

Coasts and Oceans



Prepared by:

Australian State of the Environment Committee

Theme Coordinators:

Dr Gina Newton, (until November 2000)

Jenny Boshier (from November 2000)

State of the Environment Reporting Section, Department of the Environment and Heritage

National Library Cataloguing-in-Publication Data

Coasts and oceans.

Bibliography.

Includes index.

ISBN 0 643 06751 5.

ISBN 0 643 06754 X (8 v.).

ISBN 0 643 06755 8 (7 v.).

1. Coasts – Australia. 2. Oceanography – Australia. 3. Coastal ecology – Australia. 4. Marine ecology – Australia. 5. Coastal zone management – Australia. 6. Marine organisms – Australia. 7. Environmental monitoring – Australia. I. Newton, Gina. II. Boshier, Jennifer A. III. Australia. Environment Australia. (Series : Australia state of the environment 2001).

333.9100994

© Commonwealth of Australia 2001

This work is copyright. It may be reproduced for study, research or training purposes subject to the inclusion of an acknowledgment of the source and no commercial usage or sale. Reproduction for purposes other than those above requires the written permission from the Commonwealth, available from Environment Australia. Requests and inquiries concerning reproduction and rights should be addressed to the:

Assistant Secretary
Corporate Relations and Education Branch
Environment Australia
GPO Box 787
Canberra ACT 2601
Australia

Disclaimer

The views contained in this report are not necessarily those of the Commonwealth, State or Territory Governments. The Commonwealth, which includes the Australian State of the Environment Committee, does not accept responsibility in respect of any information or advice given in relation to or as a consequence of anything contained herein.

The book is printed on Regent Recycled paper made in Australia.

Published by **CSIRO PUBLISHING** on behalf of the Department of the Environment and Heritage.
150 Oxford Street (PO Box 1139)
Collingwood VIC 3066
Australia

Telephone: +61 3 9662 7666
Freecall: 1800 645 051 (Australia only)
Fax: +61 3 9662 7555
Email: publishing.sales@csiro.au
Web site: www.publish.csiro.au

Front cover: Pink Lake near Meningie, South Australia © John P Baker

Australian State of the Environment Committee, 2001. *Coasts and Oceans*. Australia State of the Environment Report 2001 (Theme Report), CSIRO Publishing on behalf of the Department of the Environment and Heritage, Canberra.

The 2001 *Coasts and Oceans* Theme Report is one of seven produced for the Australian State of the Environment Committee which form the basis of the report *Australia State of the Environment 2001*. Theme reports for the remaining themes: Biodiversity, Atmosphere, Inland Waters, Land, Natural and Cultural Heritage and Humans Settlements are available in print from **CSIRO PUBLISHING** and on the Internet at: <http://www.ea.gov.au/soe/>

Note: Some of the images included in this report may be more easily read in colour. In those cases, readers are referred to the full-colour PDF or web versions which are available online at: <http://www.ea.gov.au/soe/>

Cover and text design by James Kelly.

Typeset by Desktop Concepts P/L, Melbourne.

Printed in Australia by Brown Prior Anderson.

Contents

ABBREVIATIONS	v
ACKNOWLEDGMENTS	vi
EXECUTIVE SUMMARY	1
Understanding the value of our coasts and oceans	1
Major issues	1
Summary	7
Implications and looking forward	7
INTRODUCTION	9
Our diverse environment	9
The coastline and beyond	10
Ocean currents around Australia	10
Australia's marine responsibilities	11
Climate variability and change—the global context	12
People cause environmental change	13
Risks to the marine environment	14
Integrated management	14
State of the Environment reporting	15
Key findings of the 1996 report	15
HABITATS AND SPECIES	16
Mangroves	16
Saltmarshes	17
Saltflats	18
Seagrasses	18
Beaches and dunes	20
Estuaries	21
Intertidal mudflats	23
Gulfs and bays	23
Coral reefs	24
Rocky reefs	25
Continental shelf and slope	27
Seamounts	27
Habitats of Australia's external territories	28
Invertebrates	29
Fish	30
Reptiles	33
Birds	35
Mammals	38
COASTAL SETTLEMENT AND DEVELOPMENT	44
Coastal settlement	44
Tourism	44
Erosion of beaches and dunes	47
Beach and ocean litter	47
Coastal weeds	48
Disturbance of coastal acid sulfate soils	49
WATER QUALITY	51
Key pollutants of marine and estuarine waters	51
Impacts on marine and estuarine water quality	55
Responses to marine and estuarine water pollution	57
Conclusions and implications	58
INTRODUCED MARINE SPECIES AND MARINE PESTS	60
Examples of pest species	61
Minimising the risk of introducing pest species	63
Summary	65

FISHERIES	66
Status of commercial wild capture stocks	67
Status of recreational fishing	70
Status of Indigenous fishing	72
Status of illegal, unregulated and unreported fishing	72
Seafood quality	72
Impacts of wild fish harvesting activity	73
Responses to fisheries issues	74
Aquaculture	77
ACTIVITIES AND USES OF THE MARINE ENVIRONMENT	80
Shipping and impacts	80
Offshore petroleum production	82
Sandmining	83
Biodiscovery	84
MARINE AND COASTAL MANAGEMENT	85
International agreements	85
Legislation and policies	86
Indigenous involvement in marine management	87
Community involvement	88
Integrated coastal zone management	89
The Australian coastal atlas	90
Marine protected areas	90
CONCLUSIONS	94
Key findings	94
Emerging issues	95
Key implications	95
GLOSSARY	97
REFERENCES	99
INDEX	105

Abbreviations

AAT	Australian Antarctic Territory.
AEZ	Australian Exclusive Economic Zone.
AFMA	Australian Fisheries Management Authority.
AIMS	Australian Institute of Marine Science.
ANZECC	Australian and New Zealand Environment and Conservation Council.
AOP	Australia's Oceans Policy.
CASS	Coastal acid sulfate soils.
CCAMLR	The Convention on the Conservation of Antarctic Marine Living Resources.
CITES	Convention on International Trade in Endangered Species of Wildlife Flora and Fauna.
COTS	Crown of Thorns Starfish.
CPUE	Catch per unit effort. The quantity of fish caught with one standard unit of fishing effort, e.g. the number of fish taken per 1000 hooks per day or the weight of fish in tonnes taken per hour of trawling.
CRC	Cooperative Research Centre.
CSIRO	Commonwealth Scientific and Industrial Research Organisation.
EEZ	Exclusive Economic Zone.
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999.
ESP Act	<i>Endangered Species Protection Act 1992</i> (Commonwealth).
FRDC	Fisheries Research and Development Corporation.
GBRMPA	Great Barrier Reef Marine Park Authority.
IUCN	World Conservation Union (formerly the International Union for the Conservation of Nature and Natural Resources).
IMCRA	Interim Marine and Coastal Regionalisation for Australia. A system of regions around the Australian coast based on biology and physical environment.
IWC	International Whaling Commission.
MPA	Marine Protected Area.
MPC	Maximum permitted concentrations, e.g. for metals in food.
MRL	Maximum residue limits, e.g. for organic compounds in food.
NLWRA	National Land and Water Resources Audit.
NPI	National Pollutant Inventory.
NRS	National Residue Survey, a national scheme of measuring residues of contaminants in food.
OCS	Offshore Constitutional Settlement.
PCBs	Polychlorinated biphenyls, a group chlorinated organic compounds that are long lived in the environment because they are resistant to biological degradation.
SOMER	State of the Marine Environment Report.
TAC	Total allowable catch; the total catch allowed to be taken from a resource in a specified period (usually a year), as defined in the management plan. The TAC may be allocated to the stakeholders in the form of quotas as specific quantities or proportions.
TBT	Tributyl tin (see glossary: <i>organotin</i>).
TED	Turtle exclusion device.
UNCLOS	United Nations Convention on the Law of the Sea.

Acknowledgments

Research and preliminary drafting

Dr Colin Gibbs, Colin Gibbs and Associates (lead researcher)
Gus Fabris, Marine and Freshwater Resources Institute
Anne Gason, Marine and Freshwater Resources Institute
Heather Gibbs, Colin Gibbs and Associates
Leanne Gunthorpe, Marine and Freshwater Resources Institute
Andy Longmore, Marine and Freshwater Resources Institute
Greg Parry, Marine and Freshwater Resources Institute
Christine Porter, Colin Gibbs and Associates

Compiling the final text

Jenny Boshier, Environment Australia
Gary Whatman, Environment Australia

Expert review panel

Dr Alan Butler, CSIRO Marine Research
Dr Michael Cappo, Australian Institute of Marine Sciences
Dr Zena Dinesen, James Cook University of North Queensland
Dr David Kay, Environment Australia
Mr Chris Roberts, Cape York Development Corporation
Dr Phil Symonds, Australian Geological Survey Organisation

Peer reviewers

Dr Rob Coles, Northern Fisheries Centre, Queensland Department of Primary Industries
Ms Diane Tarte, Marine Ecosystem Policy Advisors Pty Ltd
Dr Geoff Wescott, Deakin University
Dr Trevor Ward, University of Western Australia

Technical advisers

Australian Antarctic Division, Environment Australia
Marine and Water Division, Environment Australia
Department of Primary Industries, Northern Territory
Department of Primary Industry, Water and Environment, Tasmania

In addition, a large number of other people provided information, usually at very short notice. These include individuals in State and Territory government departments, private industry and voluntary organisations. Commonwealth government departments and members of the ANZECC State of the Environment Reporting Task Force also helped identify errors of fact or omission. Their assistance is also gratefully acknowledged. The efforts of the data coordinators in State and Territory agencies are also appreciated.

Executive summary

Understanding the value of our coasts and oceans

Australia's marine area extends over about 16 million square kilometres, from Antarctica to near-equatorial latitudes. It includes one of the largest Exclusive Economic Zones in the world, and the high degree of endemism (numbers of species found only in a particular region) in the south and the rich tropical diversity of the north create unique opportunities and challenges for Australia.

Australia is highly dependent on its marine resources in a range of ways:

- recreational use of beaches and near shore area,
- preferred living and development in the coastal margins,
- the economic benefits of marine industries, including shipping, tourism, fisheries and offshore oil and gas.

The value of our marine resources has been appreciated by Indigenous cultures for thousands of years and their cultural associations remain strong.

Australians today appreciate the value of these resources in some ways, but not in others. For example, many Australians value the clean, beautiful beaches, the clean ocean waters and the beauty of tourist destinations such as the Great Barrier Reef and the picturesque southern coastlines. Many Australians appreciate the pleasures of recreational fishing.

Some appreciate where it is fragile and where it is resistant to human influence, but relatively few Australians know of the importance to our economy of the shipping and port industries, and of the economic value added to Australia by marine tourism and the seafood industry.

Major issues

Habitats of our coasts and oceans

Mangroves are our marine forests. Australia has 43 species, representing 58% of the global diversity of these species. No mangrove species is considered threatened, and indeed, mangrove area may be increasing. However the reason for the increases in mangrove area include sea level rise, growth in areas of accreting mud banks, and incursion into saltmarsh systems. While some of these may be occurring without human influence, they are all a cause for closer scrutiny of the phenomenon.

Seagrasses are not robust ocean 'weeds': they are flowering plants and represent our productive, shallow marine pastures. They support nursery areas for fish and prawns and other species. They provide food for Dugongs. They are vulnerable to pollution from chemicals and excess sediment runoff—that is, smothering by mud.

The problem with seagrass loss is that their recovery is not assured. In the tropics many species are seasonal and regrow quickly. However in colder temperate waters the dominant *Posidonia* species takes many decades to regrow so their recovery is not practically achievable. Any loss of temperate seagrasses through local pollution pressures, such as the declines in Cockburn Sound in Western Australia, warrant attention. The recent discovery of deepwater beds in the Great Barrier Reef World Heritage Area indicates that our knowledge of seagrass is still expanding.

Dunes and beach habitat occur along 50% of the Australian coastline, yet they are among the most poorly studied coastal habitats. They are under localised pressures from development in the intense urban spread around population centres, but are generally poorly described and monitored. The deliberately introduced Bitou Bush has become a pest on the New South Wales coastal dune systems.

Intertidal mudflats are species-rich, and important in the routes of migratory bird species, but as with dunes and beaches they are not particularly well studied.

Rocky reefs are found in intertidal and subtidal areas. Their high diversity and visibility has attracted more research, which confirms their importance as a base for productive macroalgae, sponges and fish populations. About 50% of Australia's fisheries are supported by rocky reef habitats. The principal human pressures on rocky reefs come from land-based pollution and from fishing pressure.

Estuaries are the waterways where rivers reach the sea. They have been the preferred site for European settlement owing to the transport link they provided to inland waterways before roads and railways, and to the shipping link they provide as ports for ocean-going vessels. In an assessment of 970 estuaries, the National Land and Water Resources Audit has found that about half are degraded in some way, usually owing to human settlement pressure. One of the greatest pressures on estuaries is the decline in water quality caused by agricultural development and changes in water flow regimes.

Gulfs and bays are robust in being more exposed to marine influences than narrow estuaries, but exposed in that they are often a sink for sediment deposition, which is an attractant for adsorbed nutrients and pollutants. In the case of Hervey Bay there was a major loss of seagrass following a large flood event in 1992 carrying greater than normal amounts of eroded sediments into the Bay. In the case of bays near large cities, the concern is for the effects of enhanced nutrient and toxicant inputs, for increased sedimentation and turbidity, and for the input of pathogens to the water through sewage outfalls.

Coral reefs are exceptionally diverse marine systems that thrive in relatively low nutrient tropical waters. The Great Barrier Reef in north-east Australia is well known internationally, but is not our only coral reef. Ningaloo Reef in Western Australia is Australia's largest fringing reef, stretching for 230 km along a very lightly populated coastline.

A dramatic coral bleaching event in 1998 accounted for the damage of 16% of the world's reefs within one year. Australia was fortunate in that only 3% of reefs were destroyed by bleaching in the 1998 event.

Australian coral reefs have been destroyed by sediment and nutrient runoff at certain coastal locations, and brought under pressure from increasing recreational and commercial fishing at others. The Crown of Thorns Starfish (*Acanthaster planci*) is presently causing a major reduction of living coral over very large areas of the Great Barrier Reef, yet the precise triggers for the outbreaks of this boom-and-bust species remain uncertain, although freshwater runoff has been implicated.

Australia's continental shelf and slope cover a huge area, some 2.5 million square kilometres, yet it remains poorly known. It consists mainly of soft sediments, but includes diverse communities of fish and sponge gardens. Some of these may be very long-lived and slow to recover from disturbance. Our seamounts off southern Tasmania harbour similar ecosystems.

Species

The invertebrate species are the huge number of animals without backbones. In Australian waters this includes everything except the fishes, seabirds and mammals (whales, seals and the Dugong).

Expert opinion suggests that although 1000 species of echinoderms (seastars, sea urchins, sea cucumbers and brittle stars) have been described so far, as have 10 000 species of marine molluscs, these numbers represent less than half the total number of species likely to be found in Australian waters.

A variety of invertebrates are exploited by fisheries, and Australia's prawn, lobster and abalone fisheries represent very high value for relatively low volume of harvest. The human impacts on invertebrates come from coastal development and land-based pollution, and from some methods of fishing such as trawling and dredging.

In the past five years there has been an increasing adoption of Marine Protected Areas (MPAs) as a means of conserving marine invertebrates and protecting them from extractive industries. The MPA approach relies less on precise knowledge of species population status and depends more on maintenance of areas of habitat types.

The conservation status of fish species, as listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), shows one fish species is endangered (the Derwent River Spotted Handfish, *Brachionichthys hirsutus*); five species of shark are listed as vulnerable (including the Great White Shark, *Carcharodon carcharias*). Two species of freshwater fish that have a marine life stage (the Freshwater Sawfish and the Australian Grayling) are also listed as vulnerable.

The practice of setting nets for sharks near swimming beaches has affected shark populations, particularly the Grey Nurse Shark (*Carcharias taurus*), which has been reduced to about 1000 individuals. Shark mesh-netting has also killed large numbers of dolphins and Dugongs.

Six of the world's seven species of turtles breed in Australia. The eastern Australian stock of the Loggerhead Turtle breed almost exclusively in the southern Great Barrier Reef and is considered to be endangered, with a 70% to 90% decline in the nesting population in the last 30 years. Other species also show declines. The Hawksbill Turtle is recognised internationally as critically endangered, and relies heavily now on the breeding sites in the northern Great Barrier Reef. About 10 000 turtles are caught accidentally by trawl fishing each year in northern Australia, but an estimated 90% of these are released alive. Approximately 2000 to 4000 green turtles are caught by Indigenous people each year.

The vulnerability of turtles has led to a heightened international profile of the issues and national and State action plans to conserve turtle species. Fishing trawlers in most northern areas now use turtle exclusion devices that prevent turtles being caught in trawl nets. In some areas Indigenous councils have implemented management plans to control their take of Dugongs and turtles.

Disturbance to seabird populations and their habitat come from a wide variety of sources, including urban development, airports, mining and minerals exploration, off-road vehicles, tourism at nesting sites, longline fishing, discarded fishing gear, and introduced rats and feral cats on offshore islands.

There have been several new developments aimed at reducing pressures on seabird populations: for example, the Commonwealth's Threat Abatement Plan of 1998 is aimed at reducing impacts from longline fishing vessels. Nesting areas are being protected in the Great Barrier Reef region, and in southern Australia there are programs to reduce feral animal predator disturbance. Australia also has 32 coastal wetland areas declared as protected under the international Ramsar Convention, and 16 of these sites are significant points in the paths of migratory birds.

Cetaceans (whales and dolphins) are visible and valued by Australians as charismatic species deserving maximum protection. The public concern at the decline of the great whales during the past 100 years has led to international measures through the International Whaling Commission. There are still some countries that regard whales as harvestable species.

Whale-watching is rising in popularity and subject to State controls and a set of national guidelines from ANZECC. The aim is to allow people to view cetaceans and learn about them without interfering with their migration, feeding and breeding.

There are a number of species, such as the inshore dolphins, where so little is known of their population status that they cannot be categorised as vulnerable or not.

There are 10 species of seal occurring in Australian waters, all occurring in southern temperate Australia and sub-Antarctic regions, and their population dynamics are complex. Declines in Elephant Seals at Macquarie Island may be related to rises in Fur Seals and King Penguins (both of which are rapidly becoming more numerous). The cessation of harvesting and climatic changes, for example in the area of pack ice, in the Antarctic is likely to be implicated in these changes.

The Dugong (*Dugong dugon*) is Australia's only strictly marine herbivorous mammal. Dugongs are vulnerable to mesh nets in shallow coastal waters (e.g. those set for sharks and fish), and to loss of their seagrass feeding habitats. Commercial harvesting ceased many years ago, but they are legally hunted in northern Australia by Indigenous people. Dugong habitat is protected by legislation in Queensland.

Coastal settlement

The Australian coastline is lightly populated when measured against more highly populous countries, but about 75% of our population lives within a few kilometres of the coast. The trend to move to the coast is continuing, with all States showing higher population growth rates in the 3 km coastal zone than elsewhere.

Marine tourism is a significant part of Australia's economy. There is a tremendous range of activities including whale watching, visits to the Antarctic, bird watching, recreational scuba diving and snorkelling.

The developed area of Australia's coastal strip is still only a small percentage of our coastline, but its impact is one of the major strategic issues confronting the conservation and management of our coastal zone. Human activity can cause the loss or degradation of specific habitat types, alter tidal water flows in wetlands and streams, cause erosion of beaches and dunes, and degrade water quality through stormwater runoff, sewage and litter.

A New South Wales survey in 1996 found that 73% of beach litter was land-sourced plastics, 14% was other land-sourced materials and 13% was debris from fishing. Even in

remote areas, discarded plastic material can cause the entanglement and death of many species. The disposal of plastic waste at sea is prohibited under the MARPOL Convention (Annex V) and enforced in Australia through the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*. In addition there are national and fishery specific codes of conduct designed to minimise all discards and waste associated with fishing activities. Beach litter is common in Australia, but there are few surveys available to quantify the problem and no consistently collected data to allow assessment of trends.

A coastal species, the Bitou Bush, was deliberately introduced to protect dunes after sand mining, but it has now become a significant environmental weed. It is spreading quickly in New South Wales coastal regions through distribution of seeds by birds, and may affect landscapes further inland if not controlled.

The creation of acid runoff through disturbance of acid sulfate soils has already had a major impact, and there is potential for this damaging phenomenon to expand unless managed properly. These soils underlie large tracts of the populated coastal zone, where alteration to drainage and the excavation of the soil creates very acidic runoff that causes fish kills, corrosion of metal structures and mobilisation of heavy metals. Fortunately the phenomenon can be managed, and in some areas water quality is now improving. Recognition of the phenomenon by local, State and Commonwealth governments has been an essential step in this process.

Water quality

Maintenance or restoration of water quality, particularly in coastal margins of Australia's marine area, is arguably the most critical marine environmental issue confronting Australia in 2001.

Water quality is essential for ecosystem maintenance, for industries such as fishing and tourism, and for recreation and aesthetics. It is difficult to manage because the changes usually occur slowly, perhaps over generations. The incremental decline in quality makes it difficult for regulators to achieve the community support needed to reverse the negative impacts.

While many coastal areas presently have excellent water quality, there are also many that do not. The effects can be local, through land-based pollution, poor drainage and effluent management. The negative effects can also come from land-use practices many hundreds of kilometres away, in catchments far from the coast. For example, deforestation, agricultural chemical use, poor cropping or grazing practices can cause enhanced erosion and increased turbidity and nutrient supply to estuaries and coastal waters. This unwanted fertiliser and excessive sediment flow places stress on other parts of the ecosystem, such as the smothering effects on coastal seagrasses, and alters the habitat of other species—from inshore invertebrates, to fish of commercial and recreational value to the highly valued Dugong.

Individual jurisdictions are working on improving the situation. Point-source pollution is increasingly subject to regulation. For example, in the Great Barrier Reef region new regulations were established in 1999 to control the quality of aquaculture discharges.

There is no national overview of the extent and levels of toxicants found in coastal waters and sediments. Neither is there national scale information on the emission of toxicants from diffuse pollution sources. It is 'nobody's' yet 'everybody's' job to do this.

Precise statistics on the contribution of various human activities to the degradation of coastal water quality are scarce, and it is common for different sectors of our community to lay blame on other sectors. A comprehensive, nationally standardised way of reporting on water quality would build a shared understanding of the issue within the broader community. However, the problem is not owned or managed by any single jurisdiction and there is no standardised, systematic data collection scheme operating at a national level that will tell us how we are going in managing this problem.

In the meantime, the degradation caused by such diffuse or remote sources remain largely unchecked and even identifiable local degradation is often not well managed. The catchment-scale approach to understanding and managing the problem is the most logical approach and implementation should be encouraged wherever possible.

Fisheries and aquaculture

Many Australian fisheries are fully or overexploited. None is pushing species towards extinction, to the best of current knowledge, but clearly sustainable development demands much more than this benchmark. Many types of fishing gear have unwanted impacts on the environment, taking species that are not the target of fishing operations. The introduction of

turtle exclusion devices on trawl nets targeting prawns in the tropics has addressed one problem, but the effect of trawl nets on species such as sponges and other benthos remains a significant issue in some areas.

The longline fishing industry is addressing the problem of accidental capture of seabirds, although the problem is not yet under control.

Government regulators and the industry have recognized the need to accelerate implementing sustainability into all aspects of the seafood industry. Since the 1996 SoE report, a program has been underway with support of the Fisheries Research and Development Corporation, CSIRO, the Australian Fisheries Management Authority and State fisheries management organisations.

There has been progress in some areas such as the Great Barrier Reef Marine Park, where a plan is in place to reduce the amount of trawl effort in the region.

The level of uncertainty in scientific assessments of the status of fisheries remains relatively high, and a report by the Bureau of Resource Sciences on Commonwealth fisheries shows a trend to fewer fisheries classified as 'underfished' and slightly more as "uncertain". It is widely held that sustainable development of Australia's fishing industry will involve making greater returns for industry by increasing quality or value-adding to the wild-caught product, rather than by increasing the total tonnage of the catch.

About three-quarters of Australia's fisheries are under State jurisdiction. Western Australia, Queensland and New South Wales produce regular reports on the status of fish stocks, and all three of these States report that stocks are either at or near their sustainable limit.

There are very few examples for which fisheries management can claim clear success in achieving regulatory goals. A notable success story is the Western Australian Western Rock Lobster Fishery which recently became the first fishery to be accredited under the Marine Stewardship Council. In the early 1990s scientists identified that the parent stock was dwindling at a time when catches remained high. Management restrictions were introduced and parent stock subsequently increased.

It remains to be seen whether the Eastern Gemfish, found in deep water off southern New South Wales, will recover from its depleted state after overfishing in the 1970s and 1980s. Quota levels remain at zero, after stringent management controls since 1993. Orange Roughy, taken off Tasmania and the South Tasman Rise, is also under strong management controls to restrict the catch of this long-lived species.

Recreational fishing is a popular activity in Australia, with the best estimate indicating that a total of 30 000 tonnes of seafood per year is taken by about 5 million people. About 73% of recreational fishing activity is in saltwater. Since the 1996 SoE Report, several States have introduced angling licences to include marine recreational fishing, and a national survey was instigated in 2000 to gather information on the extent of recreational and Indigenous fishing.

The value of aquaculture production has been growing at 14% per year since 1989. Until the last decade, most commercial aquaculture was for oysters (edible oysters and pearl oysters), and a limited amount of fish and prawn culture. In recent years the cage culture of fish has grown rapidly. Atlantic Salmon in Tasmania and the fattening of caged Southern Bluefin Tuna in South Australia account for about one-third of Australia's \$600 million production. Aquaculture prawn production is also growing.

The growth of the aquaculture industry has brought new environmental management issues under scrutiny.

Introduced marine pests

Australia is highly dependent economically on the export of bulk commodities such as minerals, agricultural products and oil and gas. The vessels that carry these products usually arrive on our shores empty, except for massive volumes of ballast water, which is needed to maintain the stability and safety of the vessel. The ballast water taken on board in foreign ports and dumped in Australian waters can carry unwelcome hitchhikers.

There have been some 200 species introduced to our waters from foreign regions, most unintentionally in ballast water or by other means. In addition, species are imported in the biological communities growing on the outside of hulls, termed hull fouling.

Many of these species slip quietly and unnoticed into our marine systems, forming small populations that do not interfere with the ecosystem. However some of these species cause

dramatic changes and threaten entire habitat types, and some cause toxic algal blooms that threaten oyster and mussel fisheries and the health of those who eat affected shellfish.

The Northern Pacific Seastar and the Giant Fan Worm are having a major impact on waters on our southern coastline. The exotic Seastar eats oysters, mussels and other sedentary species. The Giant Fan Worm is a filter feeder, but covers existing habitat to the exclusion of other species living on the seafloor.

In 1999 specimens of the Black Striped Mussel were found in three marinas in Darwin Harbour during a resurvey. Having witnessed the ecological and financial disaster caused in the Great Lakes region of North America by its near-relative the Zebra Mussel, the Northern Territory and Commonwealth governments mounted a major effort to eradicate this pest. The effort involved 300 people and cost \$2.2 million, but was successful and is thought to be the first eradication of a marine pest species population. However, the eradication of pest species populations may not be as successful in the future.

A program of port survey is now underway through the Australian Association of Ports and Marine Authorities and the CSIRO Centre for Research on Introduced Marine Pests. However these surveys are not yet organised as a routine, repeated procedure across all ports.

The concerns about translocated organisms extend beyond ballast water transport. Exotic organisms may enter Australian waters on the outside of ships' hulls or through the trans-shipment of live or frozen seafood products. Quarantine restrictions apply to the normal importation of products, and some products are excluded on the basis of risk assessments, but there is currently no restriction on movement of the hundreds of species that are attached to ships' hulls.

Marine industry development

Australia is an island nation that depends heavily on shipping, and the infrastructure for this industry includes ports and navigation channels that require dredging. It is the disposal of the dredged material that can be of concern to environmental regulators. In 1998 ANZECC released its guidelines to assist applicants for dumping permits, and the Commonwealth government has updated its legislation to remain consistent with the London Convention. The effect of these controls is that regulators assess the impacts of dredge spoil dumping and draw distinctions between clean waste that has low environmental impact and contaminated waste that is potentially more harmful to the environment.

Antifouling paint is, by definition, toxic to animals and plants. The phasing out of tributyl tin (TBT), the most common antifoulant, is still some years away. Concern over its effects remains high.

The possibility of an oil spill is a constant concern; four incidents with environmental effects have been recorded in the past six years. The most serious occurred in 1999 in Sydney Harbour, where 250–300 tonnes of light crude oil were spilled during a cargo transfer, and harbour foreshores were affected by oiling. Offshore oil drilling effects have been restricted to the local effects of drill cuttings and drilling muds deposited adjacent to wells.

As knowledge of our marine biodiversity increases, the prospects for discovering biologically active compounds have also grown. Some useful substances have already been discovered. Corals contain chemicals that are natural sun-blockers. Sponges and other sedentary plants and animals have chemical defense mechanisms that may find application as human drugs and herbicides. In the past there have been concerns that discovery of a valuable compound may lead to overharvesting of the organism concerned, but current biodiscovery programs emphasise the need to protect natural biodiversity and synthesise, or grow by aquaculture, any valuable substances rather than harvest them from the wild.

Marine resource management

There are some 80 international agreements relating to the use of the oceans, and half of them relate to managing the marine environment, including fisheries. Some prominent ones include the UN Convention on the Law of the Sea 1980, the Convention on the Conservation of Antarctic Marine Living Resources 1980, the International Convention for the Prevention of Pollution from Ships (MARPOL), and the World Heritage Convention.

Indigenous rights to the use of marine resources have been acknowledged in a number of court decisions relating to harvesting of traditional food species, and in legislation in the case of Torres Strait Islanders' use of the marine environment.

Australia has continued to pursue the establishment of Marine Protected Areas. There are now more than 190 protected areas covering 60 million hectares. Australia's Oceans Policy

includes an undertaking to develop a national, representative system of Marine Protected Areas. Progress has been made in planning in most States, and declarations of new protected areas have been made in the Great Australian Bight, Macquarie Island, Solitary Islands, Jervis Bay, Lord Howe Island, Tasmanian seamounts, extensions to the Great Barrier Reef Marine Park, and Cartier Island. However, it is the implementation of management plans that will determine whether ecosystems and threatened species will benefit from the establishment of MPAs.

Australia's Oceans Policy was released by the Commonwealth Government in 1998, the International Year of the Ocean. This policy includes support for some innovative approaches to integrated oceans management, e.g. the concept of regional marine plans. The Oceans Policy acknowledges the need to take an ecosystem approach to natural resource management, striking a balance between environmental, economic and social objectives.

The Coastcare program has funded over 1700 projects involving restoration of habitats, development of local management plans, education and training. Between 1997 and 2000 the number of Coastcare groups rose from 700 to 2000.

As with the term ecologically sustainable development, ecosystem-based management is ill-defined at the operational level of management but nevertheless creates a framework for policy development and decision-making. Its key attribute is the recognition that the effects of any activity in a region should be assessed in light of the linkages and interdependencies within the whole ecosystem rather than focusing only on the local impacts. A good example of this is Integrated Coastal Zone Management, which aims to overcome the fragmentation of management arrangements and the "tyranny of small decisions" leading to incremental degradation through the negative effects of many small decisions that seem, on their own, inconsequential.

Summary

Water quality and loss of habitats have emerged as the major issues. There are many areas where both of these environmental values are in good condition and not of concern, however in some areas stronger action is needed to prevent decline in water quality. Overall the quality of estuarine and coastal waters has not improved, although there are some locations where signs are positive, for example around Sydney.

The effect of poor catchment management is to lower coastal biodiversity through pollution and sediment. People see the effect either directly, such as loss of fish habitat reducing recreational fishing opportunity, or indirectly, through reports of dropping numbers of species such as Dugongs.

Catchment management is a key response, and this has been recognised in most parts of Australia, and in all tiers of government. Implementation requires community involvement, cooperation of industries and governments, and alignment of regulatory regimes between local, State and Commonwealth governments. There is still no nationally applicable Coastal Zone Policy, and delivery of effective catchment management across all jurisdictions is still some way off.

Some conclusions are:

- where population density and land use is light, Australian coastal waters are in excellent condition. However in some areas there are threats to, and actual loss of, shallow marine and coastal habitats through poor catchment management and development, invasive species such as starfish and Giant Fan Worms in the south, and tropical pasture grasses in coastal lagoons in the north. Landowners are often unaware of the downstream consequences when land use is poor. The massively damaging effects of acid soil runoff in some estuaries is a good example of negative downstream consequences, and of how improving our land use practices can remedy the problems.
- mechanisms for resource allocation remain poorly developed in most areas, for example the allocation of fishing rights, among commercial, recreational and Indigenous users of fisheries resources. Our capacity to measure use of these resources is poor.

Implications and looking forward

Managing the activities of people in a way that conserves habitats while sustaining resources and industries is extraordinarily complex and difficult. When environmental, social or cultural

qualities are in decline, a key step in the remedy is for the public to be aware of the changes, and the causes of change.

In 2000 the issue of salinisation of large tracts of Australia's agricultural lands received major national publicity. The problem had been developing for decades, and local and regional governments had been working on it, yet the national will to remedy the problem has emerged only recently. It is public awareness that creates the will and motivation to effect changes in how we use the environment. Therefore publicly available information about the state of our environment is very important.

How much information is readily available to the public and to decision makers on the general state of the coasts and oceans environment? Unfortunately there is not a great deal, and it is 'nobody's job' to coordinate and deliver such information.

A major positive effect of the 1996 State of the Environment Report has been to promote the development of indicators. Things that can be measured, and when the information is published, provide an indicator of the state of our environment.

The 2001 report has shown that developing indicators is necessary but not sufficient. Many of the important indicators require a national approach to the development of data collection and reporting systems, which is yet to occur.