are applied by pressing Focus Far/Near buttons. A suspect focus mechanism can be tested by applying a 40mA current (max 12Vdc) voltage directly to the disconnected motor inside camera housing.

Notes: 1. Focus speed can not be changed even if the control voltage will be varied.
2. Focus nominal current is approx. 40mA.

4.4 No Lights

If the LIGHT ON/OFF button is in ON position and other console functions operate correctly check position of the Ground Fault Detector.
If GFD trips each time the light button is pressed try to determine which section of the system causes the GFD to trip, umbilical or light. Also,check umbilical for mechanical damage.

NOTE: It is not recommended that the Control Console and the Camera be disassembled and assembled as a routine operation.
This invalidates pressure certificate issued after pressure tests.

APPENDIX V

Salinity-Temperature Data Sheet

CALM Marine Conservation Branch

SALINITY-TEMPERATURE DATA SHEET

Project	SOUTH COAST TERRESTRIAL AND MARINE RESERVE INTEGRATION STUDY				Field Survey	FEBRUARY 1997
Site No.		Site Name		Date	Recorder	
Time	GPS Latitude		GPS Longitude		Differential	
	° ' S		° ' E		Yes ☐	No ☐

ST meter details		Salinity calibration sample bottle no.		Meter salinity reading of calibration sample	
Thermometer details		Thermometer reading of calibration sample		Meter temperature reading of calibration sample	

Depth (m)	Salinity (pss)	Temperature (℃)
0		
0.5		
1.0		
2.0		
3.0		
4.0		
5.0		
6.0		
7.0		
8.0		
9.0		
10.0		
11.0		
12.0		
13.0		
14.0		
15.0		

Depth (m)	Salinity (pss)	Temperature (℃)
16.0		
17.0		
18.0		
19.0		
20.0		
21.0		
22.0		
23.0		
24.0		
25.0		

Notes:

Marine Conservation Branch, Department of Conservation and Land Management

APPENDIX VI

NOAA-AVHRR Satellite Overpass Times Western Australia, 10-21 February 1997

DOLA Remote Sensing Applications Centre

DOLA
Department of LAND ADMINISTRATION

REMOTE SENSING SERVICES
65 Brockway Road, Floreat
WESTERN AUSTRALIA
Postal Address: PO Box 471
Wembley, Western Australia 6014

Telephone: (09) 340 9330
Facsimile: (09) 383 7142

(WST)

Sat	Orbit	Date (WST)	Equator Cross Time	Equator Cross Long	Start Time	Azim	Lat	Long	Max Elev	Min
12	29841	11/ 2/1997	552	310.940	645	2.18	-6.40	116.84	56	15
12	29848	11/ 2/1997	1741	133.730	1906	167.88	-58.61	126.71	81	16
12	29855	12/ 2/1997	530	316.470	623	14.72	-6.95	122.24	86	15
12	29862	12/ 2/1997	1719	139.260	1845	160.56	-54.72	129.97	54	15
12	29869	13/ 2/1997	508	321.990	601	26.71	-7.50	127.64	53	15
12	29912	16/ 2/1997	543	313.250	635	7.90	-4.64	119.53	66	16
12	29919	16/ 2/1997	1731	136.040	1857	165.17	-57.05	128.05	71	15
12	29926	17/ 2/1997	520	318.770	614	20.13	-8.73	124.15	70	15
12	29933	17/ 2/1997	1709	141.570	1835	159.07	-56.51	133.26	43	15
12	29940	18/ 2/1997	458	324.300	552	32.28	-9.28	129.55	43	15
12	29969	20/ 2/1997	555	310.030	648	0.33	-5.87	116.04	51	15
12	29976	20/ 2/1997	1744	132.820	1910	168.88	-55.76	124.10	82	15
12	29983	21/ 2/1997	533	315.560	626	12.69	-6.43	121.44	83	15
12	29990	21/ 2/1997	1722	138.350	1848	161.89	-55.22	129.32	59	15