AUSTRALIA'S OCEAN POLICY

Biodiversity Conservation: The major issues relating to the effective conservation of biological diversity in Australia's marine realm.

Biodiversity Conservation - Issues Paper 7

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PREFACE

Providing for the conservation of Australia's marine biological diversity in the face of existing and increasing pressures from human activities is a central component in developing a national Oceans Policy. In this review paper we define the key conservation issues that will need resolution to ensure that marine biological diversity within our jurisdiction is conserved. These issues are related to government or private-sector policies, strategies and plans: they must be addressed in the development and implementation of an Australian Oceans Policy and consequential strategies and actions for its implementation.

The biological and policy context of the key issues is only briefly described, as they are detailed in other Oceans Policy Planning and Management papers. Our aim for this review is to identify and describe the major issues relating to the effective conservation of biological diversity in Australia's marine realm. We outline the actions within the National Oceans Policy context that are needed to ensure that biodiversity is conserved and managed effectively now and in the future.

Our review draws on extensive scientific and technical data and information, including marine and terrestrial best practice in Australia and overseas, but we have tried to avoid technical language and jargon.

The review was conducted for the Portfolio Marine Group of Environment Australia, between 22 September and 14 November, 1997. It was supported by a workshop with a panel of additional experts, held in Canberra on 29 to 31 October 1997. We gratefully acknowledge the time and willing participation of those who attended the workshop (Appendix A1). We also gratefully acknowledge the extensive support and input from staff in the Portfolio Marine Group (Gordon Anderson, Adrianne Waterman, Neal Hardy, Suzanne Ferguson) and in CSIRO Marine Research (Helen Webb, Vivienne Mawson).

EXECUTIVE SUMMARY

Australia's Exclusive Economic Zone is one of the world's biggest: about 16 million square kilometres. It extends from Antarctic waters to the tropics and contains a large portion of the southern hemisphere's marine biological diversity, including many unique and threatened species. There are few such mega-diverse environments on Earth.

Our knowledge of this vast area is inadequate. For example, the massive seamounts rising thousands of metres from the ocean bed south of Tasmania are almost unknown to science, although we have discovered that their waters contain a very diverse and largely endemic fauna. In some even deeper waters, there have been no studies at all.

Our lack of geographically comprehensive and long-term scientific information is a key issue affecting the management of the marine environment, particularly the conservation of its biological diversity.

Australia's marine biodiversity is a highly significant element of the nation's natural wealth. Intrinsically valuable as the product of hundreds of millions of years of evolutionary history, and as a gene pool for the future, it is also of great commercial, cultural and recreational value to all Australians.

The main threats to the biological diversity of our oceans and estuaries are habitat loss and degradation; declining water quality and sedimentation; unsustainable use of marine and coastal resources; and introduced marine pests.

We have the skills to tackle these issues and we have, perhaps, just this one opportunity to change ineffective management practices by moving away from existing fragmented arrangements towards an integrated and strategic approach with a wider view.

That wider view is a central platform of the 1997 Oceans Policy consultation paper. It recognises that only through integrated regional management can the full range of users and impacts on marine ecosystems be identified, understood and managed on an ecologically meaningful scale. It encourages management of the marine environment within an ecosystem-based framework, acknowledging the need for multiple-use management and linking key ma

GLOSSARY OF KEY TERMS

Integrated In the context of integration of management processes, we use integration to mean:

- across natural ecological boundaries
- across geopolitical borders and boundaries
- across jurisdictions
- across sectors
- across and/or linking policy, programs and Public and Private Sector activities
- linking professional skills and expertise as inter and multi-disciplinary teams.

Ecosystem An ecosystem is a dynamic complex of animals, plants and micro organisms and the associated non-living environment interacting as an ecological unit. An ecosystem may exist across a range of scales and may include several hierarchical levels (after the *National Strategy for the Conservation of Australia's Biological Diversity* and King, 1993).

An ocean ecosystem is operationally defined for this review as a group of two or more habitats. For example, an estuary is an ecosystem comprising (usually) several discrete habitat types - intertidal flats, subtidal sand/mud, rocky reef, seagrass, mangroves etc,

Habitat An ocean habitat is a combination of biological and physical elements of the environment that can be recognised and used for management purposes.

Indicator An indicator ie. measurable element of biodiversity which can be used to assess progress of management towards achieving an objective for biodiversity more broadly.

Surrogate A surrogate is (usually) an element of biodiversity that is used in management to represent, or substitute for, a more complex element of biodiversity that is more difficult to define or measure. Surrogates may also be Indicators when they are used for performance assessment purposes.

Ecologically sustainable development (ESD) ESD means using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained and quality of life for both present and future generations is increased (after the National Strategy for Ecologically Sustainable Development).

Ecosystem integrity Ecosystem integrity is the state of the ecosystem being whole and unimpaired (King, 1993), which should be determined by reference to appropriate ecosystem indicators and criteria.

Ecosystem management Management of ecosystem values and uses recognising the interactions with the environment and responding to signals from the ecosystem to control anthropogenic activities and uses (after Harden Jones, 1994).

Large marine ecosystem Large marine ecosystems (LMEs) are relatively large regions, of the order of 200 000 km^2 or more, characterised by distinct bathymetry, hydrography, productivity, species composition and trophically inter-dependent populations (Sherman and Alexander, 1986).

1. AUSTRALIA'S MARINE BIOLOGICAL DIVERSITY

Australia's ocean territory extends from the tropical epicentre of global marine biodiversity to the Antarctic. It encompasses a large proportion of the marine biodiversity of the southern hemisphere, including many unique, rare and threatened species. The immense biodiversity in our oceans, ranging from microscopic organisms to the largest animals on earth, and our healthy ecosystems are the basis for many of our industries and aspects of our lifestyle. Australia's marine environments and habitats are generally in good condition, except near the more heavily populated parts of the coastline, where the condition of some habitats is poor. However, seven major problems need to be addressed and governments can now proceed to take informed and appropriate corrective measures.

The ocean is the cradle of life on earth. Of the 33 animal groups or phyla known, 28 are found in the sea. Of these thirteen are exclusively marine, reflecting the origins of all life. In this section we review the current status of marine biological diversity under Australia's jurisdiction.

Australia's marine biological diversity, like that of the land, is notable for its high proportion of endemic species, that is, species that are found nowhere else in the world. In the south of the continent, which has been geographically and climatically isolated for around 40 million years, about 80-90% of the species in most marine groups are considered to be endemic. Many species in Antarctica are endemic. In northern Australia only about 10% of the species in most groups are endemic. However, the species of our tropical north are mostly shared only with the Indonesian archipelago, the epicentre of global marine biological diversity, but a region where many marine ecosystems are under threat. Consequently, within Australian jurisdiction we have a greater responsibility to ensure that these tropical species can be conserved effectively. Currently, our coral reefs are the healthiest in the world and through tourism and quality of life we trade extensively on this status.

In brief, Australia's ocean territory extends from the tropical epicentre of global marine biodiversity to the Antarctic. It contains a major slice of the marine biodiversity of the southern hemisphere, including a large number of unique species (especially in the south) and species threatened in neighbouring regions (especially in the north). Appendix A2 provides more details of our marine biodiversity and its condition.

Australia State of the Environment 1996 concluded that Australia's marine environments and habitats are generally in good condition to the extent that this can be measured. However, only a few areas can be regarded as pristine, because pressures such as nutrient loading, pollution with persistent chemicals and fishing, have affected nearly all parts of our marine and estuarine systems. Near many of our cities and other parts of our coastline the condition of some habitats is poor. There is increasing concern at the state of estuaries, with assessments of declining water quality, threats to estuarine fisheries and other impacts in many areas.

However, for many systems, particularly those offshore or distant from population centres, we do not have enough information to make even a first estimate of their state of health. Remote areas are assumed to be in good health because they are thought to face few pressures, but there are too few data to confirm this. At present we lack any integrated framework to acquire knowledge of our marine and coastal systems, and to design management regimes based on ecosystem goals and environmental performance indicators (although steps towards such a system are being taken under the *National Strategy for Ecologically Sustainable Development* and the *National Strategy for the Conservation of Australia's Biological Diversity*). Likewise, there is no agreed and common understanding of ocean ecosystems, their status and the issues affecting them. Some of the most important pressures on our biodiversity are summarised in Appendix A3.

Australia State of the Environment 1996 and the *State of the Marine Environment Report for Australia* (Zann 1995) concluded that there were seven key issues for the management of Australia's estuaries and seas:

i. **Inadequate knowledge base**-Australia's 16 million km2 area of marine jurisdiction (one of the largest in the world) necessitates a major commitment to marine science. Long-term, large-scale research and monitoring are essential for marine environmental management. However, we do not have sufficient geographically comprehensive and long-term scientific information on the marine environment, particularly the biological diversity.
ii. **Habitat loss and degradation**-seagrass habitats in estuaries and coastal lakes have been particularly affected by terrestrial run-off. Saltmarshes and mangroves have been lost near urban areas through reclamation, drainage and other developments. There is widespread scientific and community concern about the environmental effects of trawling and scallop dredging on the sea floor community and habitats, about the environmental impacts and wastefulness of by-catch (the incidental catch), and about changes in marine food webs resulting from discarding by-catch and removing large predators.
iii. **Declining water and sediment quality**-high nutrient levels and sedimentation affecting inshore coral reefs and temperate seagrass are largely the result of poor catchment land-use, sewage discharges and urban run-off. Oil pollution, heavy metals and organochlorines have resulted in local pollution hot-spots around metropolitan and industrial areas. Beach and ocean litter is widespread.
iv. **Unsustainable use of marine and coastal resources**-over-harvesting of fish and other marine life, coastal developments and conflicting resource use are critical issues around Australia. Australia is not rich in fisheries and landings of some commercial fisheries have declined. Southern bluefin tuna, southern sharks, gemfish, some rock lobsters and several other species have been seriously overfished.
v. **Introduced pests**-introduction of exotic species (such as toxic marine algae, giant fan worms and the Northern Pacific seastar) via ships' ballast waters and hulls are also of great concern.
vi. **Marine reserves**-a set of representative marine reserves is required to protect samples of Australia's marine biological diversity.
vii. **Need for integrated management**-many of the problems identified in the Resource Assessment Commission's Coastal Zone Inquiry (RAC 1993), the *State of the Marine Environment Report for Australia* (Zann 1995) and *Australia State of the Environment 1996* report stem from the lack of integrated, long-term planning from the coastal and marine environments. Australia has not had an agreed national strategy, or even a clear direction, for managing its marine and coastal environments and **marine biological diversity**.

MARINE BIOLOGICAL DIVERSITY - WHAT IS IT?

Marine biological diversity is the variety of living organisms in the estuaries and oceans, their genes and the ecosystems of which they form a part (*National Strategy for the Conservation of Australia's Biological Diversity, 1996*). A marine ecosystem is a `dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit' (*Convention on Biological Diversity*, June 1992). In this review, we define operationally an ocean ecosystem as a group of two or more habitats. For example, an estuary is an ecosystem made up of several discrete habitats-intertidal flats, subtidal sand/mud, rocky reef, seagrass, mangroves and so on.

Marine biological diversity is valued for its intrinsic existence, for its cultural significance, for its direct uses (for food and other resources), for the indirect support it gives these biological resources (via a food web, for example) and for the environmental services provided by healthy marine ecosystems.

The structure of marine biological diversity can be conceptualised as a nested hierarchy with genes at the bottom and ecosystems within an ocean basin at the top. This biological structure is maintained by dynamic processes: physical (ocean currents, wind, waves, erosion etc.), chemical (sediment pH, salinity, sediment geochemistry etc.) and biological processes (migration, larval drift, predation, reproduction etc.). These dynamic processes support the ecosystem's functioning Together, the hierarchical structure and dynamic processes comprise marine biological diversity.

2. OBJECTIVES FOR CONSERVATION OF MARINE BIOLOGICAL DIVERSITY

Australia has a range of national responsibilities and international obligations for the conservation of marine biological diversity and our performance in meeting those responsibilities must be assessed against objectives defined explicitly in biodiversity terms. The existing sector arrangements result in, at best, selective and weakly quantifiable objectives for biodiversity. Comprehensive quantitative objectives, measurable in terms of biodiversity and applied at every management scale, are key components and underpin efficient, effective and accountable management of our national marine biodiversity assets.

In this section we review the need, and the basis, for management objectives to sustain marine biological diversity, consistent with best practice environmental management principles (outlined in Section 3).

The need for conservation objectives

The *National Strategy for the Conservation of Australia's Biological Diversity*, ratified by the Commonwealth and all State and Territory Governments, is Australia's most important response to its obligations under the *International Convention on Biological Diversity*. The goal of the national strategy is to protect biological diversity and maintain ecological processes and systems. It aims to provide the link between current activities and the effective identification, conservation, management and sustainable use of Australia's biological diversity. In this respect it is closely linked to the *National Strategy for Ecologically Sustainable Development*. Implementation of the *National Strategy for the Conservation of Australia's Biological Diversity* will require actions that affect all of Australia's terrestrial, aquatic and marine ecosystems.

Management of biodiversity requires comprehensive and explicit objectives relating to ecosystems as a whole as well as objectives relating to individual units such as species. It also requires management to consider and respond to the state of the ecosystem as a whole rather than to individual sector-based activities, impacts or remedial measures. This will focus attention on high-level ecosystem management outcomes (that is, on biological diversity) rather than on intermediate activities or effects.

Existing sector arrangements result in, at best, selective and weakly quantifiable objectives for biodiversity. The development of comprehensive quantitative objectives, measurable in terms of biodiversity and its determinants, is a key component of efficient management of marine biological diversity. Appropriate objectives will underpin efficient, effective and accountable management of our national marine biodiversity assets.

Defining the objectives

Building on the *National Strategy for the Conservation of Australia's Biological Diversity*, the overall goal for conservation and management of Australia's estuarine and marine biological diversity is to protect the genes, species and ecosystems from degradation; to ensure their continued in situ survival, health and evolutionary development, and to maintain marine ecological processes and systems.

To achieve this comprehensive goal, oceans management must set comprehensive and measurable conservation objectives for the biological diversity at each relevant spatial scale. These objectives for biodiversity should apply in all ocean areas and should be taken into account in by all sectors. The spectrum of marine protected areas that can be established (see IUCN categories box) provide an essential contribution towards meeting local, regional and national objectives for the conservation of biological diversity, but can only function in the context of effective measures in all ocean areas.

The need for comprehensive spatial management in all ocean areas using explicit biodiversity objectives to provide for conservation of marine flora and fauna stems from two key characteristics of marine ecosystems that result in high degrees of connectedness:

- **active and passive movement of marine biota** - apparent in, for example, the dispersion of larvae in the water and the ranges of some highly mobile species;
- **movement of ocean waters:** the water column is itself simultaneously an important habitat; the main transport mechanism for both nutrients and food; the primary physical impact on marine organisms through the forces of ocean currents, waves and tides; and the transport mechanism for pests, pathogens and pollutants.

Marine organisms are distributed in patches of different sizes over large areas (so called meta-populations), within which the total area occupied by patches may be relatively small. Patches of mobile organisms (such as fish) may form and disperse at various times. Many marine species have swimming or planktonic larval forms that move with the water column for days to months. These migratory life phases may be the key to maintaining the presence of a species in any patch. The dispersal and settlement processes are likely to be crucial to maintain gene flow and to recolonise patches after local extinctions caused by extreme events (cyclones, storms etc,). The mobility of larvae also means that some areas are particularly important for maintaining populations and ecosystem diversity - areas that provide high productivity at critical stages in life histories, or provide currents for larval dispersal, may be important spawning or nursery sites for some species.

Other marine species are highly restricted and their larvae settle in the same patch, with populations in other patches maintained by very rare events that distribute the larvae widely. Consequently they are vulnerable to local change and disruption. It is also becoming apparent that, particularly in deeper and colder waters, many bottom-living organisms and fish species are very long-lived and are slow growing; we do not know how they respond to disturbance.

In marine ecosystems small areas that are disturbed can usually be recolonised and their assemblages re-established relatively quickly, but after repeated disturbance they may not recover. Furthermore, impacts from disturbances may spread well beyond the focal point, through downstream effects and through movement of mobile animals or water. So areas that are protected but that are surrounded by disturbed areas may not be self-sustaining and can degrade through time unless disturbances are managed on a scale adequate to ensure broader ecosystem integrity. Small areas of seabed are not, therefore, likely to be self-sustaining in terms of species composition and ecosystem processes, and hence biodiversity.

To achieve national conservation of biodiversity, the regional management units must be large and match ecosystem boundaries, and the regional management arrangements must encompass the nested arrangements at smaller scales. At each of the principal levels in the management arrangements (eg. national, regional and local) management objectives must be comprehensive and consistent, and set at the correct spatial and temporal scale for that level. The objectives must cover all valued and important elements of the biodiversity and ecosystem functioning, and be able to be related to measurable performance indicators.

The National Strategy for the Conservation of Australia's Biological Diversity provides broad policy objectives relating to ecosystems and individual elements such as species and habitats. It also provides some broad strategies to achieve these objectives. Within each of the nested scales of management arrangements, operational (ie. measurable) objectives and performance measures should be defined. These definitions should be evaluated to ensure that they are adequate to achieve both the local and the broader objectives, and that they are consistent across the different scales of management.

Typically, two different types of objectives and performance measures will be needed. One will relate to overall ecosystem biodiversity, functioning and integrity; the other to specific elements of biodiversity such as habitats and species. As an example, an objective at the regional habitat level might be to ensure that there is no loss of seagrass beds. That could be measured using accepted criteria for (say) plant cover, species composition of flora and fauna, and recruitment value for fish, crustaceans or molluscs as effective indicators for this objective. The objective for seagrass beds would apply comprehensively to all ocean areas in the region, but performance might be assessed

against criteria which differ between areas. In local areas where fishing was permitted, it may be acceptable, say, for the species composition of the fauna of seagrass beds to be altered as a result of line fishing, without compromising the regional objective. Different criteria would apply for the indicators in the more highly protected components of a reserve system, where such changes are unlikely to be within acceptable limits.

The objectives must be easily linked to measurable performance indicators; they must be explicitly defined at the time and space scales relevant to management; and must be consistent across the nested management arrangements that make up the national arrangements.

At present, the oceans and estuaries are subjected to multiple uses within many jurisdictions under many different management arrangements. These focus on a particular sector's interests (such as fisheries, shipping, quarantine). Australia is now developing an overarching national Oceans Policy to provide `an integrated and strategic platform for the better planning and management of our oceans' (Australia's Oceans New Horizons, 1997). This new platform will encourage an integrated approach to managing the multiple uses of the ocean resources consistent with Australia's domestic and international responsibilities to conserve and manage the ocean's ecosystems. To achieve this, management of the oceans and estuaries will need to be integrated within an ecosystem-based framework with explicit biodiversity objectives.

3. APPLYING ECOSYSTEM MANAGEMENT

The existing legislative, organisational and administrative arrangements for management of the oceans are fragmented and lack a strategic and integrated approach to conserving the ocean's biodiversity. To be effective and accountable, a major shift from the current independent management by sectors is required. The new ocean-management arrangements must include overarching comprehensive regional objectives for biodiversity, integrated into regional ecosystem-based management within a national framework and incorporated into sectoral arrangements. Integrated Regional Ocean Management will provide for comprehensive regional-scale conservation of marine biological diversity within the context of efficient and accountable management of the ocean's wealth.

Ecosystem management has been defined as `management of ecosystem values and uses recognising the interactions with the environment and responding to signals from the ecosystem to control anthropogenic activities and uses' (Sainsbury et al., 1997; after Harden Jones, 1994). This recognises that humans are central players in ocean ecosystems, but that management can realistically control primarily only the human activities, not the ecosystems. In this section we review the process of ecosystem-based management as it can be applied to conserve marine biological diversity consistent with improved public accountability and management of the ocean's resources.

Ecosystem management explicitly recognises that a multiplicity of uses must be accommodated in meeting important economic, social and cultural goals provided that, either singly and in combination, they do not degrade or threaten ecosystem integrity. This has a strong foundation in Australia's international agreements and in existing national policies, strategies and intergovernmental agreements. When the Prime Minister announced the Oceans Policy on 3 March 1997, he highlighted multiple use as one of the major themes - '*É..multiple use of resources that will combine sensible exploitation of resources with environmental care*'. Ecosystem-based management of the oceans has five goals within the broader goal of maintaining ecosystem integrity (after Grumbine, 1994):

- to maintain, throughout the ocean realm, viable populations of all native marine species in functioning biological communities;
- to include, within a spectrum of protected areas, representatives of all marine habitat types across their natural range of variation;
- to maintain ecological processes in all ocean areas, including water and nutrient flows, community and trophic structures, ecosystem linkages and their annual and longer-term natural cycles, and the movement of broad-ranging and migratory species;
- to ensure recognition that ecosystems are dynamic and that management must be at spatial and temporal scales that maintain the evolutionary potential of marine biological diversity;
- to accomodate human uses of the oceans and the economic, social and cultural aspirations of people, within these constraints.

Ecosystem Management

Ecosystem management has to take the following ten attributes (after Grumbine, 1994):

1. Interactions between ecological levels:
   Management ensures that connections between and across all levels (species, populations, habitats, regions) are taken into account in resolving issues - focus on any one level is inadequate;
2. Ecosystem boundaries:
   Management acts within ecological boundaries and across administrative, political and jurisdictional boundaries;

3. Maintenance of ecosystem integrity:
   Management's focus includes the maintenance of ecological integrity. It has the stewardship of total national biological diversity (genes, species, communities, habitats) and the ecological processes that maintain that diversity, rather than a narrower focus on the benefits to particular sectors or areas;
4. Data collection:
   Management collects information beyond that required to manage individual sectors. It includes an inventory of biodiversity assets, baseline assessments of ecosystem functions, measurements of the interactions of sectors and improved management and use of existing data.
5. Monitoring of management:
   Management uses measurable performance indicators to assess the success or failure of its actions. Monitoring provides feedback that is critical to evaluating and refining management approaches;
6. Adaptive and precautionary management:
   Management acknowledges that, as scientific and other information is necessarily incomplete, actions with poorly understood or difficult to reverse consequences are to be avoided. Adaptive management regards management as a learning process, where incorporating the experience from previous actions and improved knowledge of the system enables managers to adapt to changing levels of uncertainty and to improve progressively.
7. Inter-agency cooperation:
   Management improves inter-agency cooperation because ecological boundaries cross traditional agency and administrative divides and Commonwealth, State and local government jurisdictions. Managers work together across such boundaries to integrate conflicting legal mandates, management practices and priorities.
8. Organisational change:
   Management recognises that the orientation, structure and modus operandi of agencies that manage ocean uses will be different from sector-based agencies. The differences may be relatively simple arrangements for inter-agency coordination, or more fundamental shifts in lines of accountability, responsibility, organisational orientation, decision-making processes, priorities and operations.
9. Management of human activities:
   Management recognises that human activities are fundamental influences on many marine ecological patterns and processes and are in turn affected by them. Although human activities are the focus of most management actions, they are recognised as being embedded in marine ecosystem functioning.
10. Values:
    Management recognises, accepts and incorporates biodiversity values into all resource allocation processes that could affect the ocean ecosystems, even when scientific and technical knowledge may be insufficient for a full definition of values. Mnagement recognises, however, that human values will play a dominant role in decisions on ocean uses.

Multiple-use management is a framework for integrating multiple uses to reach an acceptable balance of outcomes across the full range of uses and users that is consistent with four fundamental principles. They are: maintenance of ecosystem integrity; wealth generation; equity among users and generations; and an inclusive participatory framework for decision making (Sainsbury et al., 1997; Appendix A4).

To meet regional and national objectives for conservation through ecosystem management approaches, several key management activities need to be linked and coordinated at the regional scale. In particular, management needs to be integrated so that the contributions of sectors and local activities to the regional biodiversity goals are explicit and accountable. Integrated Coastal Management (GESAMP, 1996) was developed as a national approach to coastal-zone management across various levels of government. It integrates the planning, control and evaluation activities of management, using the principles of ecosystem management and multiple-use management, and provides an appropriate approach for regional and provincial management of Australia's oceans. The Integrated Coastal Management approach is used here as the basis for Integrated Regional Ocean Management to include explicitly local and regional conservation objectives in a consensus-planning approach to management of local, regional and national biodiversity.

Integrated Regional Ocean Management is adapted from Integrated Coastal Management to apply to the whole of our marine jurisdiction, based on a suitable set of regions. These regions would be set within a smaller number of broad-scale provinces that cover our complete marine jurisdiction. Some possible provinces and regions are suggested in **Australian Regional Marine Ecosystems** outlined below. Alternative management approaches, which do not provide explicit management objectives relating to exosystem functioning and integrity for each nested scale of management, cannot deliver conserbation of biodiversity or sustainable community benefits in the long term.

AUSTRALIAN REGIONAL MARINE ECOSYSTEMS

To achieve national conservation goals in the marine environment requires regional ecosystem management, so that the full range of users and impacts can be recognised, understood and managed on scales that are ecologically meaningful. To achieve these objectives there is a need to define a relatively small number of large marine ecosystems and a set of regions within them that would promote the integration of multiple uses and cooperation amongst jurisdictions and sectors. The provinces and regions should have recognisable ecological integrity, have most ecological and resource use connections contained within rather than across their boundaries, allow for ready collation of management outcomes at the national level, provide a natural setting for development of effective management and research arrangements at nested smaller space scales, and provide within them a natural setting for development of effective management and research arrangements across straddling jurisdictions and sectors.

Large Marine Ecosystems: The Provinces

The broad Australian bioregions defined in the recent Ocean Rescue 2000 initiative provide a good initial definition of possible broad marine provinces of the EEZ. These bioregions were defined from analysis of the distribution patterns of fish and sediments, bathymetry and oceanographic conditions on the continental shelf region. Seven large marine ecosystems were identified adjacent to the continent and an additional five in the Antarctic and remote zone areas.

Coastal Regions

The Interim Marine and Coastal Regionalisation for Australia (IMCRA) is an ecosystem-based classification of coastal and continental shelf environments. Its development was identified as a high priority and in 1994 a cooperative review of existing regionalisations and development of a single regionalisation at a scale of 100s-1000s km (meso-scale) started. Recognising that the information available on coastal, inshore and offshore marine areas was highly variable, a range of State, Territory and Commonwealth agencies began to develop interim meso- and provincial-scale (1000s to 10 000 km) regionalisations in 1995.

The initial IMCRA meso-scale regionalisation out to the 200 m isobath recognises about 60

inshore bioregions forming a continuous, narrow, segmented band around the continent. It provides a basis for a variety of regional planning and management activities, and can be refined as more information becomes available. Finer-scale mapping and classification will be required for planning and management within individual regions.

For efficient and effective management of the ocean's resources, management arrangements should meet **best practice** standards in management and public accountability. The arrangements should contain:

- clearly articulated objectives for management (in biodiversity terms) and a solid nexus to enabling legislation and administrative procedures;
- defined strategies and tasks to be implemented to achieve the objectives, including strategies to build partnership and ownership with the Australian community and users of the marine environment;
- measurable performance indicators to monitor progress towards achieving biodiversity objectives;
- sound management **information systems** in support of chosen performance indicators.

BEST PRACTICE IN ENVIRONMENTAL MANAGEMENT

In contemporary best practice in environmental management, all processes are conducted with the goal of continuous improvement.

The main attributes of best practice are based on the standards established by ISO 14000. In environmental management these standards require consensus planning and comprehensive stakeholder involvement, based on full information and equal empowerment. The ISO 14000 standards for environmental management are scale-independent: they apply to environmental management of regions, sectors, specific projects and individual operational activities.

The existing ocean management arrangements are fragmented and lack a strategic and integrated approach to the conservation of the ocean's biodiversity. To be effective and accountable, a major shift from the present sectoral management is required. The new ocean management arrangements must include overarching comprehensive objectives for biodiversity applied through integrated Regional Ocean Management at each nested scale of management within a consistent national framework. This will provide for comprehensive local, regional and national-scale conservation of marine biological diversity within the context of efficient and accountable management of the ocean's wealth.

DATA AND INFORMATION FOR PLANNING

Often the planning process identifies information gaps or highlights the need for better information. It is increasingly recognised that research outcomes, including the data and the management of the data, have an important part to play in reducing the level of uncertainty in any biodiversity management program. *This need (scientific information) is becoming more evident as the complexity of the relationships among the environment, resources and the economic and social well-being of human populations is fully recognized and as changes and long-term threats are discovered* (National Research Council, 1995). However, the most useful data is that derived from carefully targeted research or observational programs. Data generated by good science does not always give good management information, but good management requires good science and good information systems.

`Data' and `information' are terms that are often used interchangeably, but they are distinct concepts when used in a management framework. `Data' refers to the recordings of measurements of environmental, social or economic factors. `Information' refers to data that have been processed and analysed to contribute to management. For example, daily sea-temperature records for an area are data; the trends that come from analysis of the data provide information on climate change.

4. EXISTING GOVERNMENT MEASURES

*Many existing government activities and measures are directed to the conservation of marine biological diversity. These include species-specific activities (such as species management plans) and pollution controls, in both the coastal three-mile zone and the broader EEZ. The **National Strategy for the Conservation of Australia's Biological Diversity** provides a strong platform for designing and implementing conservation action in the Oceans Policy. The strategy clearly empowers the establishment of a **National Representative System of Marine Protected Areas** as a core component of integrated regional management of the oceans and as an important contributor to the conservation of our marine biological diversity.*

4.1 OVERVIEW OF CURRENT LEGISLATIVE MEASURES AND PROGRAMS

In general terms, under the Offshore Constitutional Settlement of 1979, the three-mile limit defines the boundary of State and Commonwealth jurisdiction over marine areas although there are other arrangements for management of some fisheries and the Great Barrier Reef. Within the total area of some 16 million square kilometres in Commonwealth waters and in areas under State and Territory jurisdiction, there are a great number of initiatives nationally that are directly or indirectly related to the conservation of marine biological diversity in all spheres of government, industry and the broader community. Within the Commonwealth Government these include Coasts and Clean Seas Program, the Marine Species Program, Marine Protected Areas Program, the Indigenous Protected Areas Program and the broader National Reserve System Program, fisheries management initiatives and those related to environmental impact assessment. There is also a number of government programs relating to international activity and to controls over export and import of marine wildlife and other products. Appendix A5 provides an overview of the major categories of biodiversity-related activities in government, sectors and the community.

There are two existing principal approaches to conserving and managing biological diversity. Site-specific measures include marine protected areas, seasonal or longer-term closures and exclusion zones. Species-, process- or sector-specific measures include wildlife and fisheries management measures, guidelines, codes of conduct and regulation of specific sectors. In isolation neither of these can provide effective long-term conservation of marine biological diversity. A third major approach - ex-situ conservation - can make an important contribution in some circumstances, by conserving of components of genetic diversity through captive breeding and by enabling large-scale reintroduction of depleted populations, such as tropical reef clams. Ex-situ conservation, however, is not a practical approach for conservation of biological communities or ecosystems.

The specific conservation measures applied within protected areas and the management measures provided by sector-specific arrangements are essential but not sufficient for complete conservation of the biodiversity. Their integration within a broader ecosystem-based regional framework will mean that both are more effective. But government-led programs are only one of the necessary components of effective management. These programs must have the support and participation of industry and the broader community and be developed within a stewardship framework. An indication of the range of programs and activities is given in those summarised in Appendix A5.

4.2 THE NATIONAL STRATEGY FOR THE CONSERVATION OF AUSTRALIA's BIOLOGICAL DIVERSITY

The National Strategy for the Conservation of Australia's Biological Diversity was agreed by the Commonwealth, State and Territory Government s in 1996. It explicitly recognises and accepts the guiding principles of the National Strategy for Ecologically Sustainable Development. The National Strategy for the Conservation of Australia's Biological Diversity deals with all of Australia's biodiversity - terrestrial and aquatic -and is the agreed basis for achieving conservation of the biodiversity in Australia's oceans. The goal of this strategy is to protect biodiversity and maintain

ecological processes and systems. To achieve this it provides a comprehensive set of objectives and actions. The key objectives of the strategy, as they relate to marine biodiversity, can be paraphrased as:

- Identify biodiversity components and threatening processes. (1.1)
- Manage on a regional basis, using natural borders. (1.2)
- Improve standards of management and protection through integrated management (1.3)
- Establish and manage a comprehensive, adequate and representative system of protected areas. (1.4)
- Strengthen off-reserve conservation of biodiversity (1.5)
- Enable threatened species and communities to thrive in their natural habitats, and prevent additional species and communities from becoming threatened. (1.7)
- Use ecologically sustainable fisheries management practices. (2.3)
- Use ecologically sustainable management practices for tourism and recreational activities. (2.6)
- Monitor, regulate and minimise activities that have adverse impacts on biodiversity and be able to respond appropriately in emergencies. (3.1)
- Control the introduction and spread of alien and genetically modified organisms and the spread of native species beyond their natural range. (3.3)
- Minimise the impacts of pollution. (3.4)
- Minimise the impacts of anthropogenic climate change on biodiversity. (3.6)
- Repair and rehabilitate degraded areas. (3.7)
- Assess and minimise the potential impacts of government projects, programs and policies on biodiversity. (3.8)
- Provide the knowledge and understanding needed for effective conservation and management of biodiversity. (4.1)
- Increase public awareness and involvement with biodiversity and its management. (5.1)
- Implement the National Strategy for the Conservation of Australia's Biological Diversity within established time frames. (7.1)

Specific objectives and actions in the strategy are linked to a number of ocean management issues. They are listed in Appendix A6.

The strategy points strongly to the current issues relevant to conservation of biodiversity and to the need for revising current arrangements for managing the oceans. It points specifically to the need for more extensive use of marine protected areas and to the use of ecologically meaningful Integrated Regional Management. A national Oceans Policy provides an opportunity to implement the *National Strategy for the Conservation of Australia's Biological Diversity* comprehensively for our ocean estate.

4.3 NATIONAL REPRESENTATIVE SYSTEM OF MARINE PROTECTED AREAS

Marine Protected Areas and their management are a central element in the *National Strategy for the Conservation of Australia's Biological Diversity*. Marine Protected Areas range from strict reserve areas through to areas managed for sustainable use of natural resources (see details on IUCN categories below) and all categories are significant for conservation of biodiversity. The strategy calls for an adequate and representative system of marine reserves and, because of the interconnectedness of marine systems, the system requires recognition of interactions with surrounding areas and their values for conservation.

Ensuring that the National Representative System of Marine Protected Areas (NRSMPA) will contribute effectively to the conservation of Australia's marine biodiversity as a component of Integrated Regional Ocean Management will critically depend on three activities: identification of the ecological units to represent the full range of biodiversity within our marine jurisdiction; design of the network of areas to effectively sustain biodiversity in the context of integrated regional management; and design of a monitoring program to detect and enable correction of departures from management's intent. To date there has been important progress on the first of these

activities, through the Interim Marine and Coastal Regionalisation for Australia (IMCRA). Identification has concentrated on the Australian continental shelf, where the data are available to support such analysis, but there are very few data and as yet relatively little effort devoted to the deeper or more remote areas of the EEZ. With Government commitment to accelerate the development of the NRSMPA, activity will now focus on the other two critical activities for successful use of the system to conserve marine biodiversity within the integrated management framework.

The National Representative System of Marine Protected Areas (NRSMPA)

Building on earlier recognition of the need for a system of marine protected areas that incorporate the range of habitats in our waters, in 1991 the Commonwealth Government announced a 10-year marine conservation program. A key component of this was expansion of the existing marine reserve system through development of a National Representative System of Marine Protected Areas (NRSMPA). This was subsequently endorsed by States and Territories under the Intergovernmental Agreement on the Environment and is being implemented in the context of the National Strategy for Ecologically Sustainable Development and the National Strategy for the Conservation of Australia's Biodiversity. The primary goal of the NRSMPA is:

`to provide for the protection, conservation, wise use, understanding and enjoyment of marine heritage in perpetuity through the creation of a national representative system of marine protected areas and through management in accordance with the principles of the World Conservation Strategy and the National Strategy for Ecological Sustainable Development of human activities that use or affect the marine environment.'

The NRSMPA is implemented through the Marine Protected Areas program of the Coasts and Clean Seas component of the National Heritage Trust. The program is delivered in cooperation with State and Territory Government s. The Commonwealth Government is actively identifying priority areas within the EEZ for the establishment of marine protected areas. The Australia and New Zealand Environment and Conservation Council (ANZECC) has created the Task Force on Protected Areas to advance the establishment of the NRSMPA.

Key tasks that remain in the development of the NRSMPA are:

- refinement and application of a national bioregionalisation for inshore and offshore waters;
- development of guidelines, criteria and processes for selection of candidate areas;
- identification of potential areas or sites within Commonwealth and State waters for inclusion in the NRSMPA;
- compilation and maintenance of accessible information on the characteristics of existing marine protected areas;
- development of management strategies for the chosen areas;
- development of performance measures for the NRSMPA, including assessment of the contribution of marine protected areas to the conservation of biodiversity in the context of integrated regional management.

IUCN GUIDELINES FOR PROTECTED AREA MANAGEMENT CATEGORIES (IUCN, 1994)

Category Ia Strict Nature Reserve: Protected Area managed mainly for science

Area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species, available primarily for scientific research and/or environmental monitoring.

Category Ib Wilderness Area: Protected Area managed mainly for wilderness protection

Large area of unmodified or slightly modified land and/or sea, retaining its natural character and influence, without permanent or significant habitation, which is protected and managed so as to preserve its natural condition.

Category II National Park: Protected Area managed mainly for ecosystem conservation and recreation

Natural area of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for this and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.

Category III Natural Monument: Protected Area managed for conservation of specific natural features

Area containing one or more specific natural or natural/cultural feature which is of outstanding value because of its inherent rarity, representative or aesthetic qualities or cultural significance.

Category IV Habitat/Species Management Area: Protected Area managed mainly for conservation through management intervention

Area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species.

Category V Protected Landscape/Seascape: Protected Areas managed mainly for landscape/seascape conservation and recreation

Area of land, with coast and seas as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, cultural and/or ecological value, often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance and evolution of such an area.

Category VI Managed Resource Protected Areas: Protected Area managed mainly for the sustainable use of natural ecosystems

Area containing predominantly unmodified natural systems, managed to ensure long term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.

5. ACHIEVING EFFECTIVE NATIONAL CONSERVATION OF MARINE BIOLOGICAL DIVERSITY

Seven key issues must be resolved to ensure the adequate and sustained conservation of our marine biological diversity. Conservation is best achieved within the framework of integrated management, where consensus planning is used to establish agreed objectives for biodiversity at each level of management (local, regional, national), set within a national management framework. Major reforms to existing management arrangements are required to achieve this. To be effective, conservation initiatives should be based on knowledge of the biodiversity. The requirements for effective oceans management exceed our present national capacity, and this must be improved in key areas such as information for management, taxonomy, surveillance, sector performance, conservation assessment and long-term monitoring. Underpinning these necessary reforms is the need to improve the stewardship of oceans by Australians and their awareness and `ownership' of the oceans - one of their most important items of natural wealth.

In this section we review and synthesise the key issues in the conservation of marine biological diversity. For each issue we define the nature of the problem and the implications of failing to resolve it, summarise the constraints on its resolution, point to some selected examples of current activities and then define a set of actions that will be needed.

5.1 WHAT IS OUR MARINE BIOLOGICAL DIVERSITY?

Our knowledge of the biodiversity in Australia's EEZ is rudimentary. We will not be able to effectively conserve and sustainably use our ocean's resources unless we increase our level of knowledge and understanding of marine biological diversity. To do this we must develop and implement a strategic national plan for the progressive acquisition and dissemination of new knowledge.

The risks

A comprehensive inventory will confirm that our marine biological diversity is a large and valuable element of Australia's natural wealth and will provide information for management of our activities to avoid its degradation. If we do not develop a comprehensive knowledge-base for marine biological diversity, we risk:

- failing to include the presently unknown elements of marine biodiversity within conservation areas, plans and strategies, and so failing to conserve them effectively - foreclosing on any potential options for their sustainable use and enjoyment;
- failing to identify elements of biodiversity under threat such as rare and endangered species, endemic species with narrow distributions and vulnerable habitats;
- failing to identify areas of marine biological diversity of greatest significance for regional and national conservation;
- continuing over-exploitation and the unwitting loss of commercially valuable elements of biodiversity;
- not providing an adequate ecological basis for best practice management of the oceans, including establishment of biodiversity objectives;
- failing to meet our acknowledged international obligations (under the Convention on Biological Diversity) to develop a comprehensive inventory of the biodiversity to be conserved and managed;
- failing to fulfil our obligations under the Law of the Sea Convention to secure rights to sustainably use and conserve the biodiversity of claimable seabed areas contiguous with the EEZ.

Existing relevant activities

There are a number of existing activities being undertaken that, sometimes coincidentally, are helping to build a comprehensive knowledge of the marine biological diversity. These include:

- the Public Sector
  Commonwealth: Australia-wide, ad hoc studies of various taxa and ad hoc mapping of other elements (eg. sediments, some oceanographic features, seagrasses, coral reefs, bioregionalisation); National State of the Environment reporting. State: regional habitat mapping, water quality etc,; State of the Environment reporting. Local Government: State of the Environment reporting, water quality, estuarine inventories, local environment plans.
- the Private Sector
  development of environment management plans, codes of practice and provision of data for the Environmental Impact Assessment (EIA) process.
- the Community Sector
  voluntary and low-cost implementation of Coastcare projects; catchment management groups, special interest groups (eg. natural history, conservation).

Constraints

Progress towards a comprehensive inventory of Australia's marine biological diversity is constrained by:

- the size, scale and complexity of the EEZ, and a limited national technological infrastructure, capability and resources;
- an historic lack of a coordinated and strategic approach to assessing and managing biodiversity and the supporting research effort, and poor coordination of jurisdictions;
- lack of a systematic, long-term commitment to developing a national biodiversity inventory;
- lack of agreed national, systematic and standardised methods and protocols for describing, assessing and managing marine biological diversity, including data and information management;
- inadequate taxonomic knowledge and a limited and declining human and institutional capacity in taxonomy;
- the historic focus on single species and related issues rather than a comprehensive habitats and ecosystems approach;
- the undervaluing of traditional and local knowledge and that gathered by the private sector;
- the failure to adopt contemporary ecological principles and understanding for conservation and management of biodiversity.

What do we need to do?

We urgently need to develop a **Strategic National Plan for an Inventory of Marine Biological Diversity** to improve our knowledge of marine biological diversity progressively. That action would be consistent with Objective 4.1 of the *National Strategy for the Conservation of Australia's Biological Diversity* and is required to ensure an adequate knowledge base for management and for identification of the extent of current and potential opportunities for sustainable development. The plan should include systematic surveys and inventories, increased taxonomic capability, better understanding of marine ecological processes and development of a rapid assessment capability. The plan should be based on an agreed and dedicated long term (at least 20 years) commitment of resources, capacity and infrastructure, and the cooperation of organisations to facilitate the progressive and continuing improvement of our national marine biological diversity knowledge-base.

The following elements of a Strategic National Inventory Plan are essential:

A1
design and implement systematic surveys of biodiversity to incrementally compile a national inventory;

A2
improve the taxonomic capacity to support the inventory of Australia's marine biodiversity and enhance our institutional capacity to curate and disseminate the information;

A3
identify areas of highest priority for bioregional planning and national conservation, using rapid assessment procedures, and agree on a set of surrogates for biodiversity to be used in planning and management of biodiversity;

A4
identify vulnerable species, habitats and biological communities, and acquire the knowledge needed to develop appropriate management plans in the context of Integrated Regional Management;

A5
identify the key ecological processes that support biodiversity to ensure that they are maintained;

A6
document and incorporate the biodiversity knowledge of traditional and local communities and industry into inventories and planning, based on partnerships with these groups.

A7
In addition to a Strategic National Inventory Plan we need to establish a competitive and prioritiesed long-term (thiry years) national research grants scheme. This would be in addition to the existing national science funding but exclusive of the items above. It would be dedicated to progressively improving our understanding of the ocean's ecological structure and function.

SURROGATES FOR BIODIVERSITY

We can never have complete knowledge of the full extent of our marine biological diversity and so, for planning and management, we will always need to need to use what are termed proxies or surrogates.

Surrogates are quantities assumed to be related to biological diversity, or shown to be related from existing knowledge, that are more easily measured or more readily available than biological diversity itself. They are used to infer distributions and measures of biodiversity from the distributions and measures of surrogates. Biodiversity surrogates fall into three fairly natural categories: sub-sets of taxa, species assemblages and environmental domains. There are advantages and disadvantages in the use of each.

Taxa sub-sets

Taxa sub-sets are selected groups of species, or other taxonomic levels of biodiversity such as families.

Advantages

- taxa are biological entities and therefore directly represent components of biological diversity

Disadvantages

- most taxa remain undescribed;
- of those that are known, only a small sub-set is sufficiently well known, both in taxonomic rank and spatial distribution, to be useful in conservation planning;

- there is little evidence, theoretical or empirical, that any taxonomic sub-set can be a predictor for any other set.

Assemblages

Assemblage is an identified group of taxa that tend to co-occur. It covers ecological concepts such as communities, associations etc,

Advantages

- assemblages are composed of biological entities that directly represent components of biological diversity;
- assemblages can be derived from field records that are geographically sparse;
- assemblages represent combinations of species and their interactions and are more ecologically complex than taxa.

Disadvantages

- assemblages are internally heterogeneous, so any one area occupied by an assemblage may not contain all the species belonging to that assemblage;
- boundaries between different assemblages are arbitrary;
- if an assemblage is defined intuitively, internal heterogeneity cannot be measured and there is no way of knowing whether part of an assemblage adequately represents the whole.

ENVIRONMENTAL DOMAINS

Environmental domains are a combination of biological and/or physical attributes of an area, commonly expressed as habitats.

Advantages

- environmental domains may encompass both unknown taxa and known taxa with unmapped ranges;
- data on physical attributes are more widely available, at a consistent level of detail and across more areas, than are biological data;

Disadvantages

- environments are internally heterogeneous, so any one area occupied by an environment may not contain all of the species normally found in that environment;
- there is no one agreed method for delineating environments and the choice of scale is arbitrary.

Some combination of these types of surrogates is usually adopted for planning purposes. Thus, for example, large regions may be divided into environmental domains and the known locations of rare and threatened taxa or a set of species thought to represent other taxa, are recorded. Priority areas of biodiversity could be selected for regional planning to sample every environmental domain and the known locations of rare, threatened or representative taxa.

Because the identification of surrogates is based on current knowledge, they should be re-

evaluated and their applicability reviewed as knowledge accumulates.

5.2 INTEGRATED REGIONAL OCEAN MANAGEMENT

Conservation and management of marine biodiversity can be best achieved when environmental, social and economic activities are managed together within ecologically meaningful regions. The management must be based on ecosystems and on cooperation, conflict resolution and consensus building across user and interest group sectors. This process must establish regional ecosystem-based conservation objectives for marine biological diversity and coordinate and harmonise the present strongly sectoral management practices to meet these objectives. A comprehensive integrated regional planning and management framework is needed to allow assessment and integration of the sectoral contributions to regional biodiversity conservation objectives.

We propose that the conservation of marine biological diversity can be best achieved through Integrated Regional Ocean Management (IROM). This is a form of ecosystem-based management using continuous improvement principles that is consistent with the principles and practice of Integrated Coastal Management (GESAMP, 1996) and with achieving multiple-use management (Sainsbury et al, 1997). A comprehensive, integrated regional approach to management will provide a natural setting for resolution of sectoral conflicts over resource allocation and for building a broadly based commitment to the regional conservation of biodiversity.

The risks

Without integrated regional management for the conservation of biological diversity we risk:

- failing to develop and promulgate processes for the efficient, effective and accountable use of public funds to conserve biodiversity;
- missing a unique opportunity to introduce effective management for the oceans that will fairly and equitably allocate resources within and between sectors, including allocation of biodiversity for conservation purposes and help to resolve conflicts (interactions) over resource allocation and use, thereby reducing conflicting uses and the consequent risk of biodiversity loss;
- failing to reduce the cost of management by eliminating duplication of environmental planning and protection activities, and avoiding sectoral conflicts over allocation of biodiversity;
- failing to develop an effective and efficient process for pre-commercial assessment of the ocean's resources that can also anticipate the impacts and interactions of future development;
- downgrading the `public good' and existence values of the oceans and their biodiversity;
- not efficiently and effectively complying with our international obligations under the Convention on Biological Diversity.

Current activities

Many current activities are relevant to the establishment of Integrated Regional Management as a framework for management to achieve efficient conservation of biodiversity. These include:

- the development of Multiple-use Management concept as a sector framework;
- planning for the National Representative System of Marine Protected Areas;
- the progressive definition of coastal ecological regions in the Interim Marine and Coastal Regionalisation for Australia process;
- the development of Integrated Catchment Management processes and procedures in many States through cooperative and coordinated State and local governments, private sector and community activities;
- the **Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)** process;
- new legislative programs to support cooperative and multiple-use management of estuaries and oceans in all States;

- some sectors (tourism, petroleum, shipping, some fisheries) are engaged in strategic activities and planning for resolution of impacts and resource allocation issues.

Ecosystem Management by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)

CCAMLR is one of the few management arrangements that has ecosystem management as an explicit objective. It aims to ensure that harvesting activities are consistent with the health of not only the target species, but also the dependent and associated species, and with maintenance of ecological relationships. The convention area was specifically designed to align closely with the natural ecosystem boundary, in this case the northern limit of the Antarctic convergence or polar ocean front. The Articles of the Convention set out the principles of conservation and rational use that the Commission applies. These are expressed in general terms, but considerable effort has been put into interpreting these to give measurable criteria to use in developing and evaluating specific conservation measures.

Several aspects of the CCAMLR process flow from the ecosystem-based conservation objectives of the Commission. They differ from the more common processes that focus on a specific industry sector. These are:

- Performance measures and criteria for evaluating management measures that relate specifically to ecosystem-level considerations.
- The scientific assessment involves a broad assessment of the state of the ecosystem as well as the usual focused assessment of the status of the target species. In particular, species that are dependent on the fishery target species are examined (for example penguins that feed on krill and seals that feed on some commercial fish species).
- There are two data collection and monitoring programs, one aimed at target species of fisheries and the other at ecosystem function and integrity.
- Precautionary management strategies for several species and fisheries have been applied in explicit recognition that the scientific knowledge of ecosystem functioning is rudimentary.
- A spatially-based zoning system to protect some particularly important parts of the ecosystem from human use and intrusion.

While CCAMLR members recognise that there is still a long way to go before comprehensive ecosystem-based assessment and management is a reality, and CCAMLR faces particular difficulties in the implementation of some conservation measures on the high seas, it nonetheless illustrates some of the important features of regional ecosystem-based marine management.

Constraints

Although some relevant activities are underway, including those of individual sectors, many are inefficient, poorly directed or poorly integrated. This itself is a serious constraint on the establishment of carefully designed and efficient integrated regional management.

Other constraints on achieving integrated regional management of our oceans are:

- management focused on single levels of biodiversity or spatial or temporal scales - this prevents effective management of related and dependent elements of biodiversity and of indirect effects in other areas;

- the sectoral focus and poor coordination of legislation and government agencies, at most levels of organisation, seriously impedes development of a holistic focus on the management of ocean ecosystems;
- the highly heterogeneous nature of some industry sectors, which reduces their capacity to agree on, and implement, sector-wide changes in management practices;
- limited understanding by the wider Australian community of the commercial and existence value of the ocean's resources, and the urgency to develop integrated management strategies prior to commercial development so as to avoid irreversible degradation of the biodiversity;
- limited technical understanding of ecosystem integrity as it applies to ocean ecosystems, limited national technical capacity for holistic management of oceans and a limited knowledge-base of the effects of sector activities on biodiversity;
- the substantial inertia of sectors (public, private and community) about responding to the new requirements for the conservation of biodiversity;
- the current trend to accord data on biodiversity a high commercial value (including that collected by publicly funded organisations), with the vexed consequential issues of data ownership, pricing and confidentiality;
- the nature of property rights already granted, implicitly or explicitly, over elements of the biodiversity without considering the needs of biodiversity conservation;
- the narrow interpretation of Ecologically Sustainable Development adopted by some sectors and in the legal interpretations.

What do we need to do?

A8

Implement Integrated Regional Ocean Management (IROM) - overarching integrated ecosystem-based management in our marine jurisdiction consistent with the principles of ecosystem management and multiple-use management. This must be based on strategic regional planning within an integrated framework, including a spatially based hierarchy. It requires clearly defined and consistent principles, guidelines, objectives for the conservation of marine biological diversity across regions and scales, and links to scales of management. This bioregional management may be progressively implemented in, initially, say three demonstration regions.

A9

Building on the commitments in the National Strategy for the Conservation of Australia's Biological Diversity, implement the NRSMPA as a core component of the integrated regional management of marine biological diversity.

A10

Develop and implement mutually supportive legislation, administrative arrangements and organisational changes to deliver integrated regional management of biodiversity; this may require the development of a new oceans management organisation with authority and responsibilities to implement IROM in regions and with an independent (of sectors) evaluation and assessment function for the purposes of accountability and performance assessment.

A11

Consolidate and extend the existing regionalisations to the whole of the EEZ at a regional scale to provide the spatial basis for integrated and hierarchical spatially-based management of biodiversity.

A12

Underpin management plans in IROM with Strategic Environmental Assessment, incorporating integrated regional management of biodiversity. The Environmental Impact Assessment process can then tackle the conservation of biodiversity in a regional context and reduce the costs of individual project-based assessments, thus simultaneously improving effectiveness and efficiency and reducing uncertainty for sector planning and resource security.

STRATEGIC ENVIRONMENTAL ASSESSMENT

Strategic Environmental Assessment (SEA) is a `process of consideration of environmental impacts of policies, plans and programs applied to higher levels of decision making with

the object of attaining ecologically sustainable development' (CEPA 1994).

SEA is a kind of Environmental Impact Assessment (EIA) process for programs, plans and policies that allows managers to consider environmental impacts over larger geographic areas and time frames. It also moves EIA away from the project-by-project approach to one which is broader and integrates the various sectors within a management framework.

5.3 BUILDING NATIONAL CAPACITY

Our area of marine jurisdiction is one of the world's largest and we are responsible for managing a large and important share of the world's global marine biodiversity (tropical, temperate and polar) which is greatly disproportionate to our population size. We accept this responsibility, as an advanced and innovative nation, but this acceptance brings with it the challenge of achieving effective and affordable stewardship of the biodiversity.

Our marine biodiversity can be a major natural asset, conserved and managed for sustainable use, but its exploitation must be matched by our capacity to avoid degradation and to achieve effective long-term conservation. As a nation, our capacity to understand and effectively manage the entire EEZ is limited. To ensure that we adequately conserve the ocean's biodiversity we must call into play the entire spectrum of our national creativity and innovation. Of particular importance are the resources for day-to-day management, in acquiring and synthesising information for management purposes, and in creating and maintaining a highly trained and innovative technical skill-base, at all levels of management. Our national capacity in these areas needs to be substantially improved.

The risks

While we accept the challenge to conserve and sustainably use our marine biodiversity, Australians are increasingly sceptical of governments and industries that prepare and promulgate policies, strategies and plans that are not supported by action, and particularly those that do not lead to tangible outcomes. The development of an effective National Oceans Policy will depend, among other things, on the vertical integration of management capabilities and on its ability to change existing ineffective ocean-management practices. If effective on-the-water management is not improved, the Oceans Policy (and initiatives like the *National Strategy for the Conservation of Australia's Biological Diversity* and the *National Strategy for Ecologically Sustainable Development*) will not change existing activities and will fail to conserve the ocean's biodiversity. Inadequate information derived from on-the-water management activities will put at risk the strategic integrated management process and risk poor conflict resolution and unsatisfactory resource allocation, planning and evaluation. Existing relevant activities

The substantial effort in on-the-water management of the oceans is today focused largely on fisheries, shipping, oil and gas, and defence. The private sector and the community are also playing larger roles in oceans management. All these activities are typically focused on specific compliance matters and there is little coordination of effort or of the data that results.

Surveillance, compliance and enforcement activities include fisheries patrols, fishery observer programs, Coastwatch, AQIS activities, community observing programs (eg. Fishcare), port facilities and vessels, science agencies, conservation agencies and the private sector.

Constraints

The key constraints to improving the efficiency and effectiveness of on-the-water management activities are:

- lack of institutional coordination in deployment of staff and infrastructure (based on inadequate administrative arrangements) and in technical training and education (based on fragmentation and competition in the training/education sector);
- inadequate strategic approach to the use of data and the lack of agreed and secure arrangements for sharing sensitive and valuable data and information among agencies and the Private Sector;

- the present sectoral-focused legislative and administrative basis for management agencies precludes their commitment to ecosystem management;
- lack of resources for on-water management activities because of the low intrinsic value accorded to non-commercial biodiversity;
- lack of a clearly prioritised set of high-value areas where scarce management resources can be focused;
- limited research is undertaken on integrated coastal or marine management processes or on the needs of management for information;
- a shared understanding of management information needs among scientists, managers and the community has not been established;
- limited transfer of business management principles and assessment of information techniques to marine management;
- the lack of long-term and consistent approaches to marine management resulting in an inconsistent approach to identifying and analysing information needs;
- limited resources for the identification, collation and analysis of data and information in many regional management agencies.

What do we need to do?

To improve our on-the-water management capacity, and the ability to acquire timely and useful data and information for management, we need to: A13
Review administrative and organisational arrangements that preclude or hinder the coordinated use of publicly funded resources (including Defence resources) to conduct cooperative surveillance, compliance and enforcement activities in all parts of our marine jurisdiction for activities that may threaten biodiversity;

A14
Give priority to funding support for remote-sensing technologies that can be used to track, position and observe vessels in the EEZ; A15
Establish national standards for data management and dissemination, including the secure use, maintenance and analysis of sensitive and valuable data derived from surveillance, compliance and enforcement programs in both the public and private sectors;

A16
Foster the development of partnerships with industries to gain access to operational data of value to environmental management and surveillance;

A17
Design and implement a coordinated national strategy to (a) enhance formal education, training and national awareness of oceans and their biodiversity, (b) emphasis the use of consistent best practice principles in managing all facets of the oceans and (c) to foster a sense of public stewardship of the oceans and the role and value of ocean-enforcement agencies.

5.4 CREATING WEALTH AND SUSTAINING MARINE BIOLOGICAL DIVERSITY

Marine biological diversity is the biological support `infrastructure' that maintains living marine resources and is of great commercial, recreational and cultural importance to Australians. Some sectors of activity focus on their direct activities and impacts on their resource base, because there are no incentive to address broader conservation objectives for marine biological diversity. As a result, their industry activities can degrade and, in places, substantially threaten the health and integrity of marine biological diversity both in the regions where they operate and (in the case of land-based sources of pollution) in adjacent areas. In sector activities, the trade-off of biodiversity for industry products and wealth is largely implicit, not explicit, because the biodiversity costs are rarely explicitly examined. In economic terms, the environmental costs are externalised. The principles of Ecological Sustainable Development applied in Integrated Regional Ocean Management provide for a broader focus on biodiversity and a better assessment of industry's effects on regional and national goals for biodiversity, as well as improving interactions with other sectors through more efficient and more certain resource allocation. However, the existing impacts of sectors need to be reduced.

SECTORS AND INDUSTRIES WITH ACTIVITIES AND INTEREST IN MANAGEMENT OF MARINE BIODIVERSITY

Marine tourism and recreation
Oil and gas
Defence
Fisheries - commercial, recreational and subsistence
Aquaculture
Shipping and transport
Mining
Agriculture (land-based sources)
Indigenous peoples
Education, research and training
Environment and conservation
Local government and communities

The risks

Marine biological diversity is degraded, in both direct and indirect ways, by the activities of sectors and their industries as they create wealth. In the long term, if this degradation exceeds acceptable contemporary standards or the natural resilience of ecosystems it will degrade our natural wealth and lead to the loss of sustainable resources, economic and recreational opportunities and jobs. The loss of biodiversity will also influence the ocean's integrity, its ecological functions and its capacity to be self-sustaining and deliver such vital ecosystem services as nutrient absorption and coastal protection.

If we do not address the fine- and broad-scale effects of individual sector and industry activities on the ocean's biodiversity we risk:

- loss of future benefits;
- exposure to huge public sector costs in attempts to rehabilitate ecosystems damaged by sector's activities (such as land-based pollution of estuaries) and to redress the human and economic consequences of the collapse of industries that reach ecologically unsustainable levels;
- failing to provide an efficient framework to reduce conflicts within and between sectors over resource allocation and environmental impact and costs, and the resulting social disruption and consequences for Australians;
- imposing unnecessary controls on sector activities because of overly cautious decisions derived from an uncertain understanding of how their activities affect biodiversity;
- continuing to support an inefficient process of resource allocation that does not provide for conservation of biodiversity.

Existing relevant activities

There are many existing activities that are pertinent to the reduction of sector impacts on biodiversity. Typically, however, these are uncoordinated and not integrated into an overall strategic plan to stop the degradation of biodiversity at local, regional or national levels.

Relevant activities in the public sector include: refinements to the implementation of Ecologically Sustainable Development; new and existing multiple-use Marine Protected Areas; fisheries regulations and management plans to ameliorate the effects of fishing on non-target species and to encourage sustainability of the target resource; International Maritime Organisation requirements (elimination of sea dumping of wastes & MARPOL - the International Convention for Prevention of Pollution by Ships); promotion of ISO 14000 and 9000 for environmental management systems; management of the Environment Impact Assessment (EIA) process.

In the private sector relevant activities include: Industry Codes of Practice; ISO 14000 and 9000 for environmental management systems, implementation of EIA activities, improved quarantine procedures, shift to ecotourism standards, eco-labelling initiatives.

Constraints

Constraints on improving industry sector's performance in reducing their impacts on biodiversity include:

- the large number and diversity of sectors that directly or indirectly affect the ocean's resources (underlining the value of the oceans to many Australians) and the diversity of their economic bases;
- the historical failure to recognise, and incorporate into planning, the ecological inter-connectedness of biodiversity to the commercially valued products;
- the common law principle that, unless otherwise specifically limited, ocean resources are owned by all, access is free and is a right for individuals, while responsibility for management and well-being is not assigned and is assumed to be shared;
- the sectoral focus and poor coordination of legislation and organisational structures, at most levels of organisation and jurisdiction, preventing development of a holistic focus on the management of ocean ecosystems;
- our limited capacity for surveillance, assessment and enforcement, encouraging self-regulation and reporting that may be open to abuse;
- although direct and obvious impacts are concentrated on the primary source or activity (such as near urban settlements), the ocean's connectedness means that problems have broad but more subtle regional `expression'; they are cumulative and interact to degrade biodiversity in unpredictable ways.

What do we need to do?

We depend on the sectors' activities for our national wealth, our jobs and our well-being. The maintenance of healthy sector activities in the oceans is of paramount importance, and in the context of Ecologically Sustainable Development, the sectors must be maintained and prosper without unacceptable degradation of the ocean's natural wealth. We must therefore: A18
Integrate sector-based sustainable uses within Integrated Regional Ocean Management (IROM), recognising that they will continue and be enhanced by Ecologically Sustainable Development, based on the principles of ecosystem management and multiple-use management;

A19
Ensure that the impacts of sector activities on biodiversity are fully internalised and accounted for in management;

A20
Develop an improved technical capacity and understanding of the causes and effects that can degrade biodiversity, for use in IROM and local project-level assessments;

A21
Develop economic instruments and incentives to address sector access rights and their impacts on biodiversity;

A22
Promote a cultural shift in sectors to adopt continuous improvement in best practice models that explicitly concern management of biodiversity;

A23
Design and implement an independent process for monitoring and evaluating the effectiveness of local, regional and national marine biodiversity conservation, related to sector activities and compliance;

A24
Improve sector-based surveillance and enforcement by maximising collaboration and cooperation of different sectors, based on partnerships, stewardship and education.

5.5 MONITORING THE CONDITIONS OF MARINE BIOLOGICAL DIVERSITY

Monitoring - the routine gathering of data on indicators of performance defined by reference to management objectives - is an intrinsic part of effective management. Reporting on the condition of the assets is a central feature of public accountability in the management of natural resources. To determine whether our management of human activities is achieving the desired level of conservation, we need to monitor the condition of our marine biological diversity. Changes in diversity that might be attributable to natural changes, or to long-term climate-induced change, must be distinguished from local or regional effects of anthropogenic activities. Future conservation of biodiversity relies on our ability to assess `management performance' in meeting biodiversity objectives within the context of substantial natural variability. This can only be achieved through monitoring carefully selected indicators of the condition of biodiversity that are part of an integrated regional management program.

The risks

Without comprehensive, broad-based monitoring programs, targeted at key indicators, we risk making the following mistakes:

- falsely assuming management plans, strategies and activities are effective in conserving diversity and so unwittingly presiding over a decline in biodiversity;
- falsely assuming management plans, strategies and activities are not effective in conserving diversity and so imposing undue costs on sectors to implement levels of protection and management that exceed the requirements of regional biodiversity objectives;
- failing to provide a benchmark and baseline of natural variability in diversity for use in coastal planning and development, and in impact assessment;
- failing to implement public accountability in management of a major element of our nation's natural wealth and, particularly, failing to explicitly meet our international obligations (under the *Convention on Biological Diversity and the Law of the Sea Convention*) to monitor our biodiversity.

Current activities

State of the Environment reporting is now carried out by national, most State and many local government agencies. A nationally coherent suite of marine and estuarine indicators for State of the Environment reporting (Ward et al., 1997; Saunders et al., 1997), is being considered for national implementation by the ANZECC State of the Environment Reporting Task Force. Much other monitoring is being undertaken, although there are few explicit and committed long-term (over decades) programs in place. The Australian Institute for Marine Science runs a limited long-term monitoring program on the Great Barrier Reef, CSIRO Division of Marine Research maintains a time-series of oceanographic variables at three coastal stations, and many universities have small and local programs of research, some of which have long term monitoring elements. Other activities include routine management-related time series of data and information for fisheries stock assessments, local monitoring programs at specific places on the Great Barrier Reef and some private sector auditing. Constraints

Constraints that impede the development and implementation of robust monitoring programs are:

- lack of adequate knowledge of the baseline levels of natural variability in most species, habitats and ecosystems;
- an accepted and cost-effective suite of indicators to reflect the state of the main elements of regional biodiversity;
- lack of performance criteria for indicators of biodiversity, with broadly agreed levels of acceptable change;
- the perception that indicators, criteria and monitoring of biodiversity are not cost-effective because biodiversity is largely undervalued and the failure to implement innovative and creative approaches to developing cost-effective solutions;
- lack of a nationally accepted suite of standard measurement and reporting protocols to standardise long-term monitoring of indicators;
- lack of a perceived utility for monitoring and evaluating biodiversity;

- lack of technical capacity and public sector resources to make routine measurements in remote, offshore and deep waters, where partnerships with sectors are likely to be few, as are direct and immediate threats to biodiversity;
- non-commercial, pre-commercial or non-threatened species are generally not the focus of information gathering, yet these species are a significant component of a region's natural wealth, are part of our obligation to manage biodiversity and need to be managed to confirm our control of the resources in our marine jurisdiction;
- the false perception that monitoring is not a scientific process and offers no scientific challenges;
- the dismal trend of research funding time-scales becoming increasingly shorter to meet false performance indicators in research funding and the failure of research agencies and funding bodies to recognise and support time-series data collection programs as strategic aspects of scientific research to be protected and fostered.

What do we need to do?

Monitoring and evaluation of biodiversity must be designed and developed as a long-term (many decades) commitment to the Integrated Regional Management process in each region. Given the difficulty of measuring biodiversity as a whole, the monitoring will be focused on surrogates and indicators of biodiversity. Where appropriate this should be coherent with national State of the Environment reporting.

Key needs and activities are to:

A25
Develop scientifically robust surrogates and indicators for biodiversity with estimates of their natural variability that can be used in cost-effective long-term monitoring programs;

A26
Develop national standards and protocols for long-term biodiversity monitoring;

A27
Foster strategic partnerships with the private sector and the community to increase their roles in monitoring to help answer wider biodiversity conservation questions;

A28
Devise and test incentive programs for sectors that participate in voluntary monitoring programs coherent with national State of the Environment reporting, including data dissemination;

A29
Fund the development of strategic and innovative approaches to the regional and national synthesis and free dissemination of publicly accessible data from long-term monitoring programs (see also A32);

A30
Fund a demonstration program in each of three demonstration Integrated Regional Management regions to illustrate how regional monitoring programs can include robust scientific design, industry/sector partnerships, State of the Environment reporting and community participation (see also A8).

5.6 IMPROVING COMMUNITY STEWARDSHIP AND PARTICIPATION

Large stretches of our coastline are uninhabited and most of our marine jurisdiction is largely inaccessible to the majority of Australians. Nevertheless, our beaches and coastlines are icons to which we appeal when searching for our national identity. Australians value their coasts and oceans as a source of recreation and commerce, and they expect them to be managed to the highest standards of ecological sustainability.

The Australian community also has strong links to a coastal history (since most cities were founded on sea transport and coastal industries such as fishing) and these still underpin the economy of many coastal centres. Australians are concerned with the threats posed in recent years by growing commercial and recreational use of our coasts and oceans. However, apart from the huge community support for protection of the Great Barrier Reef, marine conservation issues are only now receiving increasing public attention and support.

Involving the community in managing the coast is a challenge; creating a community constituency for oceanic areas is an even greater challenge. Both are vital if managers are to meet the expectations of the community and conserve marine biodiversity.

The risks

If we fail to develop a stewardship ethic in the broader community and facilitate their involvement in activities we risk:

- community disinterest in participating in planning, managing and monitoring activities;
- having a limited community understanding and support for marine biodiversity conservation initiatives;
- continuing conflicts between non-commercial and commercial sectors over access to resources and areas;
- decision-making that does not fully consider or appreciate the broader community needs;
- continuation of detrimental practices such as littering, damage to critical habitat (eg. anchor damage to coral reefs), over-fishing;
- having limited, or no, access to relevant local and traditional knowledge.

Existing activities

There are a variety of community-based activities, including specific projects under Coastcare, Dunecare, Fisheries Action and Coast and Clean Seas programs, the Marine and Coastal Community Network, various marine education programs such as Seaweek, and a variety of recreational fishing programs such as Recfish. Many dive groups do local monitoring and establish fish-attracting devices such as artificial reefs. In most states, there are growing opportunities for the community's involvement in planning and managing marine reserves and developing coastal regional management plans. There are also programs that involve and incorporate traditional management of marine and coastal resources within many communities of indigenous people.

Constraints

The main constraints on involving the community to a greater extent are:

- the size of Australia's marine jurisdiction and the length of the coastline;
- the diversity of Australia's marine and coastal ecosystems and hence the difference in value to different communities;
- the lack of direct dependence by many Australians on marine and coastal resources for the basic necessities of life (few Australians are truly subsistence users of marine diversity);
- remoteness and difficulties of access, particularly in bad weather, as well as the cost of owning a boat;
- general attitude of `right of access' which is not offset by a sense of responsibility (a marine stewardship ethic is not widely held);
- the lack of community acceptance that ocean resources are limited and under threat;
- the lack of general understanding of the extent of `connectedness' of ocean ecosystems in the community;
- management's and science's limited understanding of marine biodiversity and therefore their limited ability to (a) increase the understanding of the values of our marine and coastal systems and the human activities that cause pollution and other harmful impacts; and (b) increase the understanding of the means by which marine biodiversity can be conserved and pressures reduced in the wider community;

What do we need to do?

The key actions now needed to improve the community's stewardship of marine biodiversity, and to facilitate increased activities, are: A31

Continuation of current community programs, such as Coastcare and the Marine and Coastal Community Network, that facilitate community involvement in planning and management and provide mechanisms for information sharing and cooperation among governments, industry and the community;

A32
Improve access to research, industry and planning information by establishing innovative and publicly accessible information systems at national, regional and local levels, and improving the legislator's commitment to public consultation and access to information;

A33
Develop a range of public and formal education materials and opportunities that highlight the values of Australia's marine biodiversity and the current and emerging threats and pressures;

A34
Wherever possible, foster the establishment of genuine partnerships between the community, governments and industry to manage marine conservation areas and undertake monitoring and rehabilitation.

A35
Establish a system of community stewards for the oceans; to ensure commercial and community representatives will benefit from participation - even though they may not have direct commercial or community links to biodiversity - governments will need to provide some initial support and resources to facilitate their involvement.

5.7 FACILITATING INDIGENOUS PEOPLES' PARTICIPATION IN MARINE CONSERVATION

The Coastal Aboriginal peoples have been users and custodians of Australia's marine environment for 40 000 to 50 000 years. An indistinguishable part of the clan estate and culture of many communities is `salt-water country'. Unlike many mainland Aboriginals who have been dispossessed of their land, Torres Strait Islanders have a long dependency on the ocean resources and identify strongly with the sea.

Indigenous Australians use aquatic resources in subsistence practices that go together with other aspects of their ways of life. They exploit a variety of aquatic ecosystems. A single group may fish in the open water, reefs, seagrass beds, sandbanks and beaches, mudflats, estuaries, mangroves, swamps, rivers, seasonally inundated floodplains and freshwater lagoons. This same group would take different species depending on the season, varying from pelagic, estuarine to reef fish, and dugong, sea turtle, shellfish etc.

Aboriginal and Torres Strait Islanders do not differentiate between the coastal zone shelf and off-shore areas of the seas. Rather, they see all the elements as one `seacountry'.

Indigenous people:

- should not to be viewed as a special interest group, but to some extent as another sector;
- do not have an isolated definition of the coastal zone, shelf and off-shore but rather see the elements as a continuum and may have interests over a number of regions, although traditional and cultural boundaries are not always well defined;
- have different `values' for biophysical elements than those of European-trained scientists or industry sectors - an animal may be by-catch to the commercial fishing sector but a desirable item by Islanders and Aboriginals - and these different `values' can be difficult to express, store and present;
- have cultural attachments to many, if not all, elements of `seacountry';
- maintain that no part of the Oceans Policy or consequent conservation activities should prejudice or diminish Native Title Rights.

Constraints

Constraints to the full and effective participation of indigenous peoples in the conservation of marine biological diversity are:

- fishing activities by indigenous people overlap and interact with commercial (and other) fishing activities in highly uncertain ways;
- the difficulty of integrating management across several very different cultural and fishing management structures to ensure that use of marine resources by indigenous people is integrated into IROM;
- highly uncertain resource allocation issues within the fishing sector - are the fisheries resources upon which commercial, recreational and indigenous fishing depend sustainable?;
- lack of clear guidelines about the transition between traditional harvesting practices and commercial operations;
- lack of clear guidelines and a role for traditional practices in the management of threatened species that are also fished in a subsistence manner by indigenous peoples;
- lack of understanding in the broader community of the significance of marine resource use to indigenous communities.

What do we need to do?

To encourage the participation of indigenous peoples in Integrated Regional Planning and to make firm commitments to conservation of biodiversity, we need to:

A36

Allocate resources to improve our understanding of the cultural and physical values indigenous people place on `seacountry' and to document those values and relevant traditional knowledge;

A37

Ensure that indigenous peoples continue to be recognised as major stakeholders in management of coastal waters and are assisted to participate in the IROM process for areas of concern to them;

A38

Train indigenous people in modern technology to complement their traditional knowledge and become more involved in managing coastal oceans;

A39

Foster the use of traditional knowledge and resource data in IROM.

5.8 EMERGING ISSUES

Regional and international interactions

Northern Australia shares a common pool of biodiversity with Papua New Guinea and Indonesia. Many species of high value to commerce and to indigenous people migrate freely through this international region. If the management practices of our neighbours are less protective of these species, if, for example, there is unsustainable harvesting outside our borders, then the species we value and utilise could be seriously affected.

International agreements to jointly manage, or to agree on how to manage resources of common concern are crucial. Such agreements have been developed for Torres Strait, but are also needed for the other areas of northern Australia where our borders adjoin Indonesia and Papua New Guinea. The UN Agreement on High Seas and Highly Migratory Fish Stocks provides for the development of regional management bodies.

Similarly, international agreements may be of vital importance in establishing integrated regional management in our Heard Island territory, in this case with France.

As pressure for resource increases, the need for carefully planned and formalised agreements is paramount.

Property rights to the gene pool

Australian seas contain a vast diversity of genetic resources that have evolved in response to our unique environments. These resources have a huge potential for research and economic development. Naturally occurring gene pools can be exploited to form the basis of new aquaculture industries. Equally, genetically determined bioactive compounds produced naturally in marine organisms can be harnessed through genetic engineering to provide pharmaceuticals. These resources include not only the genetic material itself, but also the intellectual property (knowledge and ideas) associated with its identification, values and uses. Allocation of the rights to own or use these resources is a vexed issue.

International treaties (including the Convention on Biological Diversity) acknowledge a country's ownership of its own genetic resources. Privately funded research is protected by patents and secrecy agreements, but publicly funded research is (usually) published openly. Without adequate safeguards, these genetic resources can be exploited by foreign interests in an inequitable manner. This reduces direct economic returns to Australia and also compromises our ability to ensure the further research, development and sustainable use of these resources.

Unforseen effects of selling property rights to genetic material may also arise and become a direct threat to biodiversity. For example, when a species is found to have bio-active compounds, large amounts of biological material may be required for further testing and development. If the species is found in a sensitive habitat, or is from a small population, collection of large numbers can destroy the population, as would any other non-sustainable harvesting practice.

6. CONSERVATION IN OUR INTERNATIONAL REGION

Australia is a world leader in methods for the conservation of marine biological diversity. We have the opportunity to share our experience and expertise in the conservation and sustainable development of marine resources, including biodiversity. This is to our advantage because we help protect elements of our biodiversity that we share with other nations; we can maintain our conservation technology and capacity at world-class levels; and we can maintain a strategic awareness of environmental issues in our international region.

Australia and its marine waters are bordered by South-east Asia and the Indian and Pacific Ocean regions that are experiencing rapid population growth and economic development. For much of this international region, economic development will be based on exploiting coastal and marine resources. Politicians and economists see offshore territorial waters as the final development frontier when coastal resources are fully or over-exploited and land and its resources become scarce. Development in our international region provides investment, technology and research opportunities for Australia. More importantly, Australia has the opportunity to share its experience and expertise in the conservation and sustainable development of marine resources, including biodiversity.

Unfortunately, strong national or regional strategic planning for sustainable coastal and marine development are rare. Indonesia's Marine Resources Evaluation Program (MREP) is one example of strategic planning of offshore areas, although this is currently limited to 10 of the 27 coastal provinces. Under the MREP program a hierarchical planning program is used, with provincial strategies to provide broad guidelines for development of marine and coastal areas and resources. Zoning and management plans are then formulated for specific areas, resources or issues. Another exception is the Antarctic, where CCAMLR is developing ecosystem-based management programs in consultation with the international interests in the area.

Throughout South-east Asia, the Indian Ocean and the Pacific coastal and marine management programs are developed only sporadically, often focused on nearshore areas and not fully implemented. This situation emphasises the urgency to at least keep pace with, and, ideally, plan ahead, for economic growth in marine areas.

Australia is fortunate in not having a rapidly expanding population seeking economic growth as well as food, housing and employment with the same sense of urgency as is the case for some of our near neighbours. Our history of good coastal and marine management enables Australia to lead the international region in conserving marine biodiversity. The work of the Great Barrier Reef Marine Park Authority and Ningaloo Marine Park in managing large areas of coral reefs, the work of various agencies in managing mangroves and the management of marine aquaculture within a regional planning framework in Tasmania clearly demonstrate Australia's expertise and knowledge of coastal and marine management. Many of our neighbours look to Australia for leadership in managing coastal and offshore areas.

The NRSMPA program undertaken jointly by the Commonwealth and State provides the basis for identifying potential MPAs and for in situ conservation of part of Australia's marine biodiversity. The approach taken for the NRSMPA could be applied in neighbouring countries, with modifications to suit each area's cultural, social and political characteristics. The value of the NRSMPA approach is maximised within Integrated Regional Management. These, and many of the other marine and coastal management initiatives underway in Australia, provide a basis for transferring expertise and technology to our near-neighbours while ensuring sustainability of our resources.

It is in our best interests to take the leadership in conserving marine biodiversity in our international region. Much of Australia's national (especially tropical) marine biodiversity is shared between neighbouring countries, for example turtles migrate through national and international waters in the Pacific Ocean. Despite Australia's best efforts to manage many species for either sustainable use or conservation, if other countries do not meet their sustainable development obligations then our national marine biodiversity may be threatened. One way to reduce this risk is to take a

management and policy leadership role as well as to provide assistance, from technology transfer to direct aid funding, to relevant programs and countries.

A further reason for engaging our neighbours with leading-edge conservation practices is to ensure that we always maintain a strategic awareness of contemporary conservation and environmental practices. If the world's resources continue to decline but our resources and diversity can be maintained, our competitive commercial edge in such sectors as fishing, aquaculture and tourism will be enhanced. Maintaining this edge depends on maintaining our conservation technology and capacity at world-class levels; by engaging our neighbours in conservation practices we help to maintain our own competitiveness and strategic awareness.

Australia has already taken a leadership role in several coastal management initiatives, most notably in ASEAN nations. Others include institutional strengthening and human resource development such as the coastal zone management strategy for Papua New Guinea and the Southwest Pacific Sea Level Rise Study.

Australia needs to continue this assistance and, as our national ocean policy develops, to focus aid to complement the new policy where possible. Similarly, Australia needs to continue to work with other international aid agencies and lending institutions to ensure that maintenance of marine biodiversity remains a priority through funding, expertise and technical transfer. The environmental debate has great potential to demonstrate our creativity, our capacity for innovation and to confirm our status in the international region.

7. THE PROGNOSIS AND KEY ACTIONS

The value of the marine environment to both wealth generation and human enjoyment will increase substantially in the next few decades. The intensity and diversity of human uses of the marine environment will also increase, technological developments will enable fishery operations to be conducted at all depths and more minerals to be extracted from the sea-bed, and urban development will continue to focus on the coastal fringe of the continent. And, as has already been discovered elsewhere in the world, it will be keenly recognised that the marine environment is not infinite in its capacity to absorb human impacts and that serious degradation can occur. The extent to which degradation actually occurs will depend heavily on how well we understand the oceans and how effective our management is during the next few years.

We have a generally healthy environment now, except for areas near large population centres, but a very poor base of information about the structure and functioning of marine ecosystems. We do not understand the effects of the pressures, and we have very weak monitoring programs and a lack of integrated strategic planning at both scientific and management levels. For Australia, a broad interpretation of this is that the marine environment is at present generally healthy because our human population and industries are relatively small, rather than because our management is good. This is not an approach that can be expected to protect environmental quality and biodiversity in the longer term, particularly with the expected increases in use of the marine environment.

The challenge to change this situation is huge. Australia is responsible for a very large EEZ, with a very valuable biodiversity by global standards and a relatively small human population. However, this challenge is not beyond Australia's scientific, industrial, management and policy capabilities if these groups are appropriately resourced, focused and cooperative. There are several key developments that will be needed for success.

- Integrated regional management that is overarching above sector interests and that can recognise and manage all of the interacting users of the marine environment and resources within the context of maintaining regional ecosystem integrity.
- Use of explicit and measurable objectives related to the conservation of biodiversity and maintenance of ecosystem integrity in regional and other management arrangements.
- Use of precautionary and adaptive management approaches.
- Development of improved partnership and stewardship arrangements and incentives amongst industry, the community and governments in support of conservation and ecologically sustainable resource use.
- Improved baseline understanding of Australia's marine biodiversity, improved understanding of the impacts of use and improved environmental monitoring that is linked to management decision making.
- Establishment of a system of Marine Reserves that, in combination with off-reserve management arrangements, can reliably protect Australia's marine biodiversity.

These key developments form part of an overall strategic approach to management of the oceans that uses efficient, effective and accountable management practices. In the new millennium, Australians will expect nothing less.

The specific actions necessary to deliver these outcomes are:

1. Improve our knowledge of the biodiversity

A1
design and implement specific surveys

A2
improve our human and infrastructural capacity in taxonomy

A3
identify areas of highest priority for conservation purposes

A4
identify vulnerable species, habitats and biological communities

A5
identify the key ecological processes

A6
incorporate the biodiversity knowledge of traditional and local communities and industries

A7
establish a perpetual national research grants scheme for marine biodiversity

2. Establish an integrated management process for our marine jurisdiction and each region

A8
Implement Integrated Regional Ocean Management - overarching integrated ecosystem-based management of our marine jurisdiction in, initially, three demonstration regions.

A9
Declare a set of representative marine reserves as a core component of the integrated regional management process.

A10
Develop and implement legislation, administrative arrangements and organisational changes to deliver effective, efficient and accountable integrated regional management.

A11
Consolidate and extend the existing regionalisations to the whole of the EEZ.

A12
Foster Strategic Environmental Assessment in the regions.

3. Improve our national capacity to manage the oceans

A13
Foster improved coordination, administrative and organisational arrangements for surveillance, compliance and enforcement activities.

A14
Fund support for emergent remote sensing technologies that can be used to track, position and observe vessels in the EEZ.

A15
Establish national standards for data management, including the secure use of commercial data.

A16
Foster partnerships with industries to gain access to operational data.

A17
Implement a coordinated national strategy for education, training and national awareness of the oceans, their biodiversity and the role of enforcement agencies.

4. Reduce the impacts of sector activities

A18
Integrate sectoral-based sustainable uses into Integrated Regional Ocean Management.

A19
Ensure that the impacts of sector activities are fully internalised in management.

A20
Improve our understanding of causes and effects that can degrade biodiversity.

A21
Develop suitable economic instruments and incentives to address sectoral access rights and impacts on biodiversity;

A22
Promote continuous improvement in best practice models.

A23
Implement an independent process for monitoring sectoral activities.

A24
Improve sector-based surveillance and enforcement.

5. Monitor and report on the condition of the biodiversity

A25
Develop scientifically robust surrogates and indicators for biodiversity.

A26
Develop national standards and protocols for long term biodiversity monitoring programs.

A27
Foster strategic partnerships with the Private Sector and the Community to increase their participation in monitoring.

A28
Devise and trial industry incentive programs for sectors that participate in voluntary monitoring programs.

A29
Improve the public accessibility of data on biodiversity.

A30
Fund a demonstration program in three regions to illustrate well designed regional monitoring programs.

6. Improve the community's stewardship and participation

A31
Continue existing programs that facilitate community involvement in planning and management.

A32
Improve access to research, industry and planning information.

A33
Develop a range of education materials to highlight the values of Australia's marine biodiversity and current pressures.

A34
Establish partnerships between the community, government and industry to manage marine conservation areas.

A35
Establish a system of community stewardship for the oceans.

7. Facilitate the participation of indigenous peoples

A36
Improve our understanding of the value of `seacountry'.

A37
Facilitate indigenous peoples to participate in management.

A38
Foster indigenous groups with contemporary training to use this to complement their traditional knowledge and become more involved in management.

A39
Foster the use of traditional knowledge and resource use data in management.

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APPENDIX

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APPENDIX

A2 AUSTRALIA'S MARINE BIOLOGICAL DIVERSITYAN OVERVIEW

Habitats and ecosystems

Here we briefly describe the main types of marine and coastal habitats and ecosystems, and their present status, derived from the *State of the Marine Environment Report* (Zann, 1995) and more recent additional research.

Estuaries

Estuaries are the meeting places of fresh and salt waters. Naturally rich in nutrients, estuaries are ecologically highly productive and are important habitats for adult marine animals as well as critical nursery habitats for the juveniles of many species. In Australia, estuaries and sheltered bays have also been the focus of urban and industrial development, and are popular for recreation. Australia has 783 major estuaries: 415 in the tropics, 170 in the subtropics and 198 in temperate areas. There are few estuaries on the long arid coastlines in the south-west and west.

The flows of many of Australia's rivers have been significantly altered by dams and barriers, wetlands reclamation, irrigation schemes and flood-mitigation schemes, all of which interfere with the hydrodynamics or flushing characteristics of estuaries. Elevated nutrients and consequent eutrophication are periodic problems in many estuaries, as are heavy sediment loads from soil erosion. Estuaries whose rivers drain disturbed acid soils, such as in northern New South Wales and southern Queensland, may become periodically acidic, causing fish diseases such as 'red-spot' and fish kills.

As a result of these activities, many estuaries are degraded: at least 64% of estuaries in New South Wales and 22% in Victoria are considered to have 'poor' water quality. Seagrass beds have dexlined alarmingly in temperate Australia. Fisheries are considered to be threatened in 21% of esturies in New South Wales and 23% in Victoria.

Shore communities

Shores maintain diverse communities of very specialised animals and plants, and may require special conservation measures. Australia's shores include open coasts with rocky headlands, cliffs and sandy beaches, and sheltered coasts, bays and estuaries with muddy or sandy tidal flats.

Rocky shore habitats are often small and narrow, and are particularly vulnerable to human impacts. Threats to shore communities include over-harvesting of molluscs, crustaceans and sea urchins for food and bait; discharges of sewage and storm water; trampling by fishers and other visitors; debris, oil slicks and other pollutants that float on the sea surface; and loss of habitat. In the more populous south-east, south and south-west of Australia, large areas of shores around coastal cities and towns have been reclaimed or alienated by seawalls, port development, industry, housing, and tourism and recreational facilities.

Despite their great ecological and recreational values, shores are often not well protected. The effects of human uses are also not well understood or monitored. On some coasts the shores are protected by terrestrial conservation reserves that extend to the low water mark. However, management of intertidal areas can be confused by the overlapping responsibilities and poor coordination amongst management agencies.

Coastal saltmarshes

Coastal saltmarshes-intertidal plant communities dominated by herbs and low shrubs-are often associated with estuaries. Saltmarshes are highly productive, key habitats that support many other organisms.

It is estimated that Australia has 13 595 square kilometres of saltmarshes (Queensland 5 322; New South Wales 57; Victoria 125; Tasmania 37; South Australia 84; Western Australia 2 965; and Northern Territory 5 005 square kilometres). One of the main threats to saltmarshes in developed

areas is land reclamation. Already, extensive areas have been filled for ports, marinas, canal estates, and urban and industrial sites. Other threats include degradation by rubbish dumps, off-road vehicles, invading weeds (particularly introduced cord grass, pampas grass, para grass and rushes) and drainage for mosquito and sandfly control.

Mangroves

Mangroves are tree and shrub species that are adapted to tidal inundation of salty water. Mangrove forests are very productive ecosystems and are of great ecological and economic importance. Australia has the third largest area of mangroves in the world and has some of the most diverse communities.

Overall, losses of mangroves in Australia are small compared with those in other countries. However, locally significant losses have occurred around Australian coastal cities and towns; for example, 20% has been cleared in Moreton Bay near Brisbane. The main threats are continued local clearing and development, and catchment changes. Only 8% of Australia's mangrove communities are in protected areas.

Seagrass beds

Seagrass beds are ecologically important because of their high productivity, their ability to trap and stabilise coastal sediments, their role as habitats for many fish species (and juvenile fish in particular) and as the habitat for charismatic species such as dugongs and turtles. Australia has the highest biodiversity of seagrasses in the world, the largest areas of temperate seagrass and one of the largest areas of tropical seagrass.

Australia's temperate seagrass beds appear to be under threat. Increased sedimentation and nutrients from catchments have been linked with massive die-back of seagrasses in many areas. New South Wales has lost half of the Zostera seagrass in its estuaries, Victoria has lost about 85% of the seagrass in Western Port, Tasmania 94% in Pittwater, South Australia about 5 000 ha in Gulf St Vincent and Western Australia has lost around 97% of seagrasses in Cockburn Sound. The serious loss of tropical seagrasses in Hervey Bay in Queensland has caused major mortality of dugongs.

Temperate `reefs'

The subtidal hard substrata or reefs of temperate Australia are little known. The southern coastline has the world's highest diversity of red and brown algae (around 1,155 species), bryozoans (lace corals), crustaceans and ascidians (sea squirts). Long isolated in geological time and by climatic barriers, this region has a distinctive fauna and flora, with around 80% to 90% of species in most groups being endemic (found only in southern Australia).

Despite their high conservation and economic values, Australia's temperate reefs are inadequately studied and relatively few are protected. It is assumed that, outside metropolitan and industrial areas, they have been relatively unaffected by human activities.

Coral reefs

Coral reefs are among the most productive, diverse and complex ecosystems in the world. They are also under global threat: around 70% of the world's coral reefs are thought to be degraded in some way.

Australia has the largest area of coral reefs of any nation and the largest coral reef complex, the Great Barrier Reef. There are also large areas of coral reefs in Torres Strait, the Coral Sea Territories and central and northern Western Australia. The Tasman Sea reefs (Elizabeth and Middleton Reefs and Lord Howe Island fringing reef) are the highest-latitude coral reefs in the world, thriving in conditions that are marginal for coral growth elsewhere.

The main issues affecting Australia's coral reefs are the effects of sediments, nutrients, fishing and tourism, and the threats of oil spills. Specific threats include elevated nutrients in the inner Great Barrier Reef, outbreaks of crown-of-thorns starfish in the outer central and northern Great Barrier Reef and Tasman reefs, damage from the passage of tropical cyclones and outbreaks of coral-eating Drupella snails in Ningaloo Reef, Western Australia.

Coral reefs are well represented in marine protected areas in Australia. Australia's reefs are less affected by human activities than those in other countries, mainly due to low to moderate levels of use and their remoteness, but elevated nutrients and sediments resulting from inland soil erosion are a threat in our non-arid regions.

Continental shelf and slope

Continental Australia has about 2.5 million square kilometres of geomorphic continental shelf and slope, extending to about 400 metres water depth, about half of which is less than 50 metres deep.

Most scientific survey effort has focused on areas of the shelf and slope shallower than about 100 m, and the communities on the deeper areas of sea floor are poorly known to science. Few qualitative studies have been made on Australia's shelf as a whole and very few surveys of the slope (200-400 m depth) have been made. However, sites examined on shelves and slopes on the Great Barrier Reef, Bass Strait and North West Shelf had very high biodiversity and very high proportions of species previously unknown to science.

Little is known of human impacts on sea-floor communities. However, the rate of sedimentation on the sea floor has increased since European colonisation of Australia by factors of 10 to 100, or even more in some areas. Some shelf and slope fish species have been severely overfished. Trawl nets and dredges dislodge attached species such as sponges thus modifying the habitat and food chains. Most of Australia's sea floor is not actively or specifically managed, but trawling is prohibited in some areas.

Deep sea and seamounts

A large proportion of the area of Australia's marine jurisdiction is deep-sea (about 4 000-5 000 m depth). This area contains numerous seamounts-underwater mountains that do not reach the sea surface-especially off southern and eastern Australia. The deep sea supports important fisheries, such as those for orange roughy and Patagonian toothfish, and contains important habitat for some marine mammals, such as elephant seals and whales. The deep sea and seamounts of the EEZ are almost unknown to science, but the few surveys completed have revealed a level of biodiversity that is very high by world standards and a high degree of endemism. It is clear that the deep waters of the Australian EEZ contain a very diverse and largely unique fauna, but we have too little information available to map the biodiversity or to identify bioregions and habitats. Threats to this biodiversity come mainly from developing fisheries and, potentially, mineral extraction.

Phytoplankton

Phytoplankton is the food base of the oceans. Most rivers, estuaries and coastal waters near Australia's large population centres show signs of eutrophication. Blooms of toxic marine algae, some species of which may have been introduced from other countries in ships' ballast waters, are periodic, serious problems in parts of southern Australia.

Diversity of species

Little is known of the conservation status of most of Australia's marine species. Scientific interest to date has largely centred on the higher vertebrates such as turtles, seabirds, seals, dugongs and whales. Generally, microorganisms, algae, invertebrates and fish have been neglected.

Much of the effort in conservation of terrestrial biodiversity has centred on the protection of rare and endangered species. However, it is difficult to apply the endangered species concept to marine animals other than mammals, seabirds and some reptiles. Management strategies for conserving terrestrial species are often not suitable for marine species because of the interconnectivity in the marine environment and the very different life histories of most marine species.

Many marine species are naturally rare by terrestrial standards but are not necessarily endangered. Species extinctions appear to be infrequent in the marine environment but local extinctions are more common. If these occur in ecologically important species in specific communities, they may have a major impact on marine ecosystems.

We know very little about our marine biodiversity. Many marine species remain undescribed and relatively little is known about most of the described species. An enormous taxonomic and monitoring effort would be required in Australia to describe all species and to determine their status.

Given this lack of knowledge, precautionary management strategies are the only sensible way of conserving marine biodiversity. These strategies might include: establishing networks of protected areas for endemic species with small geographic ranges or restricted breeding sites; protecting long-lived, large and wide-ranging species; and rebuilding populations of excessively exploited species. These species-specific strategies would be embedded within broader strategies designed to conserve biodiversity in all areas of the ocean.

Marine plants

The seas around Australia contain thousands of different types of microscopic marine algae, fungi and bacteria. Australia's marine phytoplankton includes representatives of all 13 algal classes, including diatoms (5 000 species) and dinoflagellates (2 000 species). Australia is also very rich in macroalgae or seaweeds. Southern Australia has over 1 150 species. This is over 50% more than any comparable region in the world.

The angiosperms (flowering plants) are also very well represented. Australia has 11 of the world's 12 genera of seagrass and over half the total number of species. Australia has 16 of the world's 20 families of mangroves and 40 of the world's 55 species of mangroves.

Invertebrates

The number of marine invertebrate species in Australia is unknown but is probably in the order of tens of thousands. The conservation status of very few invertebrate species is known. A number appear vulnerable because they are rare and have quite restricted habitats. It is expected that, as scientific knowledge increases, the vulnerable invertebrates will be progressively incorporated into the legal and administrative framework used to conserve vertebrates. Habitat protection is considered to be the most useful and practical approach to conserving invertebrates. Fish
Australia has an estimated 4 000 to 4 500 species of fish, of which around 3 600 have been described. About a quarter of the species are endemic; most of these are found in southern Australia. While regulations governing many of the fished species have long existed in this country, marine fish conservation is a relatively new field and the conservation status of most species is poorly known.

Potentially vulnerable fish include the sharks, which are slow growing, have a low reproduction rate, are highly migratory and school during the mating season. Threats are commercial and sports fishers. Also vulnerable are fish species with restricted distributions which may be threatened by loss of habitat.

Recent concern has focused on the status of the larger sharks, sawfish and the endemic handfish family in southern Tasmania.

Reptiles
Sea snakes

Australia has about 30 of the world's 50 species of sea snakes, around half of which are endemic. The family of aipysurids live in coral reef waters and the family of hydrophiids live in inter-reefal waters of Australia's tropics. Sea snakes bear live young, reach sexual maturity in around three years and live for about 10 years.

Turtles

Turtles are large and exceptionally long-lived reptiles. They are slow to reach maturity; for example, green turtles take about 35 years to mature. Turtles breed perhaps only five times in their lives, making them extremely vulnerable to over-exploitation. Six of the seven world's turtle species are found in Australian waters. One-the flatback turtle-is endemic. Breeding migrations may cover hundreds to thousands of kilometres and many turtles breeding in Australia may live around the islands of Papua New Guinea, the south-western Pacific Islands and Indonesia, making species management difficult.

The main effects humans have on turtles in Australian waters are: mortality of adults in prawn trawls, shark nets and gill nets; collisions with speedboats; subsistence hunting by indigenous communities; habitat degradation; and predation on eggs by feral animals.

Seabirds

About 110 species of seabirds belonging to 12 families are found in Australia and its external territories. Of these, 76 species breed and spend their entire lives in the region. The remaining 34 species are regular or occasional visitors.

Some 14 species or subspecies of Australia's seabirds (13% of the total) are considered to be threatened, largely because their colonies on oceanic islands are few in number and are vulnerable to harvesting and natural disasters. The wandering albatross on Macquarie Island, Abbot's booby on Christmas Island and the Australian subspecies of the little tern are classified as 'Endangered' under IUCN criteria. Lord Howe's Kermadec petrel and white-bellied storm-petrel and Christmas Island's Christmas frigatebird are considered 'Vulnerable'.

Problems include: illegal poaching of adults, chicks and eggs; mortality from bushfires and feral animals; incidental capture of albatrosses and other seabirds by longline fishing; clearing of habitats; and disturbances of nesting colonies by humans and low-flying aircraft. Possibly half of Australia's nesting islands are subject to one or more of these direct human threats.

Marine mammals

Sirenia - sea cows

The tropical dugong is the only fully herbivorous marine mammal and the only Sirenian (sea cow) to occur in Australia. It is extinct or near extinct in most of its former range which extended from East Africa to South East Asia and the Western Pacific. Northern Australia has the last significant populations (estimated to be over 80 000) in the world. Large, long-lived mammals, dugongs become sexually mature at around 10 years and calve every 3 to 5 years, making them vulnerable to over-hunting. Major concerns are possible over-hunting of Torres Strait populations, mortalities in fish gillnets and shark nets and loss of seagrass habitat. A major mortality occurred in Hervey Bay (Qld) in 1992 following a die-off of seagrasses there.

Pinnipeds - seals

Three species of eared seals breed in mainland Australian waters: the endemic Australian sea lion, Australian fur seal and New Zealand fur seal. The Australian sea lion has recently been listed as 'Rare' by the IUCN. Five species of true seals and two other species of fur seals breed in Australia's sub-Antarctic islands and the Antarctic Territories.

Australia's seals were seriously over-hunted last century. They are now fully protected and some populations are increasing. Major human threats include entanglement in fishing nets and ocean litter, oil pollution and disturbances by visitors. Fur seals are still occasionally killed illegally for lobster bait and around fish farms to prevent 'stealing' of fish. Entanglement in nets and plastic box straps remains a major problem. About 2% of seals at haul-out or resting sites in Tasmania are entangled in net fragments and other plastic litter net at any time. In 1990 an oil spill in Western Australia affected a number of New Zealand fur seal pups.

Cetaceans-whales and dolphins

Eight species of baleen whales and 35 species of toothed whales, porpoises and dolphins are found in Australian waters, although none is endemic. This is almost 60% of the world's total cetacean species.

Until recently, hunting was the major impact on whales and several species were driven close to extinction. Australian breeding populations of southern right whales were seriously depleted as early as 1845. Their population has slowly increased from small remnants totalling a hundred or so, to between 500 and 800. Australian breeding populations of humpback whales were depleted by 1963. Numbers are recovering and there are now thought to be up to 4 000 breeding in Australian waters. In the Antarctic, over-hunting has endangered the blue whale, perhaps the largest animal that has ever existed, and severely depleted other baleen species.

APPENDIX

A3 KEY PRESSURES ON AUSTRALIA'S MARINE BIOLOGICAL DIVERSITY

Here we summarise, with some relevant examples, the key threats that are affecting Australia's marine biological diversity.

Harvesting of living resources

Commercial fishing

Commercial fishing in Australia includes a huge array of fishing types, target species and industry arrangements, ranging from local family businesses to major national companies with fleets of vessels. In general terms, fishing is omnipresent in the ocean-there are few places where fishing of one type or another is not practised.

Commercial fishing has serious impacts on genetic diversity, on population structures, on seabed habitats and on growth rates of the target stocks. Past fishing management practices in Australia have not always maintained the target stocks. As a result, some of Australia's fisheries are over-exploited, although most are considered to be fully exploited. As the principles of ESD and precautionary fishing begin to be more widely implemented into fisheries management plans, the adverse impacts of fishing on target species will be reduced.

Fishing often removes large quantities of top predators or other dominant species such as tunas, sharks and groupers. In most fisheries the ecological effects of this have never been documented and the impacts on inter-dependent species are unknown and difficult to predict with any certainty.

Commercial fishing also has a set of potentially serious impacts on species that are not the target of their fishing activities. There are no records of non-target animals becoming extinct as a result of fishing, but there is increasing global concern about population declines in a number of sea birds, small marine mammals and some turtles, some of which may be related to the by-catch of fisheries. There is also increasing global concern about the habitat modification caused by the by-catch of fisheries. There is also increasing global concern about the habitat modification caused by bottom trawling and the impact this may have on both biodiversity and productivity. The serious depletion of populations of several species of albatross has been attributed to fishing activities.

Recreational fishing

Recreational fishing is one of Australia's most popular pastimes. Where comparisons have been possible, recreational fishing has been found to be responsible for at least the same amount of catch as that of commercial fishing, and sometimes much more. Recreational fishers tend to target reef ecosystems and remove larger species that are high predators. The effects of selective removal of such fish, like those in commercial fisheries, are largely unknown, but probably have a major impact on the local trophic structure.

Recreational fishing is also a popular activity with shore-based tourists. Near intensively visited areas they can have a serious impact on shore populations of invertebrates that are collected for bait or trampled.

Indigenous fishing/harvesting

Local communities and indigenous people often supplement their diet, or occasionally rely totally on, products from the sea. Such traditional small-scale activities have generally been considered to be sustainable, in a regional context. However, harvesting has, in places, become very intensive, especially around cities or other population areas, and this can have very dramatic effects on shore populations of invertebrates, on shallow-water species and, in the case of some indigenous communities, on large, highly prized species such as turtle or dugong. For example, the domestic indigenous fisheries of northern Australia are estimated to harvest about 5 000 turtles per year.

Aquaculture

Australia's aquaculture industry is experiencing a period of rapid growth. The demand for clean water means that facilities are often sited in remote areas. Most aquaculture operations require exclusive use of an area of water and/or land. The use of supplemental foods to feed the stock brings attendant risks of introducing pathogens to the local waterways and the need to dispose effectively of wastes that, typically, are highly nutrient-enriched. In poorly planned or managed facilities, this results in local pollution of the water and sediments, and the potential to support algal blooms. However, apart from the direct effects of local pollution and alienation of habitats,

aquaculture also has indirect effects on biodiversity. The demand for cheap and nutritious food means that some fish stocks are targeted for use as aquaculture feeds, which can damage fisheries where management plans are ineffective or absent.

Aquaculture also frequently involves use of species introduced from beyond their normal range and genetically modified species, which could escape culture and invade natural ecosystems.

Urban sprawl, coastal tourism and recreation infrastructure

Habitat loss and fragmentation caused by the use of coastal habitats for such purposes as grazing, harbours, housing estates and landfills for airports is the most serious threat to the world's marine biodiversity. In Australia, the continuing urbanisation and industrial development of our coastal strip continues to take its toll on the natural habitats of the wetlands and adjacent shallow estuaries and coasts. The cumulative impacts of such incremental creep on the coastal biodiversity are poorly documented, but are undoubtedly of major concern. The problem is well recognised in Australia, but coastal development continues in many places without strategic assessment of its impacts on biodiversity.

Pollution

About 80 per cent of contaminants in marine and estuarine environments are thought to enter the sea from the land, both from direct point sources such as pipes and drains and from diffuse sources such as river and urban catchments, and from the atmosphere. Some of these contaminants persist in the environment and can become concentrated in fish and other organisms. Pollutants do most damage in coastal and inshore waters close to the sources. However, the more persistent contaminants may also affect offshore waters, although no data are available to confirm this.

One of the most serious large-scale threats to Australia's near-shore marine environment is the input of excessive nutrients. Tropical coral systems and temperate seagrass beds are highly sensitive to nutrient impacts. Estuaries and coastal lagoons, whose upper river catchments have been cleared for intensive agriculture and animal husbandry, may produce wastes equal to that generated from urban sewage. Algal blooms caused by excessive nutrient inputs can degrade ecosystems, decrease the recreational value of waterways, affect human health and destroy aquaculture production. Two of the worst examples of damage to biodiversity from eutrophication are the Peel Harvey estuary in Western Australia and Tuggerah Lakes in New South Wales. In both there are episodes of severe deterioration of water quality and repeated massive blooms of algae and associated benthic plants that choke the estuary system.

Other land-based problems for marine biodiversity include the clearing of forests, overgrazing and agriculture. These increase soil erosion and, consequently, the amount of sediments and suspended solids entering the sea. As well as contributing nutrients, suspended solids smother sedentary plants and animals, clog gills, reduce the light available to aquatic plants, reduce water depth and affect sediment characteristics. The rivers of Queensland's east coast catchments are estimated to deliver about 14 million tonnes of sediment annually to estuaries and coastal marine watersthree to five times more than before European settlement.

Pests

More than 100 introduced marine species are now recognised as having become established in Australian waters. Some of these directly affect aquaculture, causing fish kills, and others have very undesirable consequences for estuaries, lagoons and bays. Blooms of introduced toxic marine algae are a serious marine environmental and fisheries problem in Tasmania and Victoria and may threaten the waters of other States. However, many pests also affect local native communities of organisms. In the upper Spencer Gulf, South Australia, an exotic crustacean (probably imported in ships' ballast water) is the dominant animal inhabiting the sediments. In Tasmania, large areas of reef have been covered by a foreign species of alga. In Port Phillip Bay, Victoria, vast areas of the seabed have been carpeted by an imported fan worm, excluding most of the native species. Because few studies have ever been undertaken, the national extent of such impacts is unclear. However, in the long term, these invaders are undoubtedly a major threat to our native biodiversity.

Changes in the world's climate will cause increasing pressure on coastal biodiversity. Although the ecosystems are dynamic, their capacity to resist rapid changes is limited. This is especially true if

many species and habitats are predominantly restricted to fixed locations or reserves and cannot move as the environment changes in the climate, including increasing frequency and severity of extreme events like storms and cyclones, will have large and detrimental effects on marine biodiversity. Planning to cope with such events is crucial if losses of coastal biodiversity and associated resource sectors are to be effectively ameliorated.

APPENDIX

A4 PRINCIPLES OF MULTIPLE USE MANAGEMENT

The four fundamental principles of Multiple Use Management (from Sainsbury et al., 1997) are:

1. **Maintenance of ecosystem integrity.** This specifically includes:
    i. maintenance of biodiversity at biological community, habitat, species and genetic levels;
    ii. maintenance of the ecological processes that support both biodiversity and resource productivity;
    iii. maintenance of not only the existence of ecosystems and biodiversity but also their effective functional role in biological systems; and
    iv. application of precautionary and anticipatory decision making.
2. **Wealth generation and resource use.** The management and use of the marine environment for the sustainable, efficient and effective delivery of food, economic wealth, human enjoyment and human well-being.
3. **Equity.** The management of the marine environment to deliver and preserve inter-generational, intra-generational, cross-sectoral, cross-boundary and cross-cultural equity and options, including through ensuring national security. Equity implies a principle of stewardship by Governments and the community. Intergenerational equity is sought through avoidance of actions that are not potentially reversible on a time scale of a human generation, consideration of long term consequences in decision making and restitution of degraded aspects of the physical and biological environment.
4. **Participatory framework for decision making.** Multiple Use Management uses a decision making framework that includes and considers all sectoral and community interests, ensures its management objectives and decision making processes are not dominated or determined by particular sectors or interest groups and integrates sector specific management processes to ensure the four Multiple Use Management principles are addressed and achieved. The framework includes mechanisms to ensure participants have similar access to both information and investigative capacity, so that they can participate meaningfully in decision making. Participants recognise and accept that the decisions made may not be optimal for all individual interests and the framework provides dispute resolution mechanisms. Within the framework there is a capacity to monitor achievement with respect to the four principles of Multiple Use Management and to take corrective action as necessary.

In any application some of these principles may be given more weight than others, depending on sectoral and regional priorities, but all are necessary and fundamental for successful Multiple Use Management. Within a Multiple Use Management framework (i) management of specific industry sectors would meet objectives and performance measures based explicitly on the above principles and (ii) the combination of all uses and sector-specific management would meet regional and national objectives and performance measures based on these principles.