

Filtering the words on the rising tide of the marine conservation debate

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ABSTRACT

This chapter presents an overview of *Conserving Marine Environments Out of sight, out of mind*, and it provides a context for conserving Australia's marine environment by commenting on the *Coasts and Oceans, Australia State of the Environment 2001 (Theme Report)* then looks at the marine environment through the eyes of the media and conservation non-government organisations. The ASEC, 2001 concluded that water quality and loss of habitats are the major issues facing Australia and that the quality of estuarine and coastal waters has not improved. Commonwealth legislation is consistent around Australia, but this is not the case for the states. There is little protection in international waters, where threatened seabirds spend part of their life. Salinity has gradually intruded upstream, but proposals to increase environmental flows of freshwater to restore wetlands have not been acted on. Initially, small isolated aquatic reserves were established, but recently larger areas have been declared as multi-use parks with zones. Off-park conservation is also critical for long-term survival, given such findings that there is no area of Australia's continental shelf that has not been trawled and a large amount of the surface epifauna removed. It is essential to link excellent science and policy with immense public support, and this endeavour is being supported by some high quality journalism. The papers published here reinforce the need for active marine conservation, both of coastal and offshore habitats, and the need for sustainable management of our marine resources. The challenge is also to acknowledge the great time scale on which the marine environment functions and its immense geographical scale, not to mention the long-term contribution of the scientific imagination in everything from experimental design to the naming of a mollusc on a seamount.

Key words: marine protected areas; overfishing; marine pollution; Great Barrier Reef; dugong; seamounts; whale watching.

The rationale for the forum on conserving marine environments

The rationale for the one-day forum on conserving marine environments on 26 October 2002 – and its publication in this book – was to explore the similarities and differences between marine and terrestrial systems and how these affect the implementation of marine conservation initiatives. The subtitle of the forum, “out of sight, out of mind” was, we thought, a valid one, because so little of the marine environment is easily accessible or even visible. Even with the increasing use of SCUBA, depths below 30 m are “no go”. Yet the majority of the marine environment is greater than 30 m in depth.

In addition to presenting an overview of the forum, our aim in this chapter is to provide a broader context for conserving Australia's marine environment. The first part presents an overview of the book; the second critically comments on the *Coasts and Oceans, Australia State of the Environment 2001 (Theme Report)* ASEC 2001; and the third looks at the marine environment through the eyes of the media and conservation non-government organisations (NGOs). This book is science-based; the ASEC 2001 report has its main focus on policy, and the media and conservation NGOs see the matter through the eyes of community interests. The media and NGOs have the freedom to promote marine conservation causes through intelligent criticism and analysis. If you were comforted by the words promoted by the 1998 Australia's Oceans Policy in the ASEC report 2001, you will be jolted by the 2003 *Oceans Eleven* policy by the Australian Conservation Foundation.

For those of us who work on marine environment conservation as scientists, writers or managers, it is enriching to see that others can extend the boundaries of the marine environment well beyond our daily vision. “Art's ability to cross boundaries”, says Kent (2003), “and to draw upon other disciplines, is one of its most exciting possibilities”. The focus of the 2003 *Liquid Sea* exhibition at the Museum of Contemporary Art, in the Rocks, Sydney, was on the scientific and environmental aspects of the sea, and exhibition curator Rachel Kent's (2003) text displays how the science/art boundary can be crossed: “Through the surreal marine documentaries and micro-photographs of Jean Painlevé, and the exquisite glass marine specimens of Leopold and Rudolph Blaschka, we see a fascinating window onto life beneath the waves that resists simple classification, sitting somewhere in between science and museology, fine art and design”.

The stunning visual and tactile sensations of the marine world are familiar to marine biologists. These were, and are, the original and sustaining attractions for both the young and the crusty. However, to conceptualise the marine environment in new ways, such as surreal documentaries or glass specimens, can produce new visions and new paths for action. The creative act is not limited to the world of the artist, it is also a vital element in the work of the researcher, lawyer and editor. It is, in our view, refreshing to step outside one's speciality and to see the world as others see it. It brings new energy and an invigorated vision, and thus offers a greater chance of

conserving Australia's marine environment. What was out of sight and out of mind we have endeavoured to bring to the surface and make marine environment watching as exciting as whale watching. We now exhibit our vision of approaches to conserving the marine environment. It was formed from the words and phrases that we have filtered from the rising tide of interest in the crucial debates on conserving our marine environment.

Legal matters

Jurisdiction over Australia's marine environment is complicated, but not more so than the complex web of life for which the legal documents endeavour to provide good governance. Both the states and the Commonwealth are involved, and beyond these boundaries, international jurisdiction comes into play, with many matters still to be resolved. While Commonwealth legislation is consistent around Australia, this is not the case for the states. State waters extend out to 3 nautical miles, when it then becomes the Commonwealth's responsibility to the edge of the continental shelf and beyond. Tsamenyi *et al.* (2003) have summarised the various international treaties and how they impact on the management of the marine environment. They also cover the complex issues of the state-federal system for dealing with these marine matters. If only the fauna was aware of these boundaries! Instead, many organisms, at any one of their life stages, move in and out of these jurisdictions and some, such as the threatened seabirds studied by Priddel (2003), also spend part of their life in international waters, which poses further management problems and concerns. As Hutchings (2003) noted, while Queensland manages and regulates the coastal and island nesting sites of various species of marine turtles, it has no control over the fate of the same animals in international waters where they are adversely impacted by various fishing practices. Commercially important species, such as tuna, migrate between different national jurisdictions and each country assumes the right to harvest them, yet it is the same population which is being harvested. This has led to problems of setting and enforcing quotas. The battle at the International Whaling Commission (IWC) over killing whales is the most high profile of these deep differences of opinions and values.

The three-dimensional nature of the marine environment

One of the major features distinguishing the marine from the terrestrial environment is the three-dimensional nature of the marine environment, with the water column available for the transport of larvae, as well as for ensuring that no rapid changes in salinity or temperature occur (Kenchington 2003). This has advantages as well as disadvantages. It facilitates dispersal of larvae or propagules over considerable distances and encourages gene flow but, depending on the prevailing coastal currents, it also disperses sediment and associated pollutants from land-based sources to far offshore as well as along the coast. Seagrass fragments have been found 100 km offshore incorporated into the sediment by the subduction and bioturbation activities of the infaunal communities at these

sites (Levin *et al.* 1997). Evidence of terrestrially-derived sediments and fertilisers has been found in the lagoon of the Great Barrier Reef that smother and kill corals and change benthic communities (Fabricius and De'ath 2001). Elevated levels of nutrients can be found in reef sediments after heavy rains (Baker 2003). These characteristics must be taken into consideration when managing the marine environment. One cannot put up boundaries to protect an area from what is happening upstream. Building a dam across a river holds back fresh water, which can lead to the loss of freshwater communities as salt water, and with it marine communities, extend upstream. The mangroves, which are progressively extending up the Hawkesbury River, provide evidence that salinity has gradually intruded upstream (Recher *et al.* 1993). Similar effects have occurred in the Hunter River (Fairfull and Williams 2003) but proposals to increase environmental flows of freshwater to restore wetlands have so far not been acted on. An example of an unsuccessful barrier is the construction of groynes or seawalls along coastal beaches to restrict sand movement and, as a result, the beaches downstream suffer from erosion. Studies by Short (1993, in press) demonstrated the dynamic movement of sand up and down the coast, the presence of offshore sinks and the cyclical nature of these movements. Similarly, if dredge spoil is dumped offshore it may not remain in one spot for very long, depending on water movement patterns in the area. The water column is not static. It is continuously being moved by tidal action in coastal areas, by wind-generated waves, by ocean currents and, in deeper waters offshore, by internal waves. It is not just the water, which is being moved, but also everything suspended within it.

Conservation of habitats through Marine Protected Areas

Conservation of habitats has had a long history. The world's second national park, Royal National Park on the southern boundary of Sydney, was declared in 1879. The first marine park, also declared in 1879, covered the intertidal areas associated with Royal National Park (Brown 2002). Several more were proclaimed early in the 20th century and 430 MPAs (Marine Protected Areas) had been created by 1985 (Silva *et al.* 1986), but most were small coastal areas. By 1995 worldwide there were 1,306 subtidal MPAs with a median size of 1,584 hectares. Almost every coastal county has implemented some form of MPA (Kelleher *et al.* 1995). The largest MPA in the world is the Great Barrier Reef Marine Park (345,000 square kilometres). For more details of MPAs see Kenchington (2003). However, long before MPAs were thought about, reefs around some islands in the Pacific have been regarded as belonging to a particular village, and access to them and the right to fish was the traditional sole right of those villagers (Johannes 1981). Similarly, in Australia, coastal Aboriginal people claim sea rights adjacent to their land and the right to traditionally hunt species, which are now threatened, such as turtles and dugong *Dugong dugon*. Traditional hunting has been incorporated into management plans of the Great Barrier Reef Marine Park Authority (GBRMPA). Aboriginal communities must be consulted when activities requiring permits are requested for collecting in their traditional areas.

Although a system of terrestrial parks and reserves is being developed throughout Australia, it is increasingly recognised that offsite conservation is critical for the long-term survival of many species. As the number of vertebrates and vascular plants listed as endangered or vulnerable escalates, it is clear that we are in danger of losing our vertebrate fauna and a large proportion of our flora. Isolated reserves surrounded by urban areas are difficult to maintain. They become infested by weeds and severely affected by bush fires, and corridors connecting them to nearby reserves may have limited use in maintaining populations of vertebrates. Our knowledge of the invertebrate fauna is limited in such reserves, as is our knowledge of the ability of such faunas to recover from frequent fires. This concept of the usefulness of parks has been transferred to the marine environment (Avery 2003; Babcock 2003; Creese and Breen 2003) where our knowledge of most of the fauna (i.e. the invertebrates) is much less than our knowledge of terrestrial systems (Ponder *et al.* 2002). Initially, small isolated aquatic reserves were established in NSW (e.g. Ship Rock, Cabbage Tree Bay and Long Reef – all near Sydney) but recently, larger areas have been declared as multi-use parks with zones (Avery 2003; Creese and Breen 2003; Kenchington 2003). These parks protect only some components of the biota. The Tasmanian Seamounts Marine Reserve off southern Tasmania extends only to 500 m below the surface. This depth limit implies that removal of biota from this upper section of the water column will not adversely affect the biota on the seamounts below (Hutchings 2003).

Most attention to the issue of conflict resolution has been given by government to coastal and estuarine areas to resolve clashes in the coastal zone. This is not surprising because it is this zone, as Adam (2003) identified in the opening sentence of his chapter, that arouses great passions, as is evident in Recher's (2003) foreword. Far less attention has been given to offshore areas where the problems are just as severe but, it appears, far more difficult to promote. Ponder *et al.* (2002) concluded that there is no area of Australia's continental shelf that has not been trawled and a large amount of the surface epifauna removed. It is this epifauna which provides the three-dimensional component to the otherwise-bare substrate and is critical for many species of fish and mobile epifauna (Pitcher *et al.* 1997; Poiner *et al.* 1998; Hutchings 1990). An extensive review of the numerous threatening processes in the marine environment has been provided by Ponder *et al.* (2002). What is most disconcerting is that there are threats to these offshore communities yet we have barely begun to investigate them. Recent reviews have provided good evidence that most, if not all, commercial fisheries are unsustainable (Jackson *et al.* 2001). The view has been advanced that continual removal of large predators has irreversibly changed marine food chains (Myers and Worm 2003). None of this bodes well for the long-term survival of our commercial fisheries.

While establishing marine parks or reserves is the first step towards marine conservation, there must be some rationale to their declaration. Avery (2003) and Creese and Breen (2003) have identified that the ideal

situation is to ensure that a representative series of reserves is created to encompass the range of habitats and, by default, their biodiversity. The development of the Interim Marine Bioregionalisation of Australia (IMCRA, for a discussion of this see Hutchings 2000) was the beginning of a process aimed at characterising the marine environments around Australia using a variety of physical parameters such as depth, sediment and some biological data such as fish distributions (see Hutchings 2000 for more details). Currently, the National Oceans Office, located in Hobart, is investigating what other data can be incorporated, such as the distribution of marine invertebrates from the databases of state museums and state fisheries. An example of the use of this sort of information, and additional unpublished information, is the exercise conducted by the Great Barrier Reef Marine Park Authority to identify the various habitats present within the park with the work carried out by specialists in the field. This led to the identification of 70 bioregions which encompass both reef and non-reef habitats. The rezoning of the Great Barrier Reef Marine Park was based on ensuring that all these bioregions would be represented in highly protected zones (Day *et al.* 2002), ideally with replicate areas. This zoning plan was out for public comment at the time of publication and it will be interesting to see how the Authority reconciles the comments from the numerous users of the reef. The decision as to whether the total amount of no-take zones increases will be a political one.

Similar exercises have been undertaken for developing management plans for the marine parks established at Jervis Bay and Solitary Islands in NSW, both of which are multi-use parks. Our knowledge of them is less than for the Great Barrier Reef, but management plans can be changed as more data are accumulated. In all cases it is critical that monitoring programs are put into place to ensure that the current zoning is effective at conserving the biodiversity of the area and that any extraction of natural resources is sustainable. These monitoring programs need to be well designed (Underwood and Chapman 2003). While management plans can be enforced by rangers or other park staff, it is imperative that the general public understands the rationale for zoning. The reasons must be clear because only then will the community support the zoning. All sections of the community, including such immediate stakeholders as recreational and commercial fishers, must observe the zoning. With the installation of the vessel monitoring devices, it is easy to locate all commercial fishing vessels on the Great Barrier Reef as well as to determine if they are travelling or fishing. This is reducing the number of commercial infringements, but recreational fishers must also observe the zoning and bag limits. Over the past few years many of the stakeholders on the reef have realised that some restrictions are essential if the biodiversity of the reef is to be maintained. There is increasing evidence of the conservation value of marine reserves (Babcock 2003). Babcock's research also helps dispel concerns about adverse effects on stocks of commercially important fish and crustaceans.

Conflict or just watching

The conflict between recreational and commercial fishers remains a controversial issue, particularly in New South Wales with the closure of some estuaries to commercial fishing and the recognition of the rights of recreational fishers, while noting that cumulatively they also impact on fisheries stocks (Recher 2003). Again, it is partly a process of educating the public on the cumulative impacts of recreational fishing, but also a need for people to respect bag and size limits and realise that there is an increasing number of people fishing along our coast. This is because of the ever-increasing population on coastal areas coupled with declining fish stocks as estuarine areas are degraded by loss of habitats and freshwater run off. The management of this conflict falls on fisheries departments, and it has proved to be difficult. It is, for example, difficult to find information in the public arena on the nature of the conflict and how it is being resolved. However, we note that difficulties in conflict resolution among competing interests over natural resources is not peculiar to the marine environment. It is our view as researchers that such difficulties are compounded if information gathered is not made readily available to all parties. One of the hallmarks of the success of science has been the iterative process of publication and criticism.

Not all uses of our marine resources are extractive; some are passive, such as sailing and swimming, and others, such as whale watching, can, if controlled, be self-sustaining and provide much needed funds to coastal communities (Waples 2003). Tourism, if properly managed, can make a major contribution to our economy, but the needs of increasing numbers of tourists, with hotels, boats, fishing and wastes, is a growing problem in its own right (Recher 2003). These issues of conflict, tourism, scale and taking a national overview are covered in the next section. It aims to give background to the detailed studies recorded in this book and to comment critically on how the state of this environment is being reported to the nation.

Coasts and Oceans ASEC 2001 Theme Report

The Coasts and Oceans, *Australia State of the Environment Report 2001* (Theme Report), (ASEC 2001) is a remarkable document. The Australian State of the Environment (ASEC) reports are prepared to provide the public with information about the condition of the Australian environment. They are one of the great environmental achievements of the 1990s. The first Commonwealth report was 1996, the second was in 2001. One outcome of the Commonwealth's 1996 ASEC report was the development of indicators. Between the first and the second report, a set of national-scale environmental indicators was published. For coasts and oceans, the indicators are presented in Ward *et al.* (1998), but the ASEC 2001 report records that there has been little progress on compiling the data for these indicators at the national scale. The ASEC 2001 report acknowledged that developing indicators is necessary but not sufficient. The straightforward facts about the marine environment in this section are derived from the ASEC 2001 theme report on coasts and oceans and its value is acknowledged (www.ea.gov.au/soe/).

Australia's marine area

Australia's marine area, one of the largest in the world, extends over about 16 million square kilometres from Antarctica to near-equatorial latitudes. This is more than double the continent's land area. It includes about 12,000 islands. The 61,700 kilometres coastline (including nearby islands) is surrounded by a relatively narrow continental shelf, with the exception of the Great Australian Bight and the tropics. The continental shelf extends to depths of about 150-200 metres and varies from between 15 and 400 kilometres in width. From the edge of the continental shelf, the continental slope drops from a depth of about 150-200 metres to 4000 metres. Australia has declared a range of maritime zones (Fig. 1).

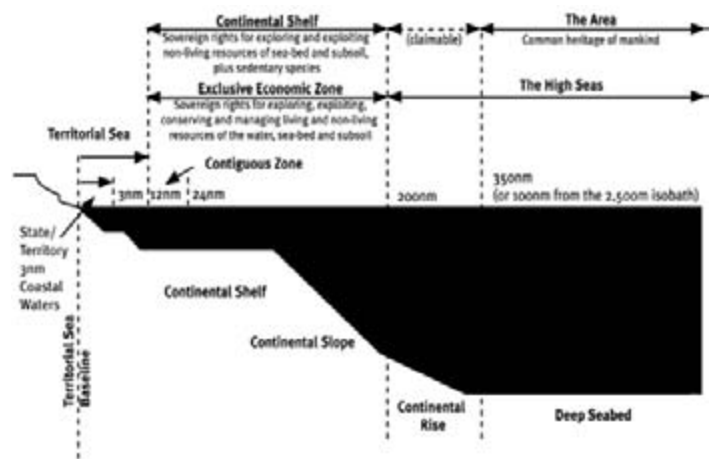


Figure 1: Australia's marine area. The outer limit of each zone is measured from the territorial sea baseline, located for the most part at the low-water mark along the coast. The zones include the territorial sea, the outer limit of which is 12 nautical miles. Australia has sovereignty over the territorial waters. The Exclusive Economic Zone (EEZ) is the area between the lines 12 nautical miles and 200 nautical miles seaward of the territorial sea baselines. In general, the States and Territories have jurisdiction over marine areas to 3 nm from the baseline, and the Commonwealth has jurisdiction beyond those waters to the outer boundaries of the EEZ. Our knowledge of the habitats and species within the EEZ is limited as only 1-2% of the EEZ has been surveyed. The continental shelf is in the area between 12 nm and 200 nm seaward of the territorial sea baseline (i.e. it covers much the same area as the EEZ) and any area of physical continental shelf beyond 200 nm. The Australian Fishing Zone was declared in 1979 and is now managed under the *Fisheries Management Act 1991*. The zone is the area of waters between 3 nm and 200 nm seaward of the baselines. Source with permission: *Coasts and Oceans ASEC 2001 (Theme Report)*.

Australia's marine environment is a common resource

The ASEC 2001 report identified that Australia's Oceans Policy (Commonwealth of Australia 1998) employs the principle that most of the marine environment is a common resource that may be used by people who do not possess an exclusive right to it. The size of economic activity of the major marine industries is estimated to be more than \$30

billion annually; marine tourism and recreation is estimated to contribute 50% to the economic activity; oil, gas and engineering 27%; shipping, transport and ship building 13%; and commercial fishing and aquaculture 5%.

The ASEC 2001 report noted that the movement of people to live near the coast had continued during the previous five years, with effects including loss of coastal and nearshore habitat, loss of open space and natural landscape, increased nutrient loads to estuaries, and increased stormwater runoff into coastal waters. The report also noted that the diversity of coastal environments, combined with the large number of agencies and bodies with an interest in coastal and marine management, has led to a lack of integration and consistent management. It observed that this problem had been recorded by the Resource Assessment Commission (1993), which recognised that the challenge was to further enhance consistent, strategic and integrated management of this important environment. The ASEC 2001 report considered that the State of the Marine Environment Report (SOMER) by Zann (1995) provided the first comprehensive scientific description of our marine environment, with the top concerns being: declining marine and coastal water sediment quality, particularly as a result of inappropriate land use practices, loss of marine and coastal habitats, unsustainable use of marine and coastal resources, lack of marine science policy, lack of long-term research and monitoring, and lack of strategic and integrated planning in marine and coastal environments.

The ASEC 2001 theme report on coasts and oceans identified that the major element of progress was the Australia's Oceans Policy (AOP) in 1998 with a framework for the integrated planning and management of our ocean environment. The need for integrated management is illustrated by the link between activities on the land and their effects on coastal resources and environments. We need to manage the whole catchment, from watershed to coast, as a single system with an integration of all the agencies involved. The AOP policy, as stated in the ASEC 2001 report, "includes support for some innovative approaches to integrated oceans management, e.g. the concept of regional marine plans, and that the policy acknowledges the need to take an ecosystem approach to natural resource management, striking a balance between environmental, economic and social objectives".

Intellectually sustainable development

The reason for this book reflects the widespread concern that one group cannot cope with both the geographical and time scales involved on the scientific side as well as all the shorter-term policy matters on the other, let alone be able to evaluate the success or otherwise of conservation measures on all fronts. Further, ASEC writers tend, in our view, to see policy as a primary means of resolving problems, but we consider that the scientific approach has a greater contribution to make than is usually acknowledged in policy documents. This particularly arises in the skill of naming the organisms, and predicting the consequences of not knowing the

names of the organisms, undertaking surveys, as well as taking an ecological approach (underpinned by a sound grasp of experimental design) to environmental matters, and encouraging scientists to tackle the difficult subjects. Support through sustained government funding that does not preclude freedom of scientists to speculate ecologically on difficult policy matters, or to make scientific predictions and test their ideas, is essential. In our opinion, too few scientists in the employment of governments speak up on controversial problems, let alone venture opinions on how to address them, especially if those opinions may be perceived as running counter to current policy. In other cases, freedom to contribute to the public debate is constrained by managers of these agencies who may not be scientists themselves and so may have difficulty in evaluating the importance of disseminating this information. Yet governments across Australia have some of the hardest working members of Australia's scientific community in their employ. Their voice has not been heard often enough in the public marine conservation debate. It has been left to the Australian Conservation Foundation, in collaboration with a raft of other well-known conservation NGOs, to assess the crisis in the marine environment. The point here is that we need to allow all voices to speak and work towards the common good of the common resource called the marine environment. Ecologically sustainable development requires intellectually sustainable development, and this RZS publication aims to help in that endeavour.

Habitats

The ASEC 2001 report commented on aspects of the habitats of the coasts and oceans, noting that dunes and beach habitat occur along 50% of the Australian coastline, yet they are among the most poorly studied coastal habitats. Similarly, intertidal mudflats are species-rich and important in the routes of migratory bird species, but are not particularly well studied. The principal human pressures on rocky reefs of both intertidal and subtidal areas come from land-based pollution and fishing. The ASEC 2001 report also pointed out that although the Great Barrier Reef is well known internationally, it 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. The ASEC report also noted that one of the greatest pressures on estuaries was the decline in water quality caused by agricultural development and changes in water flow regimes.

Species

The ASEC 2001 report stated that human impacts on invertebrates came from coastal development and land-based pollution, and from some methods of fishing such as trawling and dredging. In the past five years, the ASEC noted, 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, as seen by the report writers, "relies less on precise knowledge of species population status and depends more on maintenance of areas of habitat types". The ASEC 2001 stated that

Australia has continued to pursue the establishment of MPAs and that there are now more than 190 protected areas covering 60 million hectares.

The ASEC 2001 report noted that six of the world's seven species of marine turtles breed in Australia; that disturbance to seabird populations and their habitat come from a wide variety of sources; that cetaceans (whales and dolphins) are visible and valued by Australians as charismatic species deserving maximum protection, but that little is known of the population status of the inshore dolphins; that there are 10 seal species, all occurring in southern temperate Australia and sub-Antarctic regions, and their population dynamics are complex; and that the Dugong, Australia's only strictly marine herbivorous mammal, is vulnerable to mesh nets in shallow coastal waters and to loss of their seagrass feeding habitats.

Water quality

Water quality, its maintenance or restoration, particularly in coastal margins of Australia's marine area, was highlighted in the ASEC 2001 as "arguably the most critical marine environmental issue confronting Australia in 2001". The report commented that it is difficult to manage because the changes usually occur slowly, perhaps over generations, and that the incremental decline in quality makes it difficult for regulators to achieve the community support needed to reverse the negative impacts. The changes actually occur a lot faster than has been appreciated, as illustrated by the changes in the lower Hawkesbury River (Recher 2003). Further, precise data on the contribution of various human activities to the degradation of coastal water quality are scarce and, in the words of the ASEC 2001 report, "it is common for different sectors of our community to lay blame on other sectors". This question of blame and community conflict is rarely alluded to in ASEC reporting, so its inclusion here is telling.

Fisheries are fully or overexploited

The ASEC 2001 pulled no punches when it stated that, "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". The ASEC 2001 report also noted that the longline fishing industry is addressing the problem of accidental capture of seabirds, although the problem is not yet under control; that 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; but that the level of uncertainty in scientific assessments of the status of fisheries remains relatively high. 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 report that stocks are either at or near their sustainable limit. The ASEC 2001 report concluded that there are very few examples for which fisheries management can claim clear success in achieving regulatory goals, with a notable success story being the Western Australian Western Rock Lobster Fishery.

Other topics of importance

The ASEC 2001 report covered many other topics of importance, such as introduced marine pests. These are imported in the ships that carry our export products, and these ships usually arrive empty, except for massive volumes of ballast water taken on board in foreign ports and then dumped in Australian waters. Some 200 species have been introduced to our waters from foreign regions, most unintentionally in ballast water or by other means. Some of these species cause dramatic changes and threaten entire habitats, and some cause toxic algal blooms that threaten oyster and mussel fisheries and the health of those who eat affected shellfish. The ASEC 2001 report also commented on marine industry development, such as shipping, and the infrastructure including ports and navigation channels that require dredging, and stated that an oil spill is a constant concern. The report noted that the 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. This matter has been mentioned by the RZS previously (Benkendorff 2002) as a matter of international significance.

Importantly, the ASEC 2001 noted that the matter of indigenous rights to the use of marine resources has been acknowledged in a number of court decisions relating to harvesting of traditional food species, and in legislation in the case of the Torres Strait Islanders' use of the marine environment. It is a topic of profound importance, but it was not within the scope of this forum.

A stark summary

In a stark summary, the ASEC 2001 stated that: "Water quality and loss of habitats have emerged as the major issues. Overall the quality of estuarine and coastal waters has not improved, although there are some locations where signs are positive". The Oceans Policy, it stated, included support for some innovative approaches to integrated oceans management, e.g. the concept of regional marine plans. This subject came up for media attention and debate in 2003 as this book was going to press.

Life's a Breach: the media has its say

A brilliant photograph of a humpback whale glistening in the sun as it breached in the sea off Sydney made a great front page photograph for the *Sydney Morning Herald* (SMH 17 June 2003). It was headed by a droll caption, "Life's a breach as the annual blubberfest rolls around". A minor caption explained that, "about 300 southern right and humpback whales migrate north each winter – right off Sydney's doorstep". Watching whales is a serious matter as Kelly Waples (2003) explains in her chapter, but the point here is the one taken up by the Herald on the next day (SMH 18 June 2003) in its editorial, "Saving the whale, again". The first sentence set the scene: "It is the beginning of the whaling season off Sydney – the whale-watching season". A happy conclusion appeared in the next line: "That glorious confirmation that the human race is, after

all, capable of stepping back from the destruction of the planet". A cautionary note then emerged in the following sentence, "Yet, contrary to popular belief and despite steadily increasing numbers of humpback and southern right whales off Australia's east coast, the whale has not been definitely saved". The editorial continued with the difficult matter of what it called, "the bitter international power struggle over the future of commercial whaling at the International Whaling Commission (IWC) in Berlin [in 2003]". This sequence captures the essence of what we see at issue in conserving marine environments, namely the beauty of the marine environment, its exploitation, and now the difficulty of negotiating a path to an ecologically sustainable future.

Icons of the marine environment

We continue to revel in the icons. They are as important to conserving the marine environment as rainforests are to the terrestrial conservation battlegrounds. The Great Barrier Reef provides an example of world-class importance, as explained by Kenchington (2003) in his chapter. The SMH regularly gives it prominence and thereby contributes to its conservation, and promotes the idea that we can identify and conserve protected marine areas, a theme taken up in the chapters by Avery (2003), Babcock (2003), Kenchington (2003) and Creese and Breen (2003). On 18 June 2003 the SMH was alive with marine topics. Its graphic photo of the day was a huge photo provided by GBRMPA (Fig. 2).

The closing line in Roberts' accompanying skilful SMH piece was: "The Federal Government angered the fishing industry earlier this month with a draft plan to protect a third of the Great Barrier Reef from commercial fishing". There is no doubt that conflict within the fishing industry is deep-seated and long-running. Nevertheless, this little line in the tail of Roberts' article carried a sting. It served as a reminder that the plan to protect one-third of the reef is still a draft. This sent us back to the words in Roberts' article relating to policy, namely "the Queensland and Federal governments may limit...", and here we note the use of "may". What an intelligent reader can conclude from Roberts' article is that the scientists have identified the problem – coral struggling to reproduce – and its cause – the load of sediment and its fertiliser content flowing into the sea. Indeed, the cause was so apparent that it could be photographed and featured in big colour photo. What the careful writing by Roberts laid bare was strong language relating to impacts, with words such as "smother", "damage" and "calamity", and the limp words of "may", and "cap" and "draft" when it came to policy. The great photograph, the good writing of the experienced environmental journalist Greg Roberts, and the iconic Great Barrier Reef, have been combined to demonstrate the failure to translate the findings of science into effective marine conservation policy. Unfortunately, public support is more likely to drive policy decisions



Figure 2. The caption in the *Sydney Morning Herald* of 18 June 2003 to this telling photo read, "Muddy water...between 11 million and 14 million tonnes of sediment is carried by rivers each year into the reef, says the Australian Institute of Marine Science". The photo in the SMH was in colour, with a huge brown water plume heading out into the blue sea. It is still stark in black and white. The headline to Greg Roberts' accompanying article then captured the essence of the matter, "Coral Calamity: fertiliser caps on card to save the reef." Roberts explained that, "Sediment smothers coral in coastal reefs and reduces sunlight in the water. Fertilisers carried in the sediment promote algal growth. Both damage the capacity of coral to reproduce. The problem is getting so bad that the Queensland and Federal governments may limit quantities of fertiliser used by farmers in the reef's catchment". This article directly links science with policy and public interest. It is strong writing and there is hardly anyone who would now disagree with the proposition that there is a problem. Photo courtesy of GBRMPA.

than the careful words of scientific papers or the sensible words of a well-crafted policy paper. Hence our focus here is on what the papers are saying. We are aiming to give life to the first word of the title of this book, namely “conserving”. It is a public interest matter, a community decision and, in a democracy, the final lines on a map or words in a policy document, or act of parliament, are chosen by elected governments. We are aiming to give more life to that process by drawing all the strands together so that the next course of action is easier to see. We add, as scientists (and thus biased towards this take on the world), that it has been a sustained research effort that has made a major contribution to defining the problems. We argue that while the current policy debates rage, scientists must press on with research on a broad front, and not just with those issues that have captured today’s headlines. Scientists also need to be working on material that will underpin the headlines in a decade from now.

Any policy in relation to the Great Barrier Reef will be hard to turn into reality because of the complexity of state-commonwealth powers on environmental matters, as outlined in the chapter by Tsamenyi *et al.* (2003). This was also evident from Roberts’ SMH article: “The Queensland Environment Minister, Dean Wells, said he hoped farmers would agree to implement environmentally sound practices by negotiation, but indicated fertiliser caps were on the table”. Sound policies can be prepared and articulated, but our ability to negotiate an environmentally sound future looks like a weak link in the process. The recent release of the “Reef Water quality protection plan for catchments adjacent to the Great Barrier Reef World Heritage Area” (2003) is welcomed, yet it appears that no dedicated funding is available for its implementation.

A paralysis of intellect

The gulf between the economic and ecological timeframes presents a major block to understanding and thus to negotiations between economists or commercial interests and scientists, and there is a pressing need to integrate ecological and economic thinking to resolve the interdisciplinary conflicts of space and time (Lunney *et al.* 1997). The Great Barrier Reef provides a now classic example of this clash, hence the cautious language by political decision-makers who are trying to find common interests between two groups whose time/space paradigms differ so greatly. Notwithstanding such “paralysis of intellect”, as observed by Mark Twain in the 1880s as he was forced to leave one train to board another at Albury on the NSW/Victorian border because of a difference in rail gauge, there is no doubt that brilliant publicity does strengthen the hands of those with the authority to negotiate. Before we go too far down this path, we need to consider the problems identified in the chapter by Underwood and Chapman (2003). These include the issues of scale, in time and space, and the serious matter of how can we effectively measure changes, whether they are adverse impacts or improvements.

The whales migrate through thousands of kilometres and have a low reproductive rate. Any recovery from over-harvesting will take decades, so any decision to harvest or not harvest will not rebound on those who make, or

fail to make, the decisions. This creates a particular policy dilemma, but it is the application to policy of the question of time scale that is the problem. Ecological time frames, let alone evolutionary ones, can be far greater than the life of a policy in its manifestations, such as acts of parliament, international agreements and the various items listed in the comprehensive chapter by Tsamenyi *et al.* (2003).

Identifying the right time scale and the conflict between long-term problems and short-term funding

Underwood and Chapman (2003) urge us to consider the time scale, and we add our strongest support for the case for long-term studies to assist in that endeavour. The scientific community acknowledges their value, but obtaining funding for such endeavours is hard, especially as various organisms, locations and problems fall in and out of fashion. An equal concern is for those organisms, locations and problems that have not even been seen than other by a few researchers. Could you, at a moment’s notice, give a quick spiel on narrow range endemics or seamounts? If not, then read Ponder’s (2003) chapter, as well as the plea by Hutchings (2003) for more research effort on the small marine organisms, which are largely undescribed.

This issue of funding is not confined to a group of scientists pursuing esoteric lines of thinking, but it also affects community groups, with their huge volunteer workforce. Under the headline, “Fears for coastal work after rejig of funding” (SMH 18 June 2003), environment reporter Stephanie Peatling reports that, “Thousands of coast care projects are under threat after the Federal Government sacked their regional co-ordinators and reshaped funding for community groups”. The issue goes beyond funding, it reaches to the heart of what we are trying to achieve on our coasts, and within our coastal communities, in conserving our marine environments. It is on this part of the marine world that Adam (2003), Fairfull and Williams (2003) and Recher (2003) focus. It is the funding that so rapidly refashions our programs and it is why funding is one of the keys to putting ideas, policies and management plans into place.

The immense difficulties in the coastal zone are spelt out from two different perspectives in the chapters by Adam (2003) and Fairfull and Williams (2003). They point out that it is now apparent that earlier provisions for conserving the coast and its estuaries were not up to the task. The lamentably low position of the environment among all the issues in the run up to the 2001 federal election (Lunney 2002) gave little hope for a new lease of life for conservation. Further, the federal government’s shift away from research to funding community groups via the Natural Heritage Program (which includes coast care), exacerbates the deterioration of support for research on cryptic organisms and matters which are not in today’s spotlight. This is arguably a tragedy from a national perspective, and it mocks the plight of the deteriorating environment, as well as the research and community support for a real investment in the future of Australia’s precious environments, of which the marine environment is so crucial (Lunney *et al.* 2002).

“The Ocean blueprint”

If you enjoy puns, then the headline, “*The Ocean blueprint*” (SMH 19-20 July 2003), to Andrew Darby’s article in which he describes the federal government’s plan to better manage Australia’s marine ecosystems, is a colourful example. Darby reports that the “South-east Regional Marine Plan’s draft, covering 2 million square kilometres of sea...reaches from Bermagui in southern NSW, south to sub-Antarctic Macquarie island, and west through waters off Victoria, Tasmania and South Australia”. “This draft,” adds Darby, “is the first model for an ecosystem approach to management of Australia’s entire 16 million square kilometre marine domain.” Darby enjoys the politics of the matter. He reports that, “This is an example of what federal Environment Minister, David Kemp, calls an integrated approach to oceans management, one that takes into account all users of the ocean”. Darby then contrasts this with the simple statement: “None of the states whose shorelines are washed by the south-east’s seas has signed on to the plan”. This is then explained by citing “the Worldwide Fund for Nature’s Margaret Moore” who said, “I think they [the states] felt that they hadn’t been consulted on the original oceans policy”. Darby then cites the Australian Marine Conservation Society’s representative, Diane Tarte: “While not denying the validity of the Commonwealth, until we get integration with state waters and linkages up to the catchments, we’re never going to crack some of the big problems in marine and coastal environments”. Darby then points out that the ecosystem takes no notice of state boundaries, then complements that with a quote from Russell Reichelt, chair of the National Oceans Advisory Group: “Of course oceans don’t understand a three-mile limit”.

“Plan to lock up 30% of Barrier Reef” (SMH 2 June 2003)

In contrast with the ocean blueprint, the issue of zoning is fundamental to the current approach to managing the Great Barrier Reef. Under the misleading headline [most likely drafted by a subeditor, not the journalist], “*Plan to lock up 30% of Barrier Reef*” (SMH 2 June 2003), environment reporter Stephanie Peatling opens her piece with the statement: “Nearly a third of the Great Barrier Reef will be protected from fishing and trawling under a new plan to be announced by the Federal Government today”. Peatling continues with a few salient facts: “Less than 5 per cent of the reef has the equivalent status of a marine national park, which means no activity other than restricted research or tourism is allowed. Scientists have been warning that this is not enough to guarantee the reef’s long-term survival”. Peatling identified that, “Under the plan, which will be released for a two-month public consultation period today, representative sections of each of the reef’s 70 biological regions will be set aside for protection.” Peatling adds an alarming fact near the end of her article: “An opinion poll conducted as part of the drafting process revealed a majority of people believed the reef already had the status of a national park”. There is no doubt that sorting out the terms is difficult, even after trawling through the GBRMPA website (www.gbrmpa.gov.au). We are sympathetic to the majority of people who already believed that the reef

already had the status of a national park. What matters is the zoning, even though it is also a World Heritage Area. Certainly the Australian Conservation Foundation (ACF) is under no illusions on this matter. A lift out sheet in the June 2003 edition of the ACF journal *Habitat* was titled: “Act now to rescue the Reef”. The ACF puts its view that, “Based on scientific advice and community opinion, we believe around 50% of the Marine Park should be highly protected”.

Oceans Eleven

A major contribution by the ACF and a long list of associated NGOs was their *Oceans Eleven* policy (www.acfonline.org.au/docs/general/00432.pdf), released in March 2003. Its blunt assessment was that in 1998 the Commonwealth government’s widely-embraced Oceans Policy, which laid down a framework for ecosystem-based regional marine planning, had stalled. *Oceans Eleven* is a statement of the actions now needed to make marine planning a success. We were particularly pleased to note that of the six recommendations for action, one was aimed at research. This is far too often a missing element in recommendations for action on a variety of environmental issues by conservation NGOs. The wording is clear: “Well-targeted, well-funded, independent, integrated, expanding and accessible research is the key to building our knowledge and understanding of Australia’s marine waters”. The next sentence is even more heart-warming: “A strong policy and increased funding commitment is urgently required from the Commonwealth and state governments...”. The conclusion is unambiguous: “The success of Oceans Policy, and of ecosystem-based management, depends upon it”.

The forum recorded in this book and the *Oceans Eleven* policy have a number of common elements, particularly relating to Marine Protected Areas (MPAs), the need for an ecosystems approach and a recognition of the importance of the legal framework. The differences reflect the rare expertise that the various authors in this book have gained from a lifetime of research and participation in this continuing debate. Of particular importance in this publication is the recognition of marine invertebrates, their role, their diversity and their particular plight (Hutchings 2003; Ponder 2003; Underwood and Chapman 2003). Another element emphasised in this book is the importance of the marine environment other than the Great Barrier Reef. The Reef is perceptibly a jewel, but the depth of the problems elsewhere are profound. As ACF president Peter Garrett pointed out in his foreword to *Oceans Eleven*, there are 16 million square kilometres of ocean around Australia from the Antarctic to the tropics, and the centuries of misuse – heavy metal and oil pollution, overfishing, habitat loss – have taken their toll.

Conclusion

The papers published here reinforce the need for active marine conservation, not only of coastal habitats but also of offshore habitats, and the need for sustainable management of our marine resources. The principles for protecting biodiversity, which have been developed for terrestrial systems, are applicable to the marine environment, but there are characteristics unique to each. Some of the lessons being learnt in the marine

environment, especially in relation to multi-use parks, could potentially be transferred to the terrestrial environment where it is becoming readily apparent that relying on national parks is insufficient and that off-park conservation is also needed. In both environments, isolated areas of high protection are ineffective and in the ideal world the entire environment must be managed, where people's backyards, their catchment, their local rocky shore, stretch of estuary and favourite beach, can contribute to maintaining at least sections of the biodiversity of the region.

The ASEC 2001 report noted that the "effect of poor catchment management is to lower coastal biodiversity through pollution and sediment. Catchment management is a key response, and this has been recognised in most parts of Australia, and in all tiers of government. There is still no nationally applicable Coastal Zone Policy, and delivery of effective catchment management across all jurisdictions is still some way off". Not surprisingly, the ASEC 2001 report next stated that, "Managing the activities of people in a way that conserves habitats while sustaining resources and industries is extraordinarily complex and difficult". We agree with the ASEC's next point that, "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. Therefore publicly available information about the state of our environment is very important". It is in that spirit that the Royal Zoological Society held its forum, which is published here. The ASEC 2001 report asked, "How much information is readily available to the public and to decision makers on the general state of the coasts and oceans environment?" It answered its own question with: "Unfortunately there is not a great deal, and it is 'nobody's job' to coordinate and deliver such information". In this context, all tiers of government, all NGOs and all interest groups, or stakeholders, will need to contribute to the national debate. This book is one such contribution, and it pursues the line that the challenge is not only the measurable loss of biodiversity, or the visible signs of pollution, but the need to take an approach that acknowledges that the great time scale on which the marine environment functions is far beyond the life of any government, and the geographical scale is immense, beyond one sovereign state. Even more importantly, the long-term contribution of the scientific imagination must be recognised from its role in experimental design to the naming of a mollusc on a seamount.

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References

- Adam, P. 2003.** Planning for the future of the New South Wales coast: history and science in the quest for certainty. Pp 49-54 in *Conserving Marine Environments. Out of sight, out of mind*, edited by P. Hutchings and D. Lunney. Royal Zoological Society of New South Wales, Mosman, NSW.
- ASEC. 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.
- Avery, R. P. 2003.** Marine and terrestrial conservation planning – how different are they? Pp 18-40 in *Conserving Marine Environments. Out of sight, out of mind*, edited by P. Hutchings and D. Lunney. Royal Zoological Society of New South Wales, Mosman, NSW.
- Babcock, R. 2003.** *The New Zealand Marine Reserve Experience: the science behind the politics*. Pp 108-119 in *Conserving Marine Environments. Out of sight, out of mind*, edited by P. Hutchings and D. Lunney. Royal Zoological Society of New South Wales, Mosman, NSW.
- Baker J. 2003.** A report on the study of land sourced pollutants and their impacts on water quality in and adjacent to the Great Barrier Reef. A report prepared by an Intergovernmental Steering Committee to Premiers Department, Queensland Government www.premiers.qld.gov.au/about/reefwater.pdf.
- Benkendorff, K. 2002.** Potential conservation benefits and problems associated with bioprospecting in the marine environment. Pp 90-100 in *A Zoological Revolution. Using native fauna to assist in its own survival*, edited by D. Lunney and C. Dickman. Royal Zoological Society of NSW, Mosman, NSW.
- Brown, I. 2002.** Oldest MPA in the world: Royal National Park, New South Wales, Australia. Designated 1879. *MPA News*, 3(6):5.
- Commonwealth of Australia. 1998.** *Australia's Oceans Policy*. Canberra, Australia.
- Creese, B. and Breen, D. 2003.** Marine Protected Areas in New South Wales, Australia: challenges for research. Pp 120-128 in *Conserving Marine Environments. Out of sight, out of mind*, edited by P. Hutchings and D. Lunney. Royal Zoological Society of New South Wales, Mosman, NSW.
- Day, J., Fernandes, L., Barnett, B., Slegers, S., Kerrigan, B., Breen, D., De'ath, G., Lewis, A., Innes, J. and Oliver, J. 2002.** The representative areas program-protecting the biodiversity of the Great Barrier Reef World Heritage Area. *Proceedings of the 9th International Coral Reef Symposium, Bali, Indonesia*. Bali. Volume 2: 687-696.
- Fabricius, K.E. and De'ath, G. 2001.** Biodiversity on the Great Barrier Reef: Large-scale patterns and turbidity-related local loss of soft coral taxa. Pp 127-144 in *Oceanographic processes of coral reefs: physical and biological links in the Great Barrier Reef*, edited by E. Wolanski. London, CRC Press.
- Fairfull, S. and Williams, R. 2003.** Pp. 55-61 in *Conserving Marine Environments. Out of sight, out of mind*, edited by P. Hutchings and D. Lunney. Royal Zoological Society of New South Wales, Mosman, NSW.
- Hutchings, P.A., 1990.** A review of the effects of trawling on macro benthic epifaunal communities. *Australian Journal of Marine and Freshwater Research* 41: 111-120.

- Hutchings, P.A.** 2000. The challenge to conserve and manage Australia's marine biodiversity. *Pacific Conservation Biology* 5(4): 242-249.
- Hutchings, P.A.** 2003. . Threatened Species Management: out of its depth for marine invertebrates. Pp 81-88 in *Conserving Marine Environments. Out of sight, out of mind*, edited by P. Hutchings and D. Lunney. Royal Zoological Society of New South Wales, Mosman, NSW.
- Jackson, J. B. C., Kirby, M. X., Berger, W. H., Bjorndal, K. A., Botsford, L. W., Bourque, B. J., Bradbury, R. H., Cooke, R., Erlandson, J., Estes, J. A., Hughes, T. P., Kidwell, S., Lange, C. B., Lenihan, H. S., Pandolfi, J. M., Peterson, C. H., Steneck, R. S., Tegner, M. J. and Warner, R. R.** 2001. Historical overfishing and the recent collapse of coastal ecosystems. *Science* 293: 629-638.
- Johannes, R. E.** 1981. *Words of the Lagoon: Fishing and Marine Lore in the Palau district of Micronesia*. University of California Press, Berkeley and Los Angeles. 245pp.
- Kelleher G., Bleakley, C. and Wells. S.** 1995. *A Global Representative System of Marine Protected Areas*. The Great Barrier Reef Marine Park Authority, The World Bank, IUCN. Washington, DC 4 volumes.
- Kenchington, R.** 2003. Managing marine environments: an introduction to issues of sustainability, conservation, planning and implementation. Pp 41-48 in *Conserving Marine Environments. Out of sight, out of mind*, edited by P. Hutchings and D. Lunney. Royal Zoological Society of New South Wales, Mosman, NSW.
- Kent, R.** 2003. *Liquid Sea*. Catalogue publication, Museum of Contemporary Art, Sydney.
- Levin, L., Blair, N., De Masters, D., Plaia, G., Fornes, W., Martin, C. and Thomas, C.** 1997. Rapid subduction of organic matter by maldanid polychaetes on the North Carolina slope. *Journal of Marine Research* 55: 595-611.
- Lunney, D.** 2002. How the environment figured in the 2001 federal election. *Australian Zoologist* 32: 101-11.
- Lunney, D., Pressey, B., Archer, M., Hand, S., Godthelp, H. and Curtin, A.** 1997. Integrating ecology and economics: illustrating the need to resolve the conflicts of space and time. *Ecological Economics* 23: 135-42.
- Lunney, D., Dickman, C. and Burgin, S.** 2002. A bizarre and threatening process: the by-passing of ecological research when tackling environmental issues. Pp 97-101 in *Community and research-based conservation: a clash of paradigms*, edited by D. Lunney, C. Dickman and S. Burgin. Royal Zoological Society of New South Wales, Mosman, NSW.
- Myers R. A. and Worm, B.** 2003. Rapid worldwide depletion of predatory fish communities. *Nature* 423: 280- 283.
- Pitcher, C. R., Burrridge, C. Y., Wassenberg, T. J. and Poiner, I. R.** 1997. The effects of prawn trawl fisheries on GBR seabed habitats. *The Great Barrier Reef - science, use and management. A national conference*. Pp 107-123. Townsville, Great Barrier Reef Marine Park Authority.
- Poiner, I., Glaister, J., Pitcher, R., Burrridge, C., Wassenberg, T., Gribble, N., Hill, B., Blaber, S., Milton, D., Brewer, D. and Ellis, N.** 1998. The environmental effects of prawn trawling in the far northern section of the Great Barrier Reef Marine Park: 1991 - 1996. Summary and Introduction, Great Barrier Reef Marine Park Authority and Fisheries Research and Development Corporation. 23 (Summary).
- Ponder, W.** 2003. Narrow range endemism in the sea and its implications for conservation. Pp 89-102 in *Conserving Marine Environments. Out of sight, out of mind*, edited by P. Hutchings and D. Lunney. Royal Zoological Society of New South Wales, Mosman, NSW.
- Ponder, W.F., Hutchings, P.A and Chapman, R.** 2002. Overview of the Conservation of Australia's marine invertebrates. A report for Environment Australia. http://www.amonline.net.au/invertebrates/marine_overview/index.html
- Priddel, D.** 2003. Our seabirds at risk. Pp 73- 80 in *Conserving Marine Environments. Out of sight, out of mind*, edited by P. Hutchings and D. Lunney. Royal Zoological Society of New South Wales, Mosman, NSW.
- Recher, H. F.** 2003. Foreword. Where land and water meet. Pp iii-vi in *Conserving Marine Environments. Out of sight, out of mind*, edited by P. Hutchings and D. Lunney. Royal Zoological Society of New South Wales, Mosman, NSW.
- Recher, H. F, Hutchings, P.A and Rosen, S.** 1993. The biota of the Hawkesbury-Nepean catchment: Reconstruction and Restoration. *Australian Zoologist* 29: 3-41
- Reef Water Quality Protection Plan: for catchments adjacent to the Great Barrier Reef World Heritage Area** 2003. www.thepremier.qld.gov.au/reefwater.
- Resource Assessment Commission.** 1993. *Coastal Zone Inquiry: Final Report*, AGPS, Canberra.
- Short, A.D.** 1993. Beaches Of The New South Wales Coast, Australian Beach Safety and Management Project, Sydney, 358 pp.
- Short, A.D. (in press).** Australia beach systems - the morphodynamics of wave through tide-dominated beach-dune systems. *Journal of Coastal Research* SI.
- Silva M.E., Gately, E.M. and Desilvestre, I.** 1986. *A Bibliographic Listing of Coastal and Marine Protected Areas: A Global Survey*. Woods Hole Oceanographic Institution, MA USA Report WHOI-86-11. 156pp.
- Tsamenyi, M., Rose, G. and Castle, A.** 2003. International Marine Conservation Law and its Implementation in Australia. Pp 1-17 in *Conserving Marine Environments. Out of sight, out of mind*, edited by P. Hutchings and D. Lunney. Royal Zoological Society of New South Wales, Mosman, NSW.
- Underwood, A. J. and Chapman, G.** 2003. Problems of measuring biodiversity in coastal habitats: a summary of issues. Pp 103-107 in *Conserving Marine Environments. Out of sight, out of mind*, edited by P. Hutchings and D. Lunney. Royal Zoological Society of New South Wales, Mosman, NSW.
- Waples, K.** 2003. The role of research in the management of whale watching. Pp 62-72 in *Conserving Marine Environments. Out of sight, out of mind*, edited by P. Hutchings and D. Lunney. Royal Zoological Society of New South Wales, Mosman, NSW.
- Ward, T., Butler, E. and Hill, B.** 1998. *Environmental Indicators for National State of the Environment Reporting, Estuaries and the Sea*, Environment Australia, Canberra, ACT.
- Zann, L. (ed.)** 1995. *Our Sea, Our Future: Major Findings of the State of the Marine Environment Report for Australia*. Great Barrier Reef Marine Park Authority for the Dept of Environment, Sport and Territories, Ocean Rescue 2000 Program, Canberra.