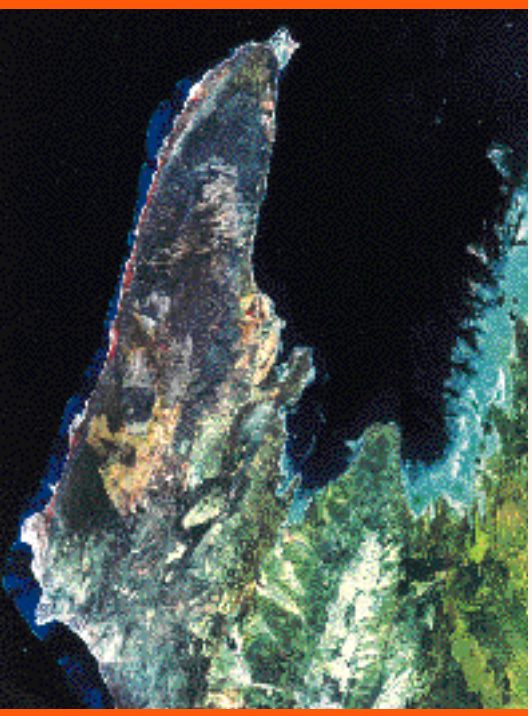

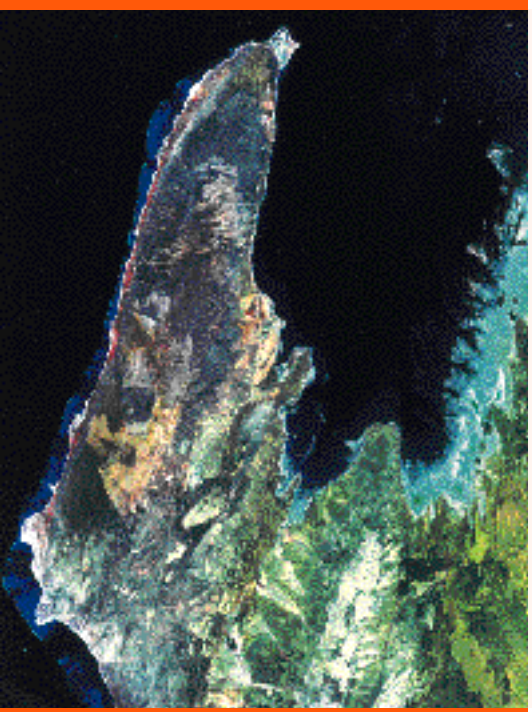

# ENVIRONMENT AL PROTECTION OF CAPE RANGE PROVINCE

## Position Statement No. 1

December 1999

Environmental Protection Authority

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*Front cover* - Landsat view of the Cape Range peninsula on 11 July 1991. The image is based on MSS bands 4,5 and 7 and centred 22°11'S, 114°18'E. The image was produced by the Australian Centre for Remote Sensing and supplied courtesy of the Biospeleology programme, Western Australian Museum of Natural Science.

**December 1999**

**Environmental Protection Authority**

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# FOREWORD

The Environmental Protection Authority has decided to prepare and publish a series of Position Statements which set out its views on some matters of environmental importance. The statements provide an avenue for the Authority to inform the public about environmental values and visions for the future. They also provide a basis for the development of an associated series of statements entitled 'Guidance for the Assessment of Environmental Factors'.

This is the first of the Position Statement series, and it is about the environmental protection of the Cape Range Province in the North-West of the State.

The Cape Range Province is important to the people of Western Australia, not only because of the magnificent coral reef contained within the Ningaloo Marine Park but also because of the limestone karst formation, which supports one of the world's most diverse subterranean fauna, as well as the landscape qualities and biological diversity within and outside the Cape Range National Park. The Province is a drawcard for tourism and recreation, and supports sections of the fishing, mining and pastoral industries.

This Position Statement provides information about the significant environmental attributes of the Province, encouragement to pursue research in an integrated manner to better understand environmental linkages and cumulative impacts, and a set of principles aimed at having development and environmental management undertaken in a manner which ensures that the long term ability of the area to accommodate human use pressures is not exceeded. The statement also contains a selected bibliography for further reading.

The principles presented by the Environmental Protection Authority are to encourage decision-makers to focus their attention on the environmental importance of the Cape Range Province and to provide a basis for guidance statements involving environmental assessment.

The Position Statement was made available as a preliminary statement for public comment, and I was pleased to receive a very positive response to the principles for environmental protection in the preliminary statement. The Position Statement is now issued here in final form and has been improved as a result of the public input.

I commend this Position Statement on the Cape Range Province for your reading, and acceptance of the principles of environmental protection as set out in Section 5.

Bernard Bowen

Bernard Bowen

Chairman
Environmental Protection Authority

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# 1. ENVIRONMENTAL SETTING

## 1.1 Introduction

The area covered by the Cape Range Province Position Statement (Figure 1) contains the Ningaloo Marine Park and Cape Range National Park as well as other coastal features extending from Ningaloo Reef around North West Cape and including the western side of Exmouth Gulf. The area is generally regarded as being special and of international significance.

Cape Range has been described by Carter (1987) as "one of the great geological set-pieces of the State" (p.108). Main (1993) stated "it ranks more and more as a world class subterranean fauna" (p. 243) and "the area ranks as unique and scientifically as world class" (Main, 1993, p.246).

There is a rich variety of landforms and landscapes and an interesting geo-evolutionary history which underpins the current attributes and biodiversity of the area. Karst formations and their associated subterranean aquifers form the backbone of the landforms of the area, both terrestrial and marine (Hamilton-Smith, Kiernan and Spate, 1998).

The significant environmental attributes of the Cape Range Province may be summarised as:

- biological diversity. There are 630 vascular plant species representing, unusually, all three botanical provinces of Western Australia (South-West, Eremean, Northern) with a number of species confined to Cape Range. The terrestrial fauna is also rich and diverse, particularly in reptiles. There are 14 species present are which declared rare or likely to become extinct. Marine fauna includes over 460 species of fish associated with Ningaloo Reef;
- karst and subterranean fauna. Limestone karst formations support one of the world's most diverse subterranean fauna with many species endemic to the area and which arguably provide evidence for continental drift following the break-up of supercontinents in past times;
- offshore islands. Valuable for nature conservation and need careful protection and management.
- coral reef. Ningaloo reef is Australia's largest fringing coral reef with high conservation, scientific and recreational values;
- landscape. Tertiary limestone canyons, coastal dunes, alluvial fans, tidal estuaries and Ningaloo Reef attest to outstanding landscape values which also emphasise the connection between land and sea on a grand scale;
- social and cultural. The Cape Range Province which includes the Cape Range National Park and the Ningaloo Marine Park represents an internationally recognised drawcard for tourism and recreation as well as supporting industries (including fishing, mining and pastoral) and providing regional infrastructure. Archaeological and ethnographic sites point to evidence of Aboriginal habitation for over 30 000 years, especially from middens. Whaling and pastoralism form part of post-European settlement history.

The Province is environmentally sensitive and should be managed using an ecosystem management approach, based on a sound understanding of the ecological interactions and processes that sustain the ecosystem structure and function. Management and environmental decisions also need to take account of human intergenerational equity.

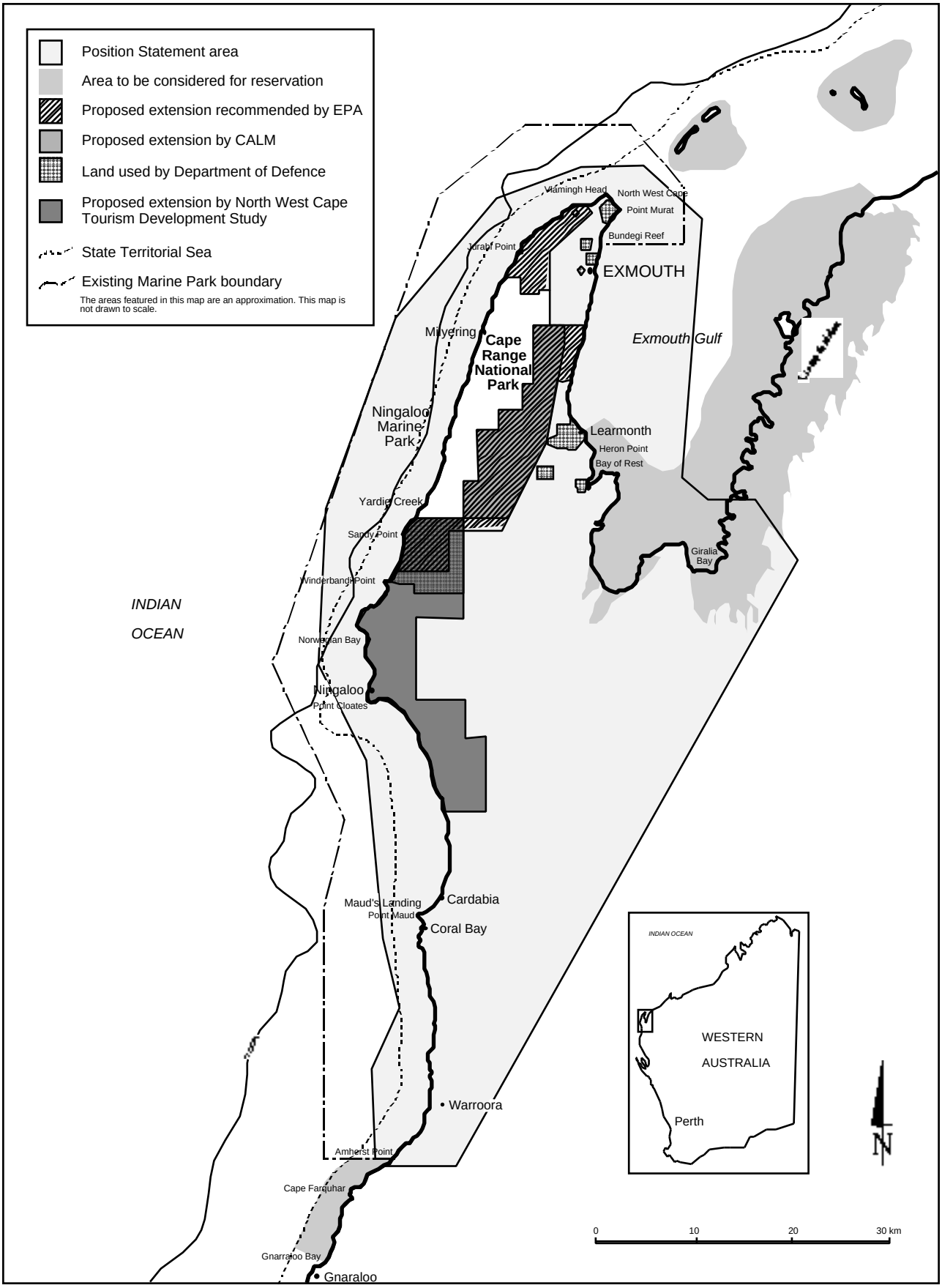


***Figure 1. Cape Range Province Position Statement area.***

## 1.2 Climate

The climate of the Cape Range Province is hot and arid with summer maximum temperatures of up to 47 degrees C. From 1976 - 1996 average rainfall was 234mm with falls occurring in both summer and winter (Shire of Exmouth, pers. comm.). Summer rainfall includes tropical cyclones which occur about every 3-5 years (WAPC, 1996). The low rainfall is accompanied by high evaporation rates of 1 700mm to 3 050mm per year, depending on seasonal conditions. Because of the low rainfall and high evaporation rate, potable water is very limited and is harvested carefully from within the sensitive karst systems.

## 1.3 Geology

Cape Range forms part of the Exmouth sub-basin of the Carnarvon Basin and the Province is underlain by about 10 km of sedimentary rocks. Those forming the Range itself are predominantly carbonate sediments of the Palaeocene – Miocene period and are about 500m thick.

Shallow water marine, alluvial, littoral and aeolian sediments of recent age form coastal plains on each side of the range.

The area is complex tectonically with the Cape Range Anticline forming a spine running approximately north – south which has been rising intermittently since the late Cretaceous.

It is the upper units (Tulki and Trealla Limestones) of the calcareous sedimentary rocks which have karstified and extensively eroded. These are about 100m thick.

The Cape Range Province includes important mineral resources, including limestone, oil and gas, and basic raw materials.

The regional water table occurs within the non-homogeneous karstic aquifer system (Allen, 1993).

## 1.4 Groundwater

The aquifer under Cape Range consists of four elements:

- vadose (free-draining) waters above the water table;
- a freshwater lens floating on, and grading into;
- brackish water that in turn rests upon;
- the seawater wedge beneath. (Hamilton – Smith et al, 1998.)

As such, it resembles that found on many islands, with a relatively thin freshwater layer, a diffusion zone about 20–30 metres thick where mixing to saline and fresh water occurs, and a low hydraulic gradient (Martin, 1990).

The water table lies a couple of metres above present sea level near the coast and rises to 15m altitude towards the inland part of the Water Corporation borefield. The aquifer is recharged both directly by rainfall and indirectly through the beds of ephemeral streams which carry storm runoff from the Range. However, limited recharge results in the thinness of the freshwater lens. The upper part of the aquifer is karst and has high permeability (Water Corporation, 1996).

# 2. SIGNIFICANT ENVIRONMENTAL ATTRIBUTES OF THE CAPE RANGE PROVINCE

## 2.1 Biological Diversity

### Terrestrial Flora

Although there is a lack of detailed botanical studies of the Cape Range area, the Province is known to be floristically rich and 630 species of vascular plants, grouped into seven major vegetation communities, have been identified by Keighery and Gibson (1993) within an area of 2 185 square kilometres. The area contains both tropical and temperate floras at the extremes of their ranges, 13 endemic taxa and seven others that are largely confined to the Cape Range peninsula. The Province also contains at least five unique minor vegetation communities confined to the limestone ranges themselves. These add to the scenic and floristic diversity of the Province. The flora is much more species-rich than other major arid and semi-arid karst areas of Western Australia, and even with the relative paucity of knowledge there are known to be more than twice as many species recorded from Cape Range than from other comparable areas in the same geographical region. Some indication of comparative floristic species richness is shown in Table 1.

**Table 1. Floristic species richness of various arid regions of W A** *(after Keighery and Gibson, 1993; and Keighery, pers. comm. (1999))*

| Region | Number of species | Area (km²) | Number of species per 1000 km² |
|---|---|---|---|
| Cape Range Peninsula | 630 | 2 185 | 288 |
| Carnarvon Botanical District | 2 100 | 91 046 | 23.1 |
| Fortescue Botanical District | 1 700 | 178 017 | 9.5 |
| Karijini National Park | 481 | 5 000 | 96.2 |
| Shark Bay Area | 855 | 5 000 | 171 |

The Cape Range peninsula is one of three major regions of massive limestone features in the State, the others being the Canning Basin Devonian Reef Complex in the Kimberley and the Nullarbor Plain (Keighery and Gibson, 1993). These three areas have very different limestone floras mainly because of the great distances between them and the different geographical localities and each is unique.

Table 2 compares the flora of Cape Range, Burrup Peninsula and Barrow Island.

### Terrestrial Fauna

The Cape Range area has a diversity of habitats and a correspondingly rich vertebrate fauna including 30 species of mammals (of which 8 were introduced by Europeans), 84 reptiles, 5 amphibians and about 200 birds (Kendrick, 1993). The bat fauna includes 11 species with representatives of both northern and southern species. Of the 84 species of reptiles, 13 are restricted to the area and one is endemic.

**Table 2. Comparison of the flora of Cape Range with two other areas in the same geographical area (Burrup Peninsula and Barrow Island)** *(after Keighery and Gibson, 1993)*

| Area of Comparison | No of species |
|---|---|
| Cape Range - Barrow Island | |
| Cape Range total species | 630 |
| Barrow Is total species | 270 |
| Species at Cape Range only | 481 |
| Species at Barrow Is only | 121 |
| Species common to both places | 149 |
| Combined total (including species common to both places) | 751 |
| Cape Range - Burrup Peninsula | |
| Cape Range total species | 630 |
| Burrup total species | 284 |
| Species at Cape Range only | 459 |
| Species at Burrup only | 113 |
| Species common to both places | 171 |
| Combined total (including species common to both places) | 743 |

The fauna of the area contains a number of species that have been listed under the Wildlife Conservation Act 1950 as rare or likely to become extinct:

Mammals

*Megaptera novaeangliae*, Humpback Whale
*Petrogale lateralis*, Black-footed Rock-wallaby or Warru
*Pseudomys fieldi*, Djoongari or Shark Bay Mouse

Reptiles

*Caretta caretta*, Loggerhead Turtle
*Dermochelys coriacea*, Leathery Turtle or Luth

Fish

*Ophisternon candidum*, Blind Cave Eel
*Milyeringa veritas*, Blind Gudgeon

Arachnids

*Draculoides bramstokeri*
*Draculoides vinei*, Cape Range Schizomid
*Hyella sp*. nov. BES 1154.2525.2546.2554, Camerons Cave Pseudoscorpion

Crustaceans

*Lasionectes exleyi*
*Stygiocaris lancifera*, Lance-Beaked Cave Shrimp
*Liagoceradocus branchialis*, Cape Range Liagoceradocus

Millipedes

*Stygiochiropus isolatus*
*Stygiochiropus peculiaris*, Camerons Cave Millipede
*Stygiochiropus sympatricus*

The fauna also contains two species that are listed under the Act as being otherwise in need of special protection:

Mammals
*Dugong dugon*, Dugong

Birds
*Falco peregrinus*, Peregrine Falcon (Western Australia, 1997)

A vast array of terrestrial invertebrate fauna inhabit the area but there is very little information regarding their regional significance (WAPC, 1996). Invertebrates play an important role in every ecosystem and represent about 98 percent of the earth's animals (EPA, 1992). The conservation status of most invertebrates is not known as most are still to be described by science.

### Cape Range National Park

Cape Range National Park covers about 50 580 hectares of the Cape Range feature near Exmouth (Figure 1). The park contains a dissected limestone range and fringing coastal plain directly adjacent to the northern part of the Ningaloo Marine Park. The Cape Range peninsula is exceptionally rich environmentally and has been described in numerous publications including Humphreys (1993).

Extensions to the Park, to include land to the north, east and south are planned but have not yet been implemented.

The National Park is managed under an approved Management Plan by the Department of Conservation and Land Management (Department of Conservation and Land Management, 1987).

## 2.2 Karst

### Karst Formations and Subterranean Fauna

The Province contains extensive karst formations and has been identified as a possible World Heritage area (Hamilton-Smith et al, 1998). Resolution 6.5 of the Sixth Conference of Contracting Parties to the Ramsar Convention (held in Brisbane in 1996) also has implications for the Cape Range Province. This Resolution urged Contracting Parties to assess the significance of karst and cave wetland systems within their territories and to consider their designation for the List of Wetlands of International Importance.

Two types of subterranean fauna live in the region - troglobites (terrestrial) and stygofauna (aquatic) faunas. Both of these are important because of their species richness, evolutionary history and adaptations, and the evidence they can provide for continental drift. Hence they are significant in terms of Australian faunal biodiversity (EPA, 1997d). Major hydrological changes would be a threat to both kinds of cave faunas (Humphreys and Adams, 1990).

Hamilton-Smith et al, (1998) state that "the most celebrated attribute of the Cape Range karst at present is its cave fauna. It is the richest and most diverse troglobite community in Australia, and probably in the world " (p.35) and "Although only very limited investigation has been focussed on the area, it has already proven to contain a richness well in excess of that which has been revealed by many decades of detailed investigation elsewhere" (p. 37) including areas where the research effort has been more than 100 times greater than in Cape Range. Cape Range so far has been shown to contain 67 subterranean species of which 41

are terrestrial and 26 are aquatic and there are distinct eastern and western components of the fauna because of isolation of provinces on the eastern and western sides of Cape Range.

Much of the aquatic cave fauna (stygofauna) occurs only in the zone where sea water and freshwater meet and diffuse into each other (the anchialine zone) and any change to the relative levels of sea water and the fresh groundwater could pose a threat to the fauna. Initial work indicates that anchialine systems are very complex and the fauna they contain can be threatened by changes in soil cover, associated algae and changes in the denitrifying bacteria within the zone.

According to Main (1993) the significance of the presence of troglobitic fauna in caves at Cape Range is not reduced by the fact that such relics may occur elsewhere, for example in the boulder beds underneath major rivers of the north west of Western Australia.

Management of karst at Cape Range may be guided by local adaptation of international policies and practices such as Guidelines for Cave and Karst Protection (Watson et al, 1997).

## Stygofauna

The Cape Range area contains a great diversity of aquatic animals that are specially adapted to subterranean life. The subterranean aquatic fauna (stygofauna) is endemic to the Cape Range peninsula and inhabits the groundwaters of the fringing plain (Humphreys, 1993) and contains a class, orders, genera and species not otherwise represented in the southern hemisphere.

The stygofauna are unrelated to that of other karst regions of Australia, and its closest relatives are found in some islands in the North Atlantic. The fauna are believed to have a common origin dating from the time the Tethys Ocean formed, breaking up the supercontinent of Pangaea into the northern continental mass of Laurasia and the southern mass known as Gondwana (Humphreys, 1994).

Most recorded stygofauna are found living in the fresh-to-brackish groundwater lens which lies over the deeper saline groundwater of the Cape Range peninsula coastal plains. Some species have been recorded below the saltwater interface of inland caves connected at depth to the sea.

“The distribution of the aquatic cave fauna (stygofauna) is determined by the hydrology of the area. The coastal plain contains a network of subterranean waterways, small sink-holes and artificial wells in caverns and fissures in limestone beneath the narrow coastal plain (1-5km wide and 70km long) that lies beneath Cape Range and the Indian Ocean on both sides of the peninsula” (AHC, 1997).

The stygofauna found on the coastal plains are more likely to be widely distributed than the troglobitic fauna because of the high degree of interconnectedness of the cavernous coastal plain limestone. The degree of connection between the eastern and western coastal plains of the Cape Range peninsula is likely to be limited as there is evidence of genetic differences between the east and west populations (EPA, 1997d). This is important in terms of biodiversity.

## Troglobitic Fauna

Troglobitic fauna are terrestrial animals which are specially adapted to living underground in air-filled, high humidity caves. They are also found in interstitial fissures and crevices in rocks (Humphreys, 1993).

The Cape Range was given interim listing on the Register of the National Estate by the Australian Heritage Commission (AHC) in 1997 and the AHC's Official Statement of Significance for Cape Range states:

*"The karst and subterranean environments of the Cape Range peninsula offer a glimpse of the palaeo-history of the region from Tethyan times through the Miocene, Pliocene, Pleistocene and Quaternary to the present.*

*Cape Range peninsula contains a rich and diverse troglobite fauna. With at least 55 species of troglobite it is amongst the world's most faunistically diverse karst areas. It supports a rich troglobite and troglophile arachnid and myriapod fauna which comprises approximately half of the known terrestrial fauna of Australia.*

*The place has high generic endemism… and the cave fauna is highly significant for its biogeographic values. The affinities of the fauna are varied but a large element of the terrestrial fauna is derived from the humid tropics and is a relict from times when humid forest covered this region. The caves have become an important refuge for species with humid tropical affinities in a harsh semi-arid tropical environment.*

*The caves and cave ecosystems are of significance in recording climate change since the Miocene. The cave systems of Cape Range are fossil and were clearly formed under more humid conditions, as evidenced by the cave fauna. Stalagmite growth has been extraordinarily slow, suggesting that the climate has not been substantially wetter than at present over the last 170 000 years.*

*The caves and subterranean waterways of the Cape Range and surrounding coastal plain are of critical importance in maintaining the troglobitic fauna of the peninsula.*

*The place contains a wealth of bio-climatic information in the fossil speleotherms, the Tethyan affinities of the stygofauna and the relictual tropical rainforest fauna found in the caves, making it valuable for research into evolutionary processes and climate change." (AHC, 1997)*

## 2.3 Coral Reef

### Ningaloo Marine Park

The Ningaloo Marine Park covers an area of 4 300 square kilometres and includes waters under State and Commonwealth jurisdictions, as well as the coastal strip between Winderbandi Point and Amherst Point (see Figure 1). The Marine Park is managed as one unit by the Department of Conservation and Land Management under an agreement with Environment Australia (Commonwealth).

The Ningaloo Reef is extensive, the reef proper commencing in the vicinity of Gnarraloo Bay to the South and running around into the Exmouth Gulf to Bundegi Reef, a distance of over 270 km. The Ningaloo Reef lagoon varies in width from about 200 m to over 6 km. The reef contains over 460 species of fish and 200 species of corals and is famous internationally for its diving and predictable visitation by whalesharks, the largest species of fish in the world.

The available information on the Ningaloo Reef is limited and baseline data are required to facilitate decision-making on marine protection and management. However, it is recognised that Ningaloo Reef has significant conservation, recreation, commercial, educational, historical and research values at national and international levels.

The reef is the largest fringing coral reef in Australia with a high species diversity and high densities of recreationally-important fish species. Many beaches fringing the reef are nesting

sites for several species of marine turtles. Marine mammals, including dugongs, occur in small numbers within the lagoon and humpback whales often pass close to the reef on their annual migration routes. Other whales, including killer whales, are also seen, and whale sharks visit between March and June congregating just after the annual coral spawning around March and April (Colman, 1997).

The Marine Park is managed under an approved Management Plant by the Department of Conservation and Land Management (Department of Conservation and Land Management, 1989).

## 2.4 Landscape

Cape Range forms a backbone to the Province and rises to about 300m. It consists of Tertiary Sediments with cave and karst features characteristic of limestone environments. The surface has deep canyons and alluvial faces to the west providing spectacular scenery. Ningaloo Reef with its proximity to shore and protected waters provides accessible submarine coral reef terrains. Coastal terrains on the west of the peninsula are superb examples and have major implications for the understudy of landform evolution in the region (Hamilton–Smith et al, 1998). On the eastern shore of Exmouth Gulf are tidal flats bordered with extensive mangroves and algal mats.

## 2.5 Archaeological Resources

The Cape Range area contains a broad range of archaeological sites including pre-figurative art and there is evidence of human habitation of the area for over 30 000 years. Artefacts, rock art and baler shells near cave water sources show that Aboriginal people used the upland areas.

## 2.6 Exmouth Gulf Marine Environment and Mangrove Systems

The Report of the Marine Parks and Reserves Selection Working Group (CALM, 1994) recommended that the nearshore waters on the eastern and south-western sides of Exmouth Gulf be considered for reservation for the protection of mangal habitat, prawn and fish nursery areas, turtle and dugong feeding areas, and coastal marine fauna and flora generally. In addition, it was suggested that the reservation of a small section of the coastline near Exmouth would adequately represent the western shore habitats. These recommendations emphasise the importance of the Exmouth Gulf for nature conservation and for sustaining local fisheries.

The Working Group also recommended that consideration be given to a southern extension of the State portion of the Ningaloo Marine Park as far as Gnaraloo Bay so as to include the full length of the Ningaloo Reef and that Commonwealth government authorities consider doing likewise in Commonwealth waters.

The eastern side of Exmouth Gulf (the Giralia Bay to Yanrey Flats mangrove area) is identified as being an area for conservation because of its extensive mangal habitat and importance to the fisheries of Exmouth Gulf. A small area on the western side of the Gulf (the Bay of Rest) is also identified as being a significant mangrove area.

# 3. STATUS OF KNOWLEDGE OF THE CAPE RANGE PROVINCE

The special attributes of the area are known in general terms but much of the detailed knowledge regarded as essential for determining detailed environmental quality objectives for the Cape Range Province is not yet available. However, the Cape Range Province provides an opportunity to protect a collection of unique environmental values of international significance and enough is known to begin to take a systems approach to environmental protection and management, where known characteristics of karst environments, such as fauna habitat, groundwater quality and quantity, provide the key to environmental protection and management.

For example, karst environments are highly integrated and depend on maintenance of groundwater quality, hydrological regime and native vegetation cover. These factors are particularly relevant in an arid region.

In this context, it is important to make the distinction between data, information, and knowledge. More research and information are needed to define the requirements for ecologically sustainable development and the fundamental ability of the ecosystems to withstand development pressures. However, there is a risk that work approached in a site-specific, sectoral manner may not augment knowledge of the systems and may not add to a useful knowledge base to improve environmental decisions and management. Ideally investigations need to be coordinated between sites and carried out in an integrated manner to address the environmental linkages and cumulative impacts. It is therefore important that research and investigations carried out by proponents within their individual project area, for example into troglobites, identify patterns of species occurrence, and populations and assemblages, as well as contributing to improving knowledge and understanding about these fauna in the area as a whole. This will increase overall knowledge which will facilitate ongoing protection and management. Until this approach is adopted and sufficient data exist, the only way to ensure adequate protection of these species is by protecting the large ecosystem units, in particular the karst formations, aquifers and wetlands.

A geographic information system (GIS) based data-set for the Cape Range Province has the potential to provide a very useful planning and management tool. A GIS would provide a model of that environment which could be used to examine the prospects for, and extent of, likely impacts from current or proposed activities in the area. Information from the GIS would provide direct input to land use planning and management. A GIS is particularly efficient at providing information as maps for timely and focussed presentations to decision makers and, with some notice, can be used interactively to explore scenarios.

As more information is gained about the Cape Range Province, the understanding of environmental threats and the knowledge about management requirements of the systems increases. This should reduce risk and uncertainty and enhance the opportunity for development of improved environmental management measures.

# 4. EPA OBJECTIVES FOR ENVIRONMENTAL PROTECTION OF THE CAPE RANGE PROVINCE

The EPA's objectives for the environmental protection of the Cape Range province are:

(i) To protect the environmental quality of all environmental systems; and

(ii) To ensure that all environmental systems are managed in accordance with the principles of ecologically sustainable development and the National Strategy for the Conservation of Australia's Biological Diversity.

# 5. EPA PRINCIPLES FOR ENVIRONMENTAL PROTECTION OF THE CAPE RANGE PROVINCE

The key to long term environmental protection and management of the Cape Range Province is to carry out development and environmental management in a manner which ensures that the long term ability of the area to accommodate human use pressures is not exceeded. The development potential of the area is based upon its natural resources. For example, horticulture and pastoral uses depend upon water availability and land capability. Aquaculture requires good water quality. Limestone mining seeks to extract high grade limestone. Water-based recreation is important for tourism (Ministry for Planning, 1998). The key constraints relate to:

- the availability of potable water;
- the availability of land which is properly suitable for development, taking account of environmental constraints;
- the maintenance of ecological processes and important habitats;
- the needs of conservation, including feral animal control;
- the need for key infrastructure to support a reasonable level of development.

To address the above, the following principles should be used to underpin environmental assessment and decision-making in the Province.

1. The Cape Range Province should be managed according to sound ecologically sustainable development and biodiversity protection principles as outlined in Appendix 2.

2. The natural attributes of the area impose constraints on the type and amount of development that can be accommodated within the limits of long term environmental acceptability. It should not be presumed that the current types of development in the area set any precedent for the environmental acceptability of any subsequent development proposal.

3. To protect the unique natural assets and ensure development is ecologically sustainable in the long term, there should be a presumption that development is required to clearly demonstrate, through relevant research and knowledge, that the implementation of a properly planned and managed development will protect or enhance the multiple environmental values of the area. Moreover, development with potentially threatening processes to the maintenance of ecological integrity will need to demonstrate avoidance or amelioration of threatening processes to acceptable levels.

4. As a means of protecting the natural attributes of the area, including where appropriate the “sense of wilderness”, development in the Cape Range Province should be consistent with and enhance the natural assets of the area and should contribute to improving environmental knowledge and management.

5. Allocation of water should recognise that consumptive use can potentially impact on the ecological values of the karst systems, as well as fauna and flora, and should be in accordance with the following key principles from the “National Principles for the Provision of Water for Ecosystems” (ARMCANZ/ANZECC, 1996):

(a) that natural ecological processes and biodiversity are sustained (i.e. that ecological values are sustained) (ARMCANZ/ANZECC, 1996, p. 9);

(b) that all water uses should be managed in a manner which recognises ecological values (ARMCANZ/ANZECC, 1996, p. 11); and

(c) that appropriate demand management and water pricing strategies should be used to assist in sustaining ecological values of water resources (ARMCANZ/ANZECC, 1996, p. 11).

Additional specific guidance on water use and management to protect karst, stygofauna and troglobytic fauna is given in Appendix 3.

6. In all instances, developments should be of the highest quality "best practice" with continuous improvement through an environmental management system. This should include ongoing research to foster knowledge of the area to enable better planning and management.

7. Baseline environmental data should be established to enable proper identification of levels of environmental change. These should be funded and carried out as a matter of urgency. It would be useful to develop a geographic information system (GIS) for the Cape Range Province using existing data sets and to accommodate new information as it arises.

8. Research results should form the basis of future decision-making to an even greater extent than for other areas of the State. One such area of research is the relationship between the level of development and the ongoing health and management of the marine and terrestrial parks, as well as other karst areas. Another priority research area relates to the protection and management of troglobitic fauna and the vulnerability of subterranean ecosystems to nutrient enrichment and other forms of pollution.

9. In assessing environmental acceptability of development proposals and meeting the environmental objectives for projects within the policy area, the EPA will employ the Precautionary Principle (Deville and Harding, 1997). This provides a means of considering environmental impacts where a high value element of the environment would be affected by development, and there is lack of knowledge, or insufficient knowledge, or uncertainty about potential impacts and management of impacts and cumulative effects. Where the impacts of a development are reversible, the EPA may advise that the development may be environmentally acceptable if an adaptive environmental management approach, using the Precautionary Principle, is adopted. An example is abstraction of water from bores where if detrimental impacts are detected, abstraction from the bore can be stopped.

   The key considerations for applying the Precautionary Principle are addressed further in Appendix 4.

10. From the environmental perspective, there should be no major development permitted on the west side of Cape Range. In this context, west side refers to the coastal area located within Planning Units 2 and 3 in the Exmouth-Learmonth Structure Plan North West Cape (Ministry for Planning, 1998). Residential development should be confined to the existing townsite (Ministry for Planning, 1998; Select Committee, 1995; Western Australian Government, 1997).

Although it may be appropriate to establish some low key, high quality ecolodge wilderness lodge/camping tourism areas on the west coast, these should be designed to meet, inter alia, the principles above, and the specific criteria (developed by the Department of Environmental Protection and Ministry for Planning) prior to referral to the EPA.

11. All development proposals should take account of the above principles, and, if pursued, should be subject to environmental impact assessment. This should include, inter alia, consideration of alternative sites for the development outside the Cape Range Province, detailed consideration of on-site and off-site impacts of the development, as well as the cumulative effect of all proposed developments in the area on environmental values and ecological processes.

12. Proposed extensions to the Cape Range National Park and the Ningaloo Marine Park should be considered by government and the decision implemented as a priority.

# 6. SELECTED BIBLIOGRAPHY

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# APPENDIX 1

## Glossary

anchialine - near coastal subterranean waters, usually with a layer of freshwater lying over seawater, that are under tidal influence but have only subterranean connections with the sea. They typically occur in volcanic or limestone bedrock.

anchialine wetland (or zone) - a wetland where sea water and freshwater meet and diffuse into each other. Any change to the relative levels of sea water and the fresh groundwater could pose a threat to the fauna they contain. Initial work indicates that anchialine systems are very complex and the fauna they contain can also be threatened by changes in soil cover, associated algae and changes in the denitrifying bacteria within the zone.

endemism - a term applied to a plant or animal to indicate that it is restricted naturally to a particular region.

arachnid - a member of the animal class Arachnida which includes spiders, ticks, mites, scorpions and other animals.

ecolodge - "development that has regard to long-range environmental and natural resource conservation and symbioses with human communities. It is the uniqueness of certain environments that creates curiosity for tourism. In providing facilities and activities for visitors, special care must be taken not to destroy the very resources or qualities they come to experience. In the ideal situation, if development is necessary, it would be constructed from natural sustainable materials collected on-site, generate its own energy from renewable resources such as solar or wind, and manage its own waste" (The Ecolodge Sourcebook for Planners and Developers, 1995).

ephemeral - seasonal, not permanent (of streams). Having a short life cycle eg ephemeral plants complete their life cycle within a single season.

ESD (ecologically sustainable development) — see Appendix 2.

The term ESD recognises that continued economic development and improved quality of life are dependent on the effective management of natural resources, including the maintenance of ecosystems. ESD has been adopted by the Australian Government and through the Intergovernmental Committee on Ecologically Sustainable Development (ICESD) and influences environmental protection in Western Australia.

Gondwana - the great southern continent formed by the split of Pangaea in the middle Jurassic, Gondwana later divided further to give rise to the southern continents of Australia, Antarctica, Africa and South America.

karst - term used to describe landscapes that are commonly characterised by closed depressions, subterranean drainage and caves. Karst landscapes are formed principally by solution of the rock, most commonly limestone and its close relatives (definition from Hamilton-Smith et al, 1998, p 8).

Laurasia - a supercontinent formed in the middle of the Jurassic Period by the separation of Pangaea into northern and southern elements. Laurasia later divided into Asia, Europe and North America.

Mesozoic - the geological time period occurring from about 240 million to 67 million years ago.

myriapod - an animal in the millipede group.

Pangaea - a great landmass of the Mesozoic Era consisting in the early Jurassic (about 185 million years ago) of North America, South America, Africa, Europe, Asia, Australia and Antarctica. Later in the Jurassic, Pangaea split into two supercontinents, a southern element called Gondwana and a northern element called Laurasia.

Pleistocene - the geological time period occurring from about 1.8 or 1.5 million years to 11 000 years ago during which four great ice ages occurred.

Pliocene - the geological time period occurring from about 5 million to 1.8 or 1.5 million years ago.

Quaternary - the most recent of the geological time periods including the Pleistocene (see above) and Recent (also known as Holocene) which commenced after the last ice age about 11 000 years ago and continues to the present.

refugia - plural of refugium. Areas that have been protected from great changes in the environment (eg climate, flood, fire) so that a relic population of plants or animals has been able to continue to exist.

relictual/relict/relic - a surviving individual, population, community or species that is characteristic of an earlier period in evolutionary history. Also an area to which a once more widespread population, species or community is now confined.

speleotherm (sic); speleothem -secondary deposition in caves (commonly calcite or aragonite) forming the cave decoration such as stalagmites.

stalagmite - a column of calcium carbonate formed on the floor of the cave when water containing dissolved minerals drips from the roof.

stygofauna - fauna living in groundwater.

Tethyan - derives from the word Tethys which was the ancient sea that in the Jurassic separated the landmasses of the northern continent of Laurasia from the southern continent of Gondwana. It was a vast ocean which spread from the Caribbean through the Mediterranean to the north of Australia. Faunas with Tethyan links are therefore extremely old.

Tethys - see above.

troglobitic - fauna living permanently underground and generally beyond the daylight zone of a cave.

troglophile - an animal capable of living its entire life cycle in caves but without any obvious morphological adaptation.

troglofauna - a general term for all cave fauna.

wilderness lodge (see ecolodge)

World Heritage - sites should meet one or more of the following criteria and fulfil the conditions of integrity set out below:

"36 …

(a) (i) be outstanding examples representing the major stages of the earth's evolutionary history; or

(ii) be outstanding examples representing significant ongoing geological processes, biological evolution and man's interaction with his natural environments as distinct from the periods of the earth's development, this focuses upon ongoing processes in the development of communities of plants and animals, landforms and marine areas and fresh water bodies; or

(iii) contain superlative natural phenomena, formations or features, for instance, outstanding examples of the most important ecosystems, areas of exceptional natural beauty or exceptional combinations of natural and cultural elements; or

(iv) contain the most important and significant natural habitats where threatened species of animals or plants of outstanding universal value from the point of view of science or conservation still survive;

and

(b) also fulfil the following conditions of integrity:

(i) the sites described in 36(a) (i) should contain all or most of the key interrelated and interdependent elements in their natural relationships; for example, an 'ice age' area would be expected to include the snow field, the glacier itself and samples of cutting patterns, deposition and colonisation (striations, moraines, pioneer stages of plant succession, etc.)

(ii) The sites described in 36(a)(ii) should have sufficient size and contain the necessary elements to demonstrate the key aspects of the process and to be self-perpetuating. For examples, an area of tropical rain forest may be expected to include some variation in elevation above sea level, changes in topography and soil types, river banks or oxbow lakes, to demonstrate the diversity and complexity of the system.

(iii) The sites described in 36(a)(iii) should contain those ecosystem components required for the continuity of species or of the other natural elements or processes to be conserved. This will vary according to individual cases; for example, the protected area of a waterfall would include all, or as much as possible, of the supporting catchment area; or a coral reef area would include the zone necessary to control siltation or pollution through the stream flow or ocean currents which provide its nutrients.

(iv) The area containing threatened species as described in 36(a)(iv) should be of sufficient size and contain necessary habitat requirements for the survival of the species.

(v) In the case of migratory species, seasonable sites necessary for their survival, wherever they are located, should be adequately protected. Agreeements made in this connection, either through adherence to international conventions or in the form of other multilateral or bilateral arrangements would provide this assurance.

(vi) The sites described in paragraph 36(a) should have adequate long-term legislative, regulatory or institutional protection. They may coincide with or constitute part of existing or proposed protected areas such as national parks. If not already available, a management plan should be prepared and implemented to ensure the integrity of the natural values of the site in accordance with the Convention…" (UNESCO, 1988).

# APPENDIX 2

## National principles for environmental protection

### 1. InterGovernmental Agreement on the Environment

- *precautionary principle* (IGAE, 1992, section 3.5.1)

Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:

(i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and

(ii) an assessment of the risk-weighted consequences of various options.

- *intergenerational equity* (IGAE, 1992, section 3.5.2)

The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

- *conservation of biological diversity and ecological integrity* (IGAE, 1992, section 3.5.2)

Conservation of biological diversity and ecological integrity should be a fundamental consideration.

### 2. National Strategy for Ecologically Sustainable Development

In the National Strategy for Ecologically Sustainable Development, the following definitions are given:

"using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained and the total quality of life, now and in the future, can be increased" (Commonwealth of Australia, 1992, p.6).

The Goal of the strategy is "Development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends" (p.8).

There are seven guiding principles and three core objectives in the strategy. These and the core objectives form a package and no objective or principle predominates over the others. The guiding principles are:

- "decision-making processes should effectively integrate both long and short-term economic, environmental, social and equity considerations.
- where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation.
- the global dimension of environmental impacts of actions and policies should be recognised and considered.
- the need to develop a strong, growing and diversified economy which can enhance the capacity for environmental protection should be recognised.

- the need to maintain and enhance international competitiveness in an environmentally sound manner should be recognised.
- cost effective and flexible policy instruments should be adopted, such as improved valuation, pricing and incentive mechanisms.
- decisions and actions should provide for broad community involvement on issues which affect them." (Commonwealth of Australia, 1992, p.8)

## 3. National Strategy for the Conservation of Australia's Biological Diversity

The principles and many of the objectives in the National Strategy for the Conservation of Australia's Biological Diversity (Commonwealth of Australia, 1996) provide useful guidance for the protection and environmental management of the Cape Range area. Specific objectives from this document which are relevant include:

"Conservation of biological diversity across Australia

- Identify important biological diversity components and threatening processes. (Objective 1.1)
- Establish and manage a comprehensive, adequate and representative system of protected areas covering Australia's biological diversity. (Objective 1.4)
- Strengthen off-reserve conservation of biological diversity. (Objective 1.5)
- Enable Australia's species and ecological communities threatened with extinction to survive and thrive in their natural habitats and to retain their genetic diversity and potential for evolutionary development, and prevent additional species and ecological communities from becoming threatened. (Objective 1.7)
- Recognise and ensure the continuity of the contribution of the ethnobiological knowledge of Australia's indigenous peoples to the conservation of Australia's biological diversity. (Objective 1.8)
- To complement in-situ measures, establish and maintain facilities for ex-situ research into and conservation of plants, animals and micro-organisms, particularly those identified by action taken in accordance with Objective 1.1. (Objective 1.9)

*Integrating biological diversity conservation and natural resource management*

- Develop and implement national integrated policies for the ecologically sustainable use of biological resources. (Objective 2.1)
- Achieve the conservation of biological diversity through the adoption of ecologically sustainable agricultural and pastoral management practices. (Objective 2.2)
- Manage water resources in accordance with biological diversity conservation objectives and to satisfy economic, social and community needs. (Objective 2.5)
- Achieve conservation of biological diversity through the adoption of ecologically sustainable management practices for tourism and recreation. (Objective 2.6)

*Managing threatening processes*

- Monitor, regulate and minimise processes and categories of activities that have or are likely to have significant adverse impacts on the conservation of biological diversity and be able to respond appropriately to emergency situations. (Objective 3.1)

- Ensure measures are in place to retain and manage native vegetation, including controls on clearing. (Objective 3.2)
- Control the introduction and spread of alien species and genetically modified organisms and manage the spread of native species outside their historically natural range. (Objective 3.3)
- Minimise and control the impacts of pollution on biological diversity. (Objective 3.4)
- Reduce the adverse impacts of altered fire regimes on biological diversity. (Objective 3.5)
- Repair and rehabilitate areas to restore their biological diversity. (Objective 3.7)
- Ensure that the potential impacts of any projects, programs and policies on biological diversity are assessed and reflected in planning processes, with a view to minimising or avoiding such impacts. (Objective 3.8)

*Improving our knowledge*

- Provide the knowledge and understanding of Australia's biological diversity essential for its effective conservation and management. (Objective 4.1)

*Implementation*

- Implement the strategy through priority actions within established timeframes. (Objective 7.1)
- Ensure that appropriate arrangements are established to implement the National Strategy for the Conservation of Australia's Biological Diversity and monitor its effectiveness. (Objective 7.2)
- Ensure that the National Strategy is complemented by State and Territory and bio-regional strategies, supported by effective legislation where necessary. (Objective 7.3)
- Ensure that the costs of biological diversity protection are equitably shared, such that they reflect contributions to degradation and benefits from protection or use. (Objective 7.4)" (Commonwealth of Australia, 1996).

# APPENDIX 3

## Guidance for water management to protect ecological values of the Cape Range Province

The environmental objectives for water management in the Province are:

(i) to manage the area so that the human carrying capacity of the resources is not exceeded. operationally, this means that augmentation of on -site water supply from desalination or other means should not occur;

(ii) to ensure protection of water-dependent ecosystems within the karst formations;

(iii) to ensure that human activities do not permanently influence the position of the saline freshwater interface either laterally or vertically, or damage fragile ecosystems;

(iv) to ensure sustainable use of the scarce water resources occurring in the area, in accordance with (i) to (iii).

Provision and management of water should be according to the following:

(a) To ensure a high standard of water management , abstraction of all water for all uses should be coordinated, managed and monitored by a single agent who has day to day production and monitoring responsibilities and is located in the Exmouth area (currently the provider for Exmouth water supply is the Water Corporation). This responsibility for coordinated management should include industrial and domestic bores as well as those at the Harold E Holt base where salinisation of the freshwater lens has already occurred some years ago. If the deep saline artesian/sub-artesian aquifer not yet exploited is to be developed it should also come under the day to day management of the single provider.

(b) Unless monitoring indicates that production of water should be reduced, the current Water Corporation borefield (including existing bores and the approved extensions) combined with bores from other users of shallow groundwater should be taken as the total amount of water available for development in the Cape Range Province. This forms a key to limiting human carrying capacity to sustainable levels.

(c) To manage water abstraction to ensure that karst formations and wetlands are protected, all bores in the area should be licensed and abstraction from all bores should be coordinated through a single provider with day to day management responsibility. As the major abstracter in the area, an on-site presence and good monitoring systems, the Water Corporation should be the current focus for this coordinated management.

(d) Total water use on the Cape Range Peninsula should be constrained and maximum recovery and reuse should be implemented with sufficient treatment to reduce nutrient and pollutants loads to levels adequate to protect karst systems. Total water cycle includes water supply for all purposes (environmental, domestic, industrial, irrigation), water collection, treatment and disposal.

(e) Activities with the potential to produce elevated nutrients or pollutants in water should be carefully designed, sited and managed. Nutrient losses to karst systems should be prevented and activities requiring application of large amounts of nutrients, such as horticulture, should be avoided. Treatment should be implemented to minimise nutrients and pollutants prior to any secondary use affecting karst.

# APPENDIX 4

## An assessment and decision-making approach for development in the Cape Range Province (after Deville and Harding, 1997)

Because of the diversity of environmental values and lack of a specific management-oriented knowledge base on the area, a conservative and prudent approach to future decision-making about the area should be adopted. Maintaining ecosystem processes within the karst provides the key to protecting environmental quality across a broad range of environmental values. The main areas are:

- maintenance of key habitats (a no net loss goal);
- maintaining native vegetation communities;
- protecting groundwater quality and quantity and hydrological processes;
- protecting marine water quality; and
- maintenance of landscape integrity and key features.

Wherever a high value element of the environment would be affected by development, and there is lack of knowledge, insufficient knowledge, or uncertainty about the potential impacts and management of the impacts in the environment of the Cape Range Province, the Precautionary Principle should be used as a tool to underpin decision-making. In deciding whether or not to apply the Precautionary Principle in a given situation, the critical considerations are;

(a) identifying the threats to the environment from the proposal (including cumulative). There are three classes to consider - threats that are known, threats that cannot be determined or quantified because of lack of knowledge, and threats that we are not even aware may exist because we may not yet be aware that what we do not know may be important in the long term (epistemological threats).

(b) identifying the seriousness of the threats. This should consider all aspects of the threats to determine their significance, including spatial scale, magnitude of impacts, value of the threatened environment, temporal scale of possible impacts, interconnectedness of the impacts of the activity, cumulative impacts in the Province and manageability, including knowledge specific to and essential for environmental management in the Cape Range Province.

(c) establishing whether the threats are reversible or irreversible and over what time frames, allowing for major climatic perturbations that have the potential to impede recovery.

(d) examining the likelihood of the threats occurring (estimates of risk) and certainty about the threats to the environment; and finally

(e) where there is reasonable scientific certainty and a high degree of confidence about the threats, establishing the most appropriate preventative measures that should be applied.

A high degree of threat to a high value environmental element with low level of knowledge of how to manage the impact would be likely to mitigate against a proposal being found to be environmentally acceptable. Significant threats to the environment, even with a high degree of scientific certainty would also be likely to militate against a proposal being found to be environmentally acceptable (Figure 2).

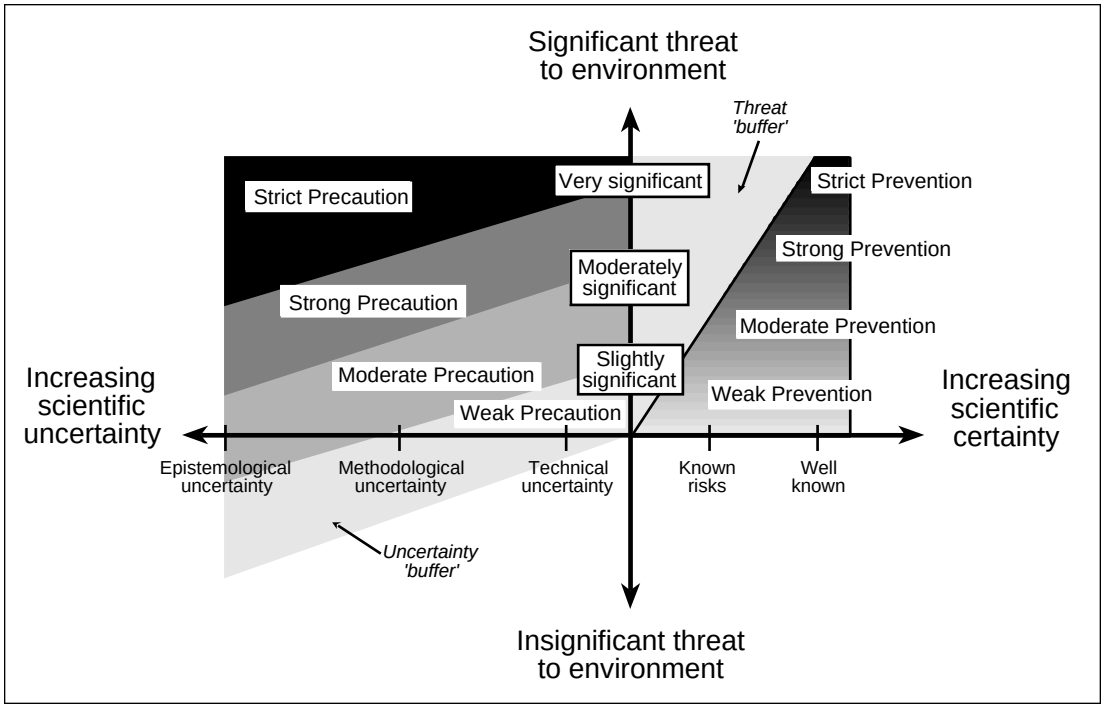


***Figure 2. Determining degrees of precaution*** (Deville and Harding, 1997, p.38)