Ocean Conservation and Management

Edited by Justin Healey

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Ocean Conservation and Management is Volume 398 in the ‘Issues in Society’ series of educational resource books. The aim of this series is to offer current, diverse information about important issues in our world, from an Australian perspective.

KEY ISSUES IN THIS TOPIC
Oceans cover over 70% of the Earth’s surface and contain a diverse array of species, habitats and ecosystems. As many as 100 million species live in our oceans, contributing to a rich biodiversity far exceeding that found on land. Marine extinction risk has ramped up rapidly in the past 50 years, to converge upon the level of risk seen on land.

People use and benefit from oceans and coasts in a number of important ways – through recreational activities, coastal living, tourism, fishing, shipping, and exploiting reserves of oil, gas and minerals found beneath the sea floor in many parts of the world.

What are the human and climate change-related impacts on Australia’s fragile ocean ecology and marine habitats? Which species are most at risk? How is Australia conserving its rich marine environment, including the unique Great Barrier Reef?

This book presents the latest key information on Australia’s ocean conservation and management approaches, fisheries and seafood sustainability, and reef management and marine pollution. Are our current efforts to preserve the treasures of our mostly aquatic planet only amounting to a mere drop in the ocean?

SOURCES OF INFORMATION
Titles in the ‘Issues in Society’ series are individual resource books which provide an overview on a specific subject comprised of facts and opinions.

The information in this resource book is not from any single author, publication or organisation. The unique value of the ‘Issues in Society’ series lies in its diversity of content and perspectives.

The content comes from a wide variety of sources and includes:
- Newspaper reports and opinion pieces
- Website fact sheets
- Magazine and journal articles
- Statistics and surveys
- Government reports
- Literature from special interest groups

CRITICAL EVALUATION
As the information reproduced in this book is from a number of different sources, readers should always be aware of the origin of the text and whether or not the source is likely to be expressing a particular bias or agenda.

It is hoped that, as you read about the many aspects of the issues explored in this book, you will critically evaluate the information presented. In some cases, it is important that you decide whether you are being presented with facts or opinions. Does the writer give a biased or an unbiased report? If an opinion is being expressed, do you agree with the writer?

EXPLORING ISSUES
The ‘Exploring issues’ section at the back of this book features a range of ready-to-use worksheets relating to the articles and issues raised in this book. The activities and exercises in these worksheets are suitable for use by students at middle secondary school level and beyond.

FURTHER RESEARCH
This title offers a useful starting point for those who need convenient access to information about the issues involved. However, it is only a starting point. The ‘Web links’ section at the back of this book contains a list of useful websites which you can access for more reading on the topic.
Marine species are more threatened than we thought – and we’ve only looked at 3%

Are marine species safe from harm, ask UK-based marine scientists Tom Webb and Nicholas Dulvy, in this article reproduced from The Conversation

Gaze out from the deck of a boat and you will see an ocean that was, in Henry David Thoreau’s phrase, “equally wild and unfathomable always”. There’s a stark contrast in appearance here between the apparently rugged and pristine ocean and our landscapes, so obviously and extensively modified by humans. As well as wild, of course the oceans are vast – they cover some 70% of Earth’s surface, and with an average depth approaching 4 km they make up 99% of our planet’s living space.

As for the organisms that inhabit our oceans – well, everyone knows they are phenomenally abundant, geographically widespread, and enormously fertile, right? Together, the vastness of the oceans and the exuberance of marine life makes the concept of marine extinction little more than a far-fetched idea.

A decade ago, one of us (Dulvy) decided to take a fresh look at some of these assumptions, reviewing what was then known about marine extinctions, and questioning the easy contrasts often made between marine (widespread, abundant, safe) and non-marine (specialist, rare, threatened) organisms.

Now, the other one of us (Webb) has published a new study in the journal *Current Biology* that attempts to put on an equal footing extinction risk across both marine and non-marine environments.

We did this by summarising data compiled in the International Union for Conservation of Nature’s *Red List of Threatened Species* across all major taxonomic groups, separately for marine and non-marine species. This could only have been possible through a decade-long concerted effort by the union to ramp up its assessment of marine organisms.

On the face of it, our results appear to support the view that marine species are at less risk. Simple views of such statistics have previously been used to confirm expectations that extinction risk is lower in the oceans.

**Focusing on the unknown**

When we dig deeper into these numbers, however, a rather different picture emerges. Our comparisons can only consider those species which have had their...
The critically endangered sawfish.

### Conservation Status

Conservation status formally assessed on the Red List. Despite 50 years of effort by tens of thousands of volunteers, during which more than 70,000 species have been assessed, we still know the status of just 3% of known marine and 4% of known non-marine species.

Across all these assessed species, extinction rates in non-marine groups are around twice those in marine groups – a much lower figure than previously thought.

Digging further still, the pattern changes markedly when we focus only on the best studied groups. This generally means the more charismatic, recognisable animals such as turtles or seabirds. While there are many more species of sea snails or crustaceans out there waiting to be discovered, taxonomists are unlikely to discover many new seabirds.

Naturally we expect the most robust estimate of extinction and threat rates for these best-studied groups. And of these animals on average 20-25% of species are threatened with extinction, regardless of whether they live on land or in sea.

### The ‘extinction-proof’ myth

Marine extinction risk has ramped up rapidly in the past 50 years, to converge upon the level of risk seen on land. There are of course some caveats to consider. Most significantly, very few marine groups meet our criteria for being ‘well known’, and most of those that do are atypical.

Some 90% of the 225,000 or so known sea species are invertebrates, with the diversity of fish more than matched by many less eye-catching groups. But the well-known groups are mainly vertebrates (seabirds, marine mammals, fish, turtles) or otherwise tied to our coastal seas (mangroves, seagrasses, corals).

Well-known groups of land animals are similarly biased towards the charismatic and convenient but – and here is a genuine marine-terrestrial contrast – most terrestrial biodiversity is contained within fewer groups to start with. Thus, while flowering plants and insects together cover much of the diversity of life on land, life in the sea is spread more evenly across dozens of major groups.

Indeed, a striking finding of this new study is that 64 of the 88 major groups of marine life, together containing almost a third of known marine species, have had no members at all assessed. Clearly the final word on marine extinction rates cannot be written until some at least of these gaps are filled in.

This task falls entirely to the volunteer scientists working in their spare time with little credit, and less funding. Securing this work is vital to ensure that we understand the true research and conservation priorities rather than that provided by the increasingly barren narrative litany of ocean calamities.

Despite the lack of overall representation of the marine tree of life in the new study, one group that is included is the archetypal ‘extinction-proof’ marine fish. Thomas Henry Huxley, Darwin’s Bulldog himself, pronounced with authoritative confidence at the 1883 Fisheries Exhibition in London "probably all the great sea fisheries, are inexhaustible; that is to say, that nothing we do seriously affects the number of the fish," a preconception that still clings stubbornly to 21st century discourse.

The emerging evidence over the past decade shows that abundant/widespread/fertile paradigm of marine life histories is the exception rather than the rule. So are marine species safe from harm? This new work confirms that the precautionary working hypothesis is, “no more than those on land”.

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### The Conversation

Protecting Australia’s oceans and coasts

Oceans and coasts are important to the animals and plants that call them home, but for centuries humans have also reaped large rewards from these environments, according to WWF Australia.

Oceans cover over 70% of the Earth’s surface and contain a diverse array of species, habitats and ecosystems. As many as 100 million species – from the world’s biggest animal, the blue whale, to the tiniest bacteria – reside in our oceans, contributing to a rich biodiversity that far outweighs that on land.

Oceans and coasts are important to the animals and plants that call them home, but for centuries humans have also reaped large rewards from these environments.

People use and benefit from oceans and coasts in a number of important ways, including through:

- Recreational activities like boating, swimming, snorkelling and scuba-diving.
- Enjoying pleasant living environments. According to the United Nations, 60% of the world’s population lives within 60 kilometres of the coast.
- Tourism. Coastal regions and oceans support a significant tourism industry, which represents 80% of all tourism.
- Fisheries industries that are a significant source of nutrition, particularly protein. Fisheries also create significant economic benefits through generating income, jobs and supporting related industries.
- Reserves of oil, gas and minerals, which are located beneath the sea floor in many parts of the world. Their extraction currently contributes significantly to our energy and resource needs.

Even those people who will never see the ocean benefit from the oil and mineral production, sea-based transport systems and seafood production derived from commercial fishing. More fundamentally, oceans play a significant role in the production of oxygen and the regulation of our weather systems.

WWF’s core areas of action for our oceans and coasts:

- Creating marine protected areas
- Manage threatened, endangered and protected marine species
- Managing commercial shipping and recreational boating
- Reducing marine pollution and debris
- Adapting to changing climate
- Collaborating across borders to forge regional solutions.

- Shipping. Our oceans are used to transport goods, people and cargo around the world.

Even those people who will never see the ocean benefit from the oil and mineral production, sea-based transport systems and seafood production derived from commercial fishing. More fundamentally, oceans play a significant role in the production of oxygen and the regulation of our weather systems.

Conserving Australia’s marine environment

KEY DIRECTIONS STATEMENT FROM THE AUSTRALIAN COMMITTEE FOR IUCN

A national priority – Australia is an island continent, our land is ‘girt by sea’ and the health and productivity of those seas are critical to our nation’s future. The next decade should be one of continuing progress in all aspects of marine conservation at local, state, territory and national level and Australia should maintain and increase its leadership in marine conservation and management in our region and beyond. Many elements of Australian society stand ready to contribute to the achievement of that goal.

1. Prioritise marine conservation in the national interest
   Protecting the multiple economic, social, cultural and ecological values of our marine environment is both an international commitment and in the long-term national interest and therefore a key priority of all Australian governments.

2. Ensure science-based decision-making
   Australia’s marine policy at all levels should rest on the best science available.

3. Establish a national vision with measurable targets and timelines
   The Australian Government should work with all sectors to develop a national vision and a set of objectives and actions with measurable targets and timelines to guide the planning, protection, management and monitoring of Australia’s marine environment.

4. Reinvigorate integrated marine planning
   In a nation with an immense marine estate conservation needs to go well beyond isolated areas of protection to holistic and collaborative approaches to integrated planning, management, law and policy for the marine environment.

5. Introduce a ‘State of the Seas’ report
   A national independent analysis of the ‘State of our Seas’ would help determine whether current management systems are effectively addressing the objectives of Australia’s Oceans Policy and then provide solutions for management gaps.

6. Continue to build the National Representative System of Marine Protected Areas (NRSMPA)
   The task of building a truly comprehensive, adequate and representative (CAR) network of marine reserves is unfinished. Representativeness, particularly of inshore and continental shelf systems needs to be a priority.

7. Recognise and support indigenous sea country policy and management
   Enhanced recognition and engagement of indigenous peoples in sea country management, will result in better governance of coastal and marine cultural and natural values while also contributing to improvements in indigenous wellbeing.

8. Evaluate the economic benefits of Australia’s marine environment
   We need good data on both the market and non-market benefits of Australia’s oceans. Such information will enhance our capacity to make decisions when change to the marine environment will affect the economic benefits derived from healthy oceans.

9. Continue to take a strong international leadership role
   Through international leadership Australia can contribute to global best-practice outcomes in such areas as reducing overfishing, preventing uncontrolled extraction of the high seas and supporting neighbouring marine nations to protect and sustainably use their marine resources.

10. Avoid a short-term approach to multiple threats
    All governments need to address these threats over the long term in a systematic and integrated manner and avoid short-term, politically-driven decision making.

11. Address cumulative impacts
    Appropriately scaled strategic frameworks that contain consistent environmental standards and provide a robust basis for both planning and approvals processes can be a key mechanism to avoid cumulative impacts.

12. Exclude critically sensitive areas from extraction
    Places in our marine environment of high ecological and cultural values should be permanently off limits to damaging activities and protected under a range of mechanisms.

13. Improve knowledge and ensure transparency of resource extraction industries
    Policy and legislation should ensure any industry operating in Australian waters meets the highest standards to avoid or reduce environmental impacts from their operations and such industries should contribute directly to marine conservation efforts.

14. Increase Australia’s biosecurity against marine invasive species
    Greater support is vital to aid in decreasing the possibility of irreversible damage invasive species can place on native marine species and habitats.

15. Ensure fisheries management is based on science to avoid ‘fishing down’ pressures
Many Australian commercial and recreational species are currently much reduced in their natural size range and densities. We need to set a national priority to rebuild fish stocks and to manage fisheries based on science with standards set to maintain systems with natural levels of ecological function.

16. **Enhance efforts to reduce marine pollution**
Strict regulation needs to be applied to all potential marine pollutants and major programs applied to issues like terrestrial run off and prevention of marine pollutants, dumping and debris. Community efforts need support.

17. **Use the marine environment’s carbon absorption to mitigate climate change**
The marine environment can make a major contribution to reducing the Earth’s carbon levels. A priority is to avoid this release of ‘blue carbon’ emissions by protecting existing marine and coastal ecosystem carbon stocks.

18. **Maximise marine and coastal ecological health for climate change adaption**
Climate change adaptation requires actions to reduce stresses to maximise ecological health and resilience. New coastal and marine developments should require a strong climate change impact ‘filter’.

19. **Ensure public participation and transparency in decision making**
Best-practice frameworks for public participation in any decision making and planning processes should be encouraged and supported. A national network would allow communities to share their networks and information.

20. **Increase support of community activities and citizen science**
Active collaboration between scientists, educators, environmental interest groups, businesses and concerned citizens can result in stronger support for scientific research and greater communication and acceptance of environmental issues within the community.

21. **Connect people to nature with wildlife tourism**
Well managed marine wildlife species provide many highly valued experiences that assist people to value the marine environment. Responsible operators play an important role and support local and regional economies.

22. **Work with recreational fishers**
Recreational fishing is an enjoyable outdoor pastime for many Australians. There is a strong common goal between recreational fishers and other marine conservation interests for healthy wild fish populations in our seas for all times and agreement that respect and dialogue will produce more positive outcomes.

23. **Communicate marine benefits**
It is essential that we continue to communicate the positive benefits that Australia’s marine environment provides across cultural and language barriers and use language that is easy to understand.
THE HISTORY

The story of marine conservation in Australia is the history of our responses to the human pressures on marine species, assemblages, habitats, ecosystems and their functions – mainly, resource exploitation and management in post-European settlement period (the last 200 years). Matters as diverse as sand/reef mining, water pollution, wetland reclamation, trawling, whaling, sewage disposal, oil and gas exploration, dredge spoils, and port/harbour development all have a significant place in this history.

This can be summarised into five recognisable periods/epochs (after Kelleher and Kenchington, 1991; Grech et al., forthcoming):

1. **1788-1930 unregulated expansion, resource depletion, limited responses**
2. **1930-1970 recognition of need for more significant intervention/responses: first marine parks, first fisheries control/management, first coastal impact reduction measures**
3. **1970-1995 first responses: broad commencement of responses such as the United Nations Convention on the Law of the Sea (UNCLOS), Resources Assessment Commission (RAC), Offshore Constitutional Settlement arrangements (OCS), Environment Protection and Biodiversity Conservation Act 1999 (EPBC), Australian National Parks and Wildlife Service (ANPWS); non-government organisations (NGO) addressing marine conservation (such as the Australian Committee for IUCN (ACIUCN), Queensland Littoral Society (QLS), New South Wales Littoral Society (NSWLS), Australian Littoral Society (ALS), Australian Marine Conservation Society (AMCS); and marine parks**
4. **1995-2013 major responses: accompanying coastal developments in the tropics and heightened recognition of decay in the temperate areas: first substantive national policy initiatives, such as the State of the Marine Environment Report for Australia (SOMER), Oceans Policy, state/commonwealth marine parks, EPBC implementation, fishery reforms, Australian Fisheries Management Authority (AFMA) harvest and bycatch policies**
5. **2013 – review and consolidation phase: review and analysis of the achievements of marine parks, rebuilding of fisheries, better planning/management of coastal developments in the context of climate changes, establishment of more integrated national response to consolidate gains, and new policy to improve the effectiveness of existing practices.**

From this history, and the evidence of recent overviews of the condition and trends of the marine environment (Zann, 1996; DSEWPAC, 2011) and our awareness of new pressures, we can confidently assert that the marine ecosystems within Australia’s jurisdiction are in progressive decline. However, on the other side of the ledger, there are many achievements that are evident and have no doubt tempered this decline. Recognising these, what has and hasn’t worked with their strengths and weaknesses, will assist in better planning for the future.

ACHIEVEMENTS

The peaks of these achievements across the past 50 years can be summarised as:

1. **Building of a constituency: the issues of marine conservation are now widespread and well acknowledged in the Australian community.**
2. **National regulation: the EPBC Act has been an effective piece of legislation for directly addressing many (but not all) marine issues, and it is now clear that better national regulatory systems are needed.**
3. **State regulation: the various sets of state environment impact/management legislation (and ancillary national policies such as water quality criteria/guidelines) have greatly reduced coastal impacts, such as pollution of coastal waterways and reclamation of wetlands, and provided for significant restoration of habitat. However the growth of coastal development in the tropics and sub-tropics appears to be a rapidly emerging threat.**
4. **Protected areas: the protected area network has expanded, although there are important issues surrounding the effectiveness of such networks, such as residuality.**
5. **Fishing pressure has been reduced: while this is confounded with a major reduction in stock sizes created by fishing itself, there have also been major parallel advances in reducing bycatch, harvest reference points, better reporting systems, etc but much remains to be improved before the fished populations can be considered to be ecologically healthy.**
6. **Environment reporting systems have emerged: while as yet embryonic, performance reporting systems are slowly improving, in respect of marine conservation issues (species, assemblages, functions, habitats, ecosystems), and to inform assessments of the effectiveness of past investments.**
CHALLENGES

In the current era of review and consolidation, there are five central challenges in the strategic fundamentals that we should directly address and attempt to overcome. None are new, so there is a track record to build from (hopefully more successfully than our earlier attempts). Addressing these matters here is to promote discussion about efficient ways to respond to existing and new pressures (at the ocean basin, national, and local scales), to deal with incremental, cumulative and cross-scale impacts, and to simultaneously achieve strong conservation outcomes while maintaining wealth-generation for a growing human population (getting the trade-offs right).

Challenge 1: Effective and efficient governance system

The development of an Oceans Policy was an attempt to develop and promulgate the basis for a set of policies and practices for integrated ecosystem-based management. The original vision was one of integration (not only coordination), of national scope (not just Commonwealth), and of standards for process delivery and biodiversity outcomes that would provide for conservation as well as wealth generation. Our challenge now is, building on the earlier efforts (including others such as the Resource Assessment Commission), to reinvigorate those aspirations and develop a hierarchical (with subsidiarity) system of policies and practices that give effect to the original vision of integration that was to be embedded into a national Oceans Policy.

Challenge 2: Marine ecology knowledge base

The existing knowledge base is heavily biased towards the needs of the resource exploitation sectors. There is a critical need to fund an ongoing program of fundamental ecological research that explicitly targets improvement of the knowledge base for the purposes of assessing condition and trends (particularly in biodiversity structure and function). The priorities for such pure marine ecology knowledge development should be set through a prioritisation process independent from government or industry requirements and advocacy (which are already funded through other mechanisms).

Challenge 3: Fishing

The conflicts between commercial/recreational fishing and marine conservation are obvious, but are mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. There is no inherent reason why catch in many mostly inaccurately portrayed because of institutional issues. However, in addition to management that is based on ecosystem measures, there also has to be a single and common approach to design and implementation that achieves both fishing and conservation outcomes for fished species, which currently seems unachievable (for institutional reasons). Reducing or eliminating this conflict is the single most critical need for simultaneously achieving better marine conservation outcomes, a better network of MPAs and improved fishing.

Challenge 4: MPAs

The current network of marine protected areas (MPAs) (State and Commonwealth) is substantially ‘residual’, leaving open the question of the actual type and extent of their contribution to cross-scale biodiversity outcomes. The main challenge now is to review the type and extent of MPA contributions to biodiversity outcome objectives, reconcile what they do deliver versus what they could/should deliver, and rationalise boundaries and management zoning to improve their effectiveness.

Challenge 5: Audit

A central driving force for environmental improvements is the rigor of transparent independent auditing and reporting, made contestable by full disclosure in the public domain. The provision of independent audit findings, generated by a decision model with low bias, is the engine room for incremental improvement of the condition of Australia’s marine biodiversity. Our current challenge is to ensure that there are cross-scale audit and reporting systems in place, that continue to be improved and that will provide transparent and low-bias assessments of the condition of marine biodiversity using well-founded ecological metrics.

REFERENCES


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Ocean Conservation and Management
Under the United Nations Convention on the Law of the Sea, Australia has rights and responsibilities over 16 million square kilometres of ocean – more than twice the area of the Australian continent.

Within this area live thousands of marine species, some of which are unique to Australia and all of which contribute to making Australia the most biodiversity rich developed country.

Environment Protection and Biodiversity Conservation Act 1999

The Australian Government uses the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) to protect and manage threatened, migratory and marine species. Threatened species are listed under the EPBC Act. Threatened marine species conservation and management involves:

- Determining the threats faced by marine species
- Preventing, mitigating and/or managing those threats
- Supporting the recovery of the species until they can be removed from the EPBC Act list of threatened species.

Our long-term strategy for the recovery of threatened marine species includes scientific research, community education and awareness, partnership building and working with relevant industries and other stakeholders.

WHALES, DOLPHINS AND PORPOISES

How is Australia protecting whales?

Whales, dolphins and porpoises are warm-blooded, air-breathing marine mammals which give birth to live young. ‘Cetacean’ is the scientific name (of the Order Cetacea) which refers to whales, dolphins and porpoises.

Australian waters are home to a large number of unique and magnificent marine mammals, including 45 species of whales, dolphins and porpoises. Some of these species are permanent residents in Australian waters, whilst others are occasional visitors, migrating from their summer feeding grounds in the Antarctic to the warmer waters of the Australian coast during the winter.

Australians have long recognised the importance of whales, dolphins and porpoises to our unique marine ecosystems, and believe that it is essential to ensure the survival of these mammals long into the future. The Australian Government has made whale, dolphin and porpoise conservation a priority and is a world leader in the protection and conservation of these species both in Australia and on an international scale.

Whale and Dolphin Protection Plan

The Whale and Dolphin Protection Plan is made up of three components, the National Dolphin Conservation Plan, the National Whale Trail and the National Strandings and Entanglement Action Plan.

DUGONGS

Dugongs occur in tropical and subtropical waters around the world. Dugongs are large grey mammals which spend their entire lives in the sea. Fully grown, they may be three metres long and weigh 400 kilograms. Dugongs swim by moving their broad whale-like tail in an up and down motion, and by use of their two flippers. They come to the surface to breathe through nostrils near the top of their snouts. Dugongs’ only hairs are the bristles near the mouth.

Dugongs are subject to a range of human threats throughout their global distribution, including entanglement in shark nets for bather protection, entanglement in fishing nets (e.g. mesh and gill nets), entanglement in marine debris (see the Threat Abatement Plan for the impacts of marine debris on vertebrate marine life), loss and degradation of important habitat such as seagrass meadows, unsustainable traditional use and collisions with boats (also known as boat strikes).

Legislative protection

Environment Protection and Biodiversity Conservation Act 1999

In Australia, dugongs are protected under the Australian Government’s Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), which lists them as marine and migratory species, and various State and Northern Territory legislation.

Dugongs are an integral part of the traditional culture of many coastal indigenous peoples throughout the world. Dugongs may be legally hunted by Aboriginal and Torres Strait Islander people under Section 211 of the Native Title Act 1993 for personal, domestic or non-commercial communal needs.

International conventions

Internationally, dugong are listed on Appendix I of the Convention on International Trade in Endangered Species of Wilde Fauna and Flora (CITES), and on Appendix II of the Convention on Migratory Species (the CMS). Australia is a signatory to both these conventions. More recently, an International Memorandum of Understanding (MoU) on the Conservation and Management of Dugongs and their Habitats throughout their Range was developed under the CMS. Australia is a signatory to the MoU which entered into force on 31 October 2007. The MoU is designed to facilitate national level and transboundary actions that will lead to the conservation of dugong populations and their habitats.

Dugongs

Within this area live thousands of marine species, some of which are unique to Australia and all of which contribute to making Australia the most biodiversity rich developed country.
Habitat and biology

**Habitat**
Dugongs undertake long-distance movements, which means Australia shares populations with other neighbouring countries. In Australia, dugongs occur in the shallow coastal waters of northern Australia from the Queensland/New South Wales border in the east to Shark Bay on the Western Australian coast. They are also found in other parts of the Indian and Pacific Oceans in warm shallow seas in areas where seagrass is found.

**Shelter**
Dugongs are usually found in shallow waters protected from large waves and storms. They may also swim in deeper water, further offshore, in areas where the continental shelf is wide, shallow and protected.

**Breeding**
Female dugongs give birth underwater to a single calf at three to seven year intervals. The calf stays with its mother, drinking milk from her teats and following close by until one or two years of age. Dugongs reach adult size between 4 and 17 years of age. These low breeding rates, long-term care of their calves, long time between calves, as well as their dependence on seagrass, make dugongs vulnerable to human threats.

**Diet**
Dugongs are sometimes called ‘sea cows’ because they graze on seagrasses. These marine plants look like grass growing on a sandy sea floor in shallow, warm water. Dugongs need to eat large amounts of seagrass.

**Defence**
Dugongs are slow-moving and have little protection against predators. Being large animals, however, only large sharks, saltwater crocodiles and killer whales are a danger to them. Young dugongs hide behind their mothers when in danger.

Indigenous culture and dugongs
Dugongs have important cultural and social values for Aboriginal and Torres Strait Islander people living in coastal areas of northern Australia. Hunting these species is important for maintaining family relations (kinship) and social structure, has important ceremonial and community purposes and also provides valuable protein in regions where fresh food is expensive and difficult to obtain.

Indigenous communities are working collaboratively with government agencies and scientists to develop and implement community-based management for sustainable hunting of dugongs. This work is primary supported through the Australian Government’s Caring for Our Country and Working on Country programs.

Under the *Native Title Act 1993*, Traditional Owners have the right to take marine resources, including hunting of dugongs for personal, domestic or non-commercial communal needs and in exercise and enjoyment of their native title rights and interests.

MARINE AND ESTUARINE FISHES

Conservation Overview and Action Plan for Australian Threatened and Potentially Threatened Marine and Estuarine Fishes

This Conservation Overview and Action Plan has been prepared for the Natural Heritage Division of Environment Australia by scientists from the NSW Fisheries Research Institute and the Australian Museum. It reviews the biological characteristics and conservation status of 114 species of threatened and potentially threatened Australian marine and estuarine fishes, and outlines some of the constraints encountered in carrying out the task.

Work on the project commenced in January 1999. The majority of the work was completed by September 2000, but editing continued until September 2001. A specialist workshop, held in September 1999, brought
together approximately 40 experts from government and non-government organisations, private industry and academic institutions in Australia, New Zealand and the USA. The main aims of the workshop were to discuss the proposed Australian conservation status of as many of the identified species as possible, and to attempt to reach consensus on a conservation status for each species.

Information from the workshop discussions has been incorporated into the species synopses where appropriate. Comments and advice were also sought from a wide range of individuals and organisations with expertise in fishes throughout the duration of the project.

**MIGRATORY BIRDS**

Australia provides critical habitat for millions of migratory birds each year. To ensure their conservation the Australian Government has fostered international cooperation through a range of important agreements, including bilateral migratory bird agreements with Japan (JAMBA), China (CAMBA) and the Republic of Korea (ROKAMBA), the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention), the Ramsar Convention on Wetlands, the Agreement on the Conservation of Albatrosses and Petrels (ACAP), and through the East Asian-Australasian Flyway Partnership.

A range of important activities are also undertaken within Australia to conserve migratory bird populations and their habitats. These activities have largely focused on waterbirds, mostly shorebirds and seabirds; because their tendency to aggregate in flocks in coastal areas makes them particularly vulnerable to disturbance and predation.

**Threats**

Wetland habitat loss and degradation is a significant threat to migratory waterbirds, and the conservation of important sites both within Australia and along their migration routes is essential to their survival. Many pressures are contributing to this degradation, of which population growth and associated coastal development are of particular concern.

**International cooperation**

**Bilateral migratory bird agreements**

For over 30 years, Australia has played an important role in international cooperation to conserve migratory birds in the East Asian-Australasian Flyway Partnership (the Flyway), entering into bilateral migratory bird agreements with Japan in 1974, China in 1986 and most recently the Republic of Korea in 2007. Each of these agreements provide for the protection and conservation of migratory birds and their important habitats, protection from from take or trade except under limited circumstances, the exchange of information, and building cooperative relationships.

Birds listed on the annexes to these three agreements, together with those on Appendices I or II of the Bonn Convention, must also be placed on the migratory species list under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

JAMBA, CAMBA and ROKAMBA provide an important mechanism for pursuing conservation outcomes for migratory birds, including migratory waterbirds.

**Other international agreements**

Australia has further international commitments to protect migratory birds under the Ramsar Convention and the Bonn Convention.

- *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention)
- Ramsar Convention on Wetlands
- *Agreement on the Conservation of Albatrosses and Petrels* (ACAP)

**East Asian-Australasian Flyway Partnership**

Australia encourages multilateral cooperation for migratory waterbird conservation.

The Partnership was launched in 2006. Its main purpose is to focus international efforts on conserving migratory waterbirds and their habitats in the Flyway.

**Conservation activities in Australia**

In Australia the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides for protection of migratory species as a matter of national environmental significance. The EPBC Act prohibits a person taking an action that has, will have, or is likely to have a significant impact on a listed migratory species unless the Minister for the Environment has given approval.

The EPBC Act also provides for the development of plans to conserve listed migratory species in the Wildlife Conservation Plan for Migratory Shorebirds.

**Bird and bat banding**

The Australian Government under the auspices of the Australian Bird and Bat Banding Scheme (ABBBS) manages the collection and collation of mark/recapture information on threatened and migratory bird and bat species.

**MARINE INVERTEBRATES**

Marine invertebrates comprise many groups of different organisms and occur from the sea surface to the seafloor and into the substrate. They represent the vast majority of marine biodiversity and include, for example, sponges, corals, bluebottles, worms, shells, sea urchins, starfish, crustaceans, sea cucumbers and nudibranchs. Their size ranges from tiny microscopic organisms to several metres in length, and they have an amazing diversity of form.

Some invertebrates are commercially important, e.g. oysters, prawns, scallops and pearl oysters, whilst others, such as corals, are one of the major attractions for tourists. Even though all marine ecosystems depend on
invertebrates for their continued functioning, large gaps remain in our knowledge relating to their taxonomy, biology and ecological requirements.

Conservation
- Overview of the conservation of Australian marine invertebrates, Australian Museum, July 2002.

MARINE TURTLES IN AUSTRALIA

Marine turtles have lived in the oceans for over 100 million years. They are an integral part of the traditional culture of many coastal indigenous peoples throughout the world. Marine turtles migrate long distances between their feeding grounds and nesting sites. They have a large shell called a carapace, four strong, paddle-like flippers and like all reptiles, lungs for breathing air. The characteristic beak-like mouth is used to shear or crush food.

All marine turtle species are experiencing serious threats to their survival. The main threats are pollution and changes to important turtle habitats, especially coral reefs, seagrass beds, mangrove forests and nesting beaches. Other threats include accidental drowning in fishing gear, over-harvesting of turtles and eggs, and predation of eggs and hatchlings by foxes, feral pigs, dogs and goannas.

Species found in Australia

There are only a few large nesting populations of the green, hawksbill and loggerhead turtles left in the world. Australia has some of the largest marine turtle nesting areas in the Indo-Pacific region and has the only nesting populations of the flatback turtle.

Of the seven species of marine turtles in the world, six occur in Australian waters:
- Flatback turtle (Natator depressus)
- Green turtle (Chelonia mydas)
- Hawksbill turtle (Eretmochelys imbricata)
- Leatherback turtle (Dermochelys coriacea)
- Loggerhead turtle (Caretta caretta)
- Olive Ridley turtle (Lepidochelys olivacea).

Legislative protection

Environment Protection and Biodiversity Conservation Act 1999

In Australia, all six species of marine turtles that occur in our waters are protected under the Australian Government’s Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and various State and Northern Territory legislation.

The leatherback, loggerhead and olive ridley turtle are each listed as endangered under the EPBC Act which means that these species may become extinct if the threats to their survival continue.

The green, hawksbill and flatback turtle are each listed as vulnerable which means that they may become endangered if threats continue.

Turtles may be legally hunted by Aboriginal and Torres Strait Islander people under Section 211 of the Native Title Act 1993 for personal, domestic or non-commercial communal needs.

Recovery Plan for Marine Turtles in Australia

The National Recovery Plan for Marine Turtles in Australia was adopted in July 2003. The Recovery Plan provides for research and management actions necessary to stop the decline and support the recovery of marine turtles so that their chances of long-term survival in nature are maximised.

International agreements

Marine turtles are recognised internationally as species of conservation concern. The six species found in Australia are listed in the 2000 IUCN (World Conservation Union) Red List of Threatened Animals.

All marine turtle species occurring in Australian waters are listed on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). In addition, all marine turtles occurring in the Indo-Pacific region are a priority for conservation under the Convention on the Conservation of Migratory Species of Wild Animals (CMS, also known as the Bonn Convention). The flatback turtle is listed on Appendix II of the CMS and the other species are listed on both Appendices I and II. Australia is also a signatory to the CMS Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA MoU). The MoU is designed to facilitate national level and transboundary actions that will lead to the conservation of turtle populations and their habitats.

Indigenous culture and marine turtles

Marine turtles have important cultural and social values for Aboriginal and Torres Strait Islander people living in coastal areas of northern Australia. Hunting these species is important for maintaining family relations (kinship) and social structure, has important ceremonial and community purposes and also provides valuable protein in regions where fresh food is expensive and difficult to obtain.

Indigenous communities are working collaboratively with government agencies and scientists to develop and implement community-based management for sustainable hunting of marine turtles. This work is primarily supported through the Australian Government’s Caring for Our Country and Working on Country programs.

Under the Native Title Act 1993, Traditional Owners have the right to take marine resources, including hunting of marine turtles for personal, domestic or non-commercial communal needs and in exercise and enjoyment of their native title rights and interests.

SEALS AND SEA LIONS

Ten species of seals and sea lions occur in Australian waters. Of these, three are commonly found in southern
Australian waters and the remainder occur in Australia’s Antarctic Territory.

Many seal and sea lion populations declined significantly in the 18th and 19th Centuries due to indiscriminate harvesting and, although most populations have recovered, some remain at low levels. Current threats to seals and sea lions in Australian waters include interactions with commercial fishing operations and exposure to harmful marine debris.

Three species of seal and sea lion are currently listed as threatened by the Australian Government.

**Government action**

*Environment Protection and Biodiversity Conservation Act 1999*

Under the EPBC Act all seals and sea lions occurring within Australian waters are listed as marine species (EPBC Act 1999; Section 248). It is an offence to kill, injure, take, trade, keep, or move any member of a listed marine species on Australian Government land or in Commonwealth waters without a permit.

Where these animals occur in state jurisdictions relevant state legislation applies.

**Threatened status**

Three species of seal are also listed under the EPBC Act as Vulnerable (section 178), which provides additional protection.

These species are:

- The sub-Antarctic fur seal (*Arctocephalus tropicalis*)
- The southern elephant seal (*Mirounga leonina*) and
- The Australian sea lion (*Neophoca cinerea*).

Besides a range of protective measures also afforded to marine species (see above), the EPBC Act requires that any action that has, will have or is likely to have a significant impact on a threatened species must be referred to the Department of the Environment for assessment before the action goes ahead.

**Recovery plan**

Under the threatened species legislation, listed threatened species can have a recovery plan made in order to guide actions to help the species recover.

Of the three listed seals in Australian waters, the sub-Antarctic fur seal and southern elephant seal have recovery plans.  

- **Sub-Antarctic fur seal and southern elephant seal recovery plan – 2004**
- **Biology, threats and conservation status of the sub-Antarctic fur seal and Southern elephant seal in Australian waters – 2004**.

The Australian sea lion does not yet have a recovery plan. However, a recovery plan for this species has been drafted and version made available for public comment. Comments are currently being incorporated into the plan and the final draft is being prepared.

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**Seals found in Australian waters**

Seals, sea lions and walruses are marine mammals and belong to the order pinnipedia. There are 33 species of pinnipeds, divided into three families. The family otariidae contains 14 species, including the fur seals and sea lions. Otariid species are typically more upright when on land, and can move with reasonable agility. The family phocidae is made up of the ‘true seals’ and contains species such as the leopard seal and the southern elephant seal. Unable to ‘walk’ on land like the otariids, the phocidae move in a lunging caterpillar-like motion. The third family, odobenidae, contains only the walrus.

**Breeding sites**

The Australian sea lion, New Zealand fur seal and Australian fur seal breed on the southern Australian coastline and its near shore islands. The remaining species breed on Antarctic pack-ice or sub-Antarctic Australian territories, and occasionally haul out on southern Australian beaches or reefs.

Seals breed on land or on ice, with peak mating and pupping taking place in the summer months for most species. However, the Australian sea lion is something of an exception as it has a 18 month asynchronous breeding cycle, meaning that it can pup in any month of the year and that month changes over time. Seal pups usually become independent from their mothers at ages varying from 10 weeks to about a year and a half for Australian sea lions.

**Diet**

Diet differs between species but usually includes squid and fish and, for Antarctic species, krill. Some
seals, like the leopard seal, are known to eat seabirds such as penguins, and even other seals.

**Threatening processes**

Seals were hunted in Australia in the last century for their meat, oil and fur. By 1820, seal populations had been reduced to remnants. Some breeding colonies, such as the Australian sea lion colonies in Bass Strait, were completely destroyed. Today, all seals are protected in Australian waters and populations of some species are recovering from this over-harvesting.

However, some species of seal remain threatened by human activities, particularly from interactions with commercial fishing operations and entanglement with fishing gear and other debris. Other potential threats include a reduction in food supply; human disturbance; oil spills and chemical contaminants and disease. Seismic survey activity and climate change may also impact on seals, although little is known about the effects of these at this time.

**Where to see seals**

There are many places along the coastline of southern Australia where seals can be seen in the wild. Visitors must take a great deal of care not to disturb seals as this may interfere with their efforts to feed their young. Some seals can also move quickly overland and may bite if harassed. Some of the best places where organised viewing of seals takes place include Seal Bay on Kangaroo Island, Montague Island on the New South Wales South Coast, Seal Rocks in Victoria, various places in Tasmania and on accessible islands around Perth and Albany in Western Australia.

**Sharks in Australian Waters**

Worldwide, there are about 400 species of sharks. Of these, around 180 species occur in Australian waters, of which about 70 are thought to be endemic. Sharks occur in all habitats around the Australian coast line, however most are found on the continental slope or shelf, primarily on the bottom. However, many sharks are also found in coastal waters and a small number are even found in freshwater systems, such as rivers and estuaries.

**Legislative protection**

*Environment Protection and Biodiversity Conservation Act 1999*

In Australia, most sharks can be legally caught by commercial and recreational fishers. However, due to declines in numbers, a handful of species are now listed as ‘threatened’ under the *Environmental Protection and Biodiversity Conservation Act 1999*.

Under the *EPBC Act*, it is an offence to kill, injure, take, trade, keep, or move any member of a listed threatened species on Australian Government land or in Commonwealth waters without a permit. The *EPBC Act* also requires that any action that has, will have or is likely to have a significant impact on a threatened species must be referred to the Department of the Environment for assessment before the action goes ahead.

The listed shark species are:

- **Critically endangered species**
  - Grey Nurse Shark (*Carcharias taurus*) – East coast population
  - Speartooth Shark (*Glyphis glyphis*)

- **Endangered species**
  - Northern River Shark (*Glyphis garricki*)

- **Vulnerable**
  - Grey Nurse Shark (*Carcharias taurus*) – West coast population
  - Whale Shark (*Rhincodon typus*)
  - White Shark (*Carcharodon carcharias*)
  - Dwarf Sawfish, Queensland Sawfish (*Pristis clavata*)
  - Freshwater Sawfish (*Pristis microdon*)
  - Green Sawfish, Dindagubba, Narrowsnout Sawfish (*Pristis zijsron*)

**Legislative changes for recreational fishing of three shark species**

On 15 July 2010, an amendment was made to the *EPBC Act*. This change means recreational fishing of longfin and shortfin mako and porbeagle sharks can now occur in Commonwealth waters.

**Memorandum of Understanding on the Conservation of Migratory Sharks**

The Memorandum of Understanding on the Conservation of Migratory Sharks was developed under the auspices of the Convention on the Conservation of Migratory Species of Wild Animals (CMS). Australia became the 14th country to sign the Sharks MoU, signing on 4 February 2011.

Six out of these seven species covered by the Sharks MoU occur in Australian waters – the white shark, whale shark, basking shark, porbeagle, shortfin mako and longfin mako. Action under the Sharks MoU aims to improve understanding of migratory shark populations, key pressures and key habitats, and current and future actions to conserve these species.

**Recovery plans**

Under the threatened species legislation, listed threatened species can have a recovery plan made in order to guide actions to help the species recover.

Currently, recovery plans exist for the white shark, grey nurse shark and whale shark.

In addition to the existing plans, a multi-species recovery plan is currently being developed for the three species of sawfish and two *Glyphis* species.

**Habitat and biology**

Sharks are primarily oceanic and are widespread in tropical to temperate zones. Sharks vary greatly in size. The largest species, also the largest of all fishes, is
the plankton eating giant the whale shark (*Rhinododon typus*). The largest measured specimen was 12.65 m long and weighed 21.5 tonnes, but the whale shark probably attains 18 metres. Some of the deepwater shark species attain only about 25 cm.

Sharks (elasmobranchs) comprise about 1% of all living fishes, and share nearly all the major features of their finned relatives. Like all fishes sharks use gills to extract oxygen from the water in which they live. Sharks have five to seven gill openings along each side of the head, through which they breathe. Primarily marine fishes, a few have adapted to fresh water, such as the Northern River shark and speartooth shark (*Glyphis garricki* and *Glyphis glyphis*) found in northern Australia.

### Feeding

Most sharks are predators. Many sharks species become active after dusk and hunt during the night. The majority of sharks feed on other fishes. Large sharks, such as the white shark (*Carcharodon carcharias*) and tiger shark (*Galeocerdo cuvier*), prey on large marine mammals such as seals, sea lions, dolphins as well as large fishes, turtles and even seabirds.

While some sharks are probably not very selective feeders, certain sharks eat some foods more than others. For example, hammerhead sharks are known for eating stingrays; bull sharks eat other sharks; and smooth dogfish eat crabs and lobsters. Many species of sharks are adapted for bottom feeding. Bottom feeders use the upper jaw to help pick up prey items.

One example of a bottom feeder, the Port Jackson shark (*Heterodontus portusjacksoni*), has two types of teeth. Front teeth are pointed for grasping and back teeth are flat and molarlike for crushing. Another mechanism some sharks use for collecting food is filter feeding. The basking shark (*Cetorhinus maximus*) and the megamouth shark (*Megalachasma pelagios*) strain enormous quantities of plankton from the water on gill rakers. Whale sharks also filter feed, but instead of using gill rakers, they strain plankton through a spongy tissue supported by cartilaginous rods between the gill arches. Filter feeders have reduced, nonfunctional teeth.

Several species of shark are known to be dangerous to humans: the white shark, tiger shark, bull shark (*Carcharhinus leucas*) and other whaler sharks (*Carcharhinus sp.*). No shark is thought to target humans as prey, rather the majority of shark attacks can be attributed to the shark confusing us with its normal prey.

### Breeding

Mating in sharks is facilitated by the clasper organs of males, which are inserted into the female's cloaca during courtship. Fertilisation is always internal, and reproduction occurs in one of three modes:

1. Laying eggs (*oviparous*).
2. Live bearing (*viviparous*).
3. Young hatching from eggs within the mother (*ovoviviparous*).

Examples of all three reproduction methods are found in sharks living in Australian waters. The Port Jackson shark lays spiral shaped eggs that young hatch from (*oviparous*), the smooth hammerhead (*Hpyrhma zygana*) gives birth to live young (*viviparous*) and the grey nurse shark (*Carcharias taurus*) gives birth to pups after they have hatched from eggs within the uterus (*ovoviviparous*).

### Threats

Sharks are relatively long lived, slow to reach sexual maturity and have low fecundity rates. This suite of characteristics makes many species of sharks vulnerable to mortality above natural levels, either through harvesting by commercial or recreational fishing or through depletion from other sources such as habitat degradation or shark control activities.

### Shark attack

Many Australians are concerned about the risk of shark attack. However, fatal shark attacks occur relatively infrequently in Australian waters – over the last 50 years there have been 53 fatal attacks, which is approximately one fatal attack per year.

There are some easy and commonsense precautions to take that can help reduce the risk of a shark attack. This risk minimisation advice is reproduced from the *Australian Shark Attack File*.

1. Swim at beaches that are patrolled by Surf Life Savers.
2. Do not swim, dive or surf where dangerous sharks are known to congregate.
3. Always swim, dive or surf with other people.
4. Do not swim in dirty or turbid water.
5. Avoid swimming well offshore, near deep channels, at river mouths or along drop-offs to deeper water.
6. If schooling fish start to behave erratically or congregate in large numbers, leave the water.
7. Do not swim with pets and domestic animals.
8. Look carefully before jumping into the water from a boat or wharf.
9. Do not swim at dusk or at night.
10. Do not swim near people fishing or spear fishing.
11. If a shark is sighted in the area leave the water as quickly and calmly as possible.

For more information on shark attacks, risk minimisation, statistics and maps, please see:
- *Australian Shark Attack File (ASAF)*
- *International Shark Attack File (ISAF)*.

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Australia’s oceans are special and worthy of protection, extols the Australian Marine Conservation Society

Australia has an ocean territory twice the size of our land. Our oceans are the third-largest and most diverse on the planet. We have three major oceans, five climate zones, numerous underwater seascapes and a complex system of currents all of which make our oceans unique and marvelled by the world. Just off our shores we have the largest single reef – the Great Barrier Reef – and the largest seagrass meadow (Shark Bay, Western Australia) on the planet.

We also have the third-largest area of mangroves and more than half of the world’s mangrove and seagrass species. Our oceans provide refuge for a diversity of species including six of the seven known species of marine turtles, 45 of the world’s 78 whale and dolphin species, and 4,000 fish species – 20 per cent of the global total.

Our environment, economy, society and culture are deeply dependent on healthy oceans. Australians are islanders, coastal people. We love the beach, are proud of our coral reefs, and love to get out on the water, boating, swimming, surfing, diving and fishing. It’s a part of our lifestyle. Our oceans provide us with food, oxygen and a place to work and play.

However our oceans like many around the world have suffered from our use and a lack of protection. Threats such as unsustainable coastal development, overfishing, offshore petroleum extraction and production, introduced marine pests and climate change are taking their toll. Our oceans need protected areas just like on land, places that provide a safe haven where ocean wildlife can recover – without them our efforts to minimise other threats will be undermined.

Creating marine parks

Marine parks (also referred to as marine protected areas and marine reserves) are special places, underwater parks that are managed primarily for the conservation of their ecosystems, habitats and the marine life they support. While some people assume that marine parks are closed to fishing and other uses, this is not the case. In Australia, marine parks are multi-use areas and allow a wide range of activities according to different management zones. This may include activities such as recreational and charter fishing; marine tourism such as diving, snorkelling, whale watching; commercial fishing; ports development and shipping; and oil and gas exploration.

Marine parks are an important tool in the toolbox of ocean conservation to help reduce stress on marine ecosystems. As well as establishing networks of marine parks we need to ensure our ocean use is better planned, managed and ecologically sustainable, we need to reduce land-based pollution and take action to address climate change.

Sanctuary zones

Within marine parks there are often highly protected areas called sanctuary zones, green zones, marine national parks or no-take zones. These areas are similar to national parks on land – areas where wildlife and their habitats are fully protected from extractive industries such as fishing and oil and gas exploration.

Anyone can enter sanctuary zones. They are designated sanctuaries – natural places where people can boat, swim, snorkel and dive. They are far from being places that are ‘locked up’ – they are places where ocean life is protected and people can see nature at its best.

Sanctuary zones are vital for the protection of the ocean’s rich diversity of life. They allow fish to spawn and grow, provide unspoilt...
Our environment, economy, society and culture are deeply dependent on healthy oceans ... However our oceans like many around the world have suffered from our use and a lack of protection. Threats such as unsustainable coastal development, overfishing, offshore petroleum extraction and production, introduced marine pests and climate change are taking their toll.

natural sites where people can visit and offer areas for education and research. Sanctuary zones offer a way to protect our unique, vulnerable marine life such as turtles, sharks and dugongs and the habitats they depend on. They have been scientifically proven to encourage growth and recovery of stocks of fish and marine life – benefits that can then flow over into areas open to fishing.

Just two years after the sanctuary zones were expanded on the Great Barrier Reef in 2004, scientists found that Coral Trout, for example, had increased by 60% in the protected areas.

The equation is simple – if you leave fish to breed and replenish, over time there will be greater numbers of bigger fish.

We all stand to benefit from better protected oceans. Sanctuary zones act as an insurance policy, and help us to provide a lasting legacy for future generations.

Marine parks in Australia
Since 1998 Australia’s Commonwealth, state and Northern Territory governments have been working together to establish a National Representative System of Protected Areas (NRSMPA). In 2002 at the United Nations World Summit on Sustainable Development, Australia made a commitment to establish a national system of marine parks by 2012.

In Australia there are Commonwealth and State and Territory marine parks and all governments have been working to honour this commitment – some making more progress than others.

Commonwealth marine parks
Commonwealth marine parks can be created over any water in the Commonwealth Marine Area which extends from state/territory waters (3 nautical miles or 5.5km) to the outer limit of the Exclusive Economic Zone (200 nautical miles). They are created and managed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

In 2012 the Federal Government established a network of marine parks throughout Commonwealth waters. The network is vital for the protection of our sea life and the culmination of fifteen years of advocacy, science and consultation. Prior to the 2013 federal election the Coalition announced it would ‘suspend and review’ the marine reserves if elected. In December 2013, Environment Minister Greg Hunt announced that management plans for our marine reserves would be “redrafted”.

State and territory marine parks
State or territory marine parks can be created over state or territory waters which start at the coast and generally extend to 3 nautical miles (5.5 km) from shore and include bays estuaries and the waters around islands. These marine parks are created and managed under various state and territory laws.

Commonwealth marine reserves – overview

Australia has the world’s largest network of marine reserves – protecting over 3.1 million square kilometres of our marine environment, according to this fact sheet from the Department of the Environment

What are Commonwealth marine reserves?
Commonwealth marine reserves are areas established under Australian environment law to help us conserve the spectacular marine life in our oceans. They allow ecologically sustainable use of our marine resources and provide special places for people to enjoy and appreciate the fantastic diversity of our marine habitats.

Marine reserves are sometimes known as marine protected areas or marine parks.

Parks Australia manages our Commonwealth marine reserves. The reserves and the zones within them are one of the tools we use to protect our oceans. Others include working with local communities and industries to continually improve how our oceans are managed.

Commonwealth marine reserves are situated in Commonwealth waters. These waters generally extend from three nautical miles off the coast to the outer limit of Australia’s Exclusive Economic Zone (200 nautical miles). Marine reserves closer inshore are the responsibility of the states or the Northern Territory.

Why do we need marine reserves?
Marine reserves help protect and maintain our unique biodiversity including endangered or threatened species – such as whales and marine turtles and their habitats.

Marine reserves provide for sustainable use, to keep our oceans healthy.

They are important places for families to enjoy boating and diving and in some areas, recreational fishing.

While not designed as a fisheries management tool, marine reserves can enhance fisheries by ensuring places such as breeding grounds are protected.

They also provide opportunities for research and a focal point for education about marine ecosystems.

The creation and effective management of marine reserves is widely regarded, both nationally and internationally, as one of the most effective ways to maintain the long-term health and productivity of our oceans.

Our marine ecosystems
Commonwealth marine reserves represent examples of all the different marine ecosystems and habitats found in the oceans around Australia. They protect important habitats like coral reefs, undersea canyons and seamounts, and the diversity of marine life they support.

To find out more about Australia’s individual marine reserves go to our map and select the area you’re interested in (www.environment.gov.au/topics/marine/marine-reserves).

For more on the science and planning behind Commonwealth marine reserves go to our science and planning pages (www.environment.gov.au/topics/marine/marine-reserves/overview/background).


Marine reserves help protect and maintain our unique biodiversity including endangered or threatened species – such as whales and marine turtles and their habitats. Marine reserves provide for sustainable use, to keep our oceans healthy. They are important places for families to enjoy boating and diving and in some areas, recreational fishing.

How are marine reserves managed?
Once a Commonwealth marine reserve is proclaimed, Parks Australia has to develop a management plan for the reserve. Management plans can also be developed that cover more than one reserve. Management plans have a maximum life of 10 years and set out how the reserves are to be managed including what activities are allowed and which zones of the reserve they are allowed in.

In March 2013 management plans were approved for the South-west, North-west, North and Temperate East reserve networks and the Coral Sea marine reserve. These management plans have now been set aside and new plans will be developed as part of the Australian Government’s wider Commonwealth Marine Reserves Review. This means there are no changes ‘on the water’ for users of the new marine reserves until new management plans come into effect.

For the 25 reserves, including the South-east Commonwealth Marine Reserves Network, which predated last year’s extension of the Commonwealth marine reserve network, there are also no changes – users can continue to operate under their previous approval or permit. No additional administrative requirements apply.


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ACTIVITIES ALLOWED IN MARINE RESERVES – WHAT DOES IT MEAN FOR ME?

Many members of the community use the marine environment, either for recreational activities including boating, diving and fishing, or for commercial activities such as tourism, charter fishing and commercial fishing.

Activities in the South-east Commonwealth Marine Reserves are managed in accordance with the South-east Commonwealth Marine Reserves Network Management Plan 2013–2023.

For all other reserves in the South-west, North-west, North and Temperate East networks and the Coral Sea Commonwealth marine reserve transitional management arrangements are currently in place and will apply until statutory management plans come into effect.

There are no changes ‘on the water’ for users in the Commonwealth marine reserve estate.

The management arrangements for former Commonwealth marine reserves, Marine National Nature Reserves and Marine Parks will remain in place under transitional management arrangements until new management plans come into effect.

Commonwealth marine reserves include a range of different management zones within which different types of activities are or will be permitted.

The zoning restrictions in the new reserves of the South-west, North-west, North and Temperate East networks and the Coral Sea marine reserve will not apply until management plans come into effect.

A general summary for a range of activities is provided below.

**Recreational fishing**

Recreational fishing is an important leisure pursuit for millions of Australians. The Australian Government understands the importance of recreational fishing and has worked closely with the recreational fishing sector to largely avoid locating highly protected Marine National Park (IUCN II) zones in areas important to recreational fishers.

Recreational fishing will be allowed in all zones in the marine reserves except in highly protected Marine National Park (IUCN II) zones which are coloured green on the available regional maps. Recreational fishing is permitted in Multiple Use (IUCN VI) zones, Special Purpose (IUCN VI) zones, Habitat Protection (IUCN IV) zones and Recreational Use (IUCN IV) zones. These zones are used extensively over the continental shelf and shelf edge where most recreational fishing occurs.

The marine reserves are in Commonwealth waters, which start 3 nautical miles (5.5km) from shore. They do not include beaches, bays, estuaries or coastal waters.

Two thirds of the reserves are zoned to allow recreational fishing. A large majority of the highly protected areas are remote from access points such as boat ramps or far offshore. Under the Commonwealth Marine Reserves Network, some 96 per cent of all waters within 100km of the shore (excluding the Great Barrier Reef Marine Park) are open to recreational fishing.

A large majority of the highly protected areas are remote from access points such as boat ramps or far offshore. Under the Commonwealth Marine Reserves Network, some 96 per cent of all waters within 100km of the shore (excluding the Great Barrier Reef Marine Park) are open to recreational fishing.

**Commercial fishing**

Commercial fishing will be allowed in all zones in the marine reserves of the South-west, North-west, North and Temperate East networks and the Coral Sea marine reserves, except in Marine National Park (IUCN II) zones. However, there will be some restrictions on the types of fishing gear permitted in the different zones. These restrictions vary between networks. Information about the restrictions and types of fishing gear that will be excluded is provided in the relevant overview of the zoning scheme for each regional reserves network.

The management arrangements in the reserves that existed before November 2012, have been maintained through transitional arrangements. This includes restrictions on commercial fishing.

Class approvals will apply for commercial fishing activities permitted in marine reserves. In most cases commercial fishers will not be required to seek individual approvals to operate in Commonwealth marine reserves in addition to those approvals required for the relevant state, territory or Commonwealth managed fisheries.

The operations of some commercial fishing businesses will be affected by the new reserves. The Government will provide assistance to help commercial fishers adjust to changes brought about by displacement of commercial fishing from the new reserves.

**Marine tourism**

Tourism activities that do not involve the extraction or harvesting of marine resources (such as diving, snorkelling, whale watching and photography), will be permitted within all zones in the marine reserves.
Australia’s network of Commonwealth marine reserves

**Zoning**
- Sanctuary Zone (IUCN Ia)
- Marine National Park Zone (IUCN II)
- Recreational Use Zones (IUCN II and IV)
- Habitat Protection and Conservation Park Zones (IUCN IV)
- Habitat Protection Zone (Coral Sea) (IUCN IV)
- Special Purpose Zones (IUCN VI)
- Special Purpose Zone (Oil and Gas Exclusion) (IUCN VI)
- Multiple Use Zone (IUCN VI)
- General Use Zone (IUCN VI)

**IMPORTANT INFORMATION FOR MARINE USERS**
Transitional arrangements apply to the South-west, North-west, North and Temperate East Networks and the Coral Sea reserve. These arrangements involve NO CHANGES ON THE WATER for marine users. Note, there are no changes to management arrangements in the marine reserves that existed prior to the establishment of the new reserves, that is, the same restrictions on activities will continue to apply even where those reserves have been incorporated into new reserves. More information is available at www.environment.gov.au/marine/reserves

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networks. The management of these activities is likely to be through the use of permits or activity class approvals.

Activities that impact on or involve the extraction of marine biodiversity will not be allowed in Marine National Park (IUCN II) zones. Some restrictions may apply in some Habitat Protection (IUCN IV) zones.

**Charter boat operations (fishing)**
Charter boat operations that involve fishing – e.g. charter fishing tours – will be permitted in all zones except in Marine National Park (IUCN II) zones.

**Mining and oil and gas activities**
Mining activities – including petroleum exploration and development – will not be allowed in Marine National Park (IUCN II) zones, anywhere in the Coral Sea Commonwealth marine reserve or in the Special Purpose (Oil and Gas Exclusion) zone in the South-west Marine Reserves Network. Restrictions on mining activities will also apply in Habitat Protection (IUCN IV) zones. Mining operations will be allowed within Multiple Use (IUCN VI) zones and some Special Purpose (IUCN VI) zones in the marine reserves network.

A permit or approval by the Director of National Parks will be required for mining activities, some of which will be provided in the form of class approvals, including in conjunction with the assessment and approval provisions of the **EPBC Act**.

**Port development and shipping**
The transit of vessels though all areas of the marine reserves network, including through Marine National Park (IUCN II) zones, will be permitted. While ballast water exchange is managed under national arrangements, restrictions may apply in sensitive areas.

Activities associated with port operations and development, including maintenance dredging and the dumping of spoil, will be permitted in Multiple Use (IUCN VI) zones, but may be subject to assessment and approval under the **Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)**. These activities will not be permitted in Marine National Park (IUCN II) zones and Habitat Protection (IUCN IV) zones.

**Zoning for marine reserves**

**Zoning for newly proclaimed marine reserves**
Please note that these zoning schemes are not in effect.

- **South-west** – Overview of Zoning Scheme for the South-west Commonwealth Marine Reserves Network
- **North-west** – Overview of Zoning Scheme for the North-west Commonwealth Marine Reserves Network
- **North** – Overview of Zoning Scheme for the North Commonwealth Marine Reserves Network
- **Temperate East** – Overview of Zoning Scheme for the Temperate East Commonwealth Marine Reserves Network
- **Coral Sea** – Overview of Zoning Scheme for the Coral Sea Commonwealth Marine Reserve.

**Zoning for South-east Commonwealth Marine Reserves**

- **Activities and zoning for the South-east Commonwealth Marine Reserves Network**

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Why are Australia’s marine parks being reviewed so soon after they were signed off?

Marine parks are valuable tools to help safeguard species such as seagrasses, write Elizabeth Sinclair, Diana Walker and Gary Kendrick

The current government review of Australia’s proposed network of marine parks, called the Commonwealth Marine Reserves (CMRs), seems rather premature. After all, the management plans were approved only in March 2013 and as yet only the south-east region is being actively managed.

Back in June 2012, when then federal environment minister, Tony Burke, unveiled the plans for the world’s largest network of marine parks, it was the culmination of more than a decade’s work on both sides of politics and a wide spectrum of sectors.

The work began in 1999, when then Liberal prime minister, John Howard, established the National Oceans Office with the aim of putting protections in place around Australia’s entire continental shelf. More than 80,000 submissions were received during the consultation process, ultimately resulting in the creation of reserves covering almost 3.2 million square km of Commonwealth waters.

These reserves were set up mainly outside existing commercial fishing zones, mining regions and away from population centres, and designed to have minimal impact of human maritime activities. The implementation of the CMRs has been suspended while the current review is under way.

Not just fish

The Commonwealth reserves (as well as similar reserves in state-administered waters) were part of the wider National Representative System of Marine Protected Areas, which aimed to:

- establish and manage a comprehensive, adequate and representative system of marine reserves (general and special-purpose zones and marine parks) to contribute to the long-term ecological viability of marine and estuarine systems, to maintain ecological processes and systems, and to protect Australia’s biological diversity at all levels.

So, clearly, marine reserves are not just about fish but also about maintaining resilience in marine ecosystems and protecting valuable biodiversity. Their wider benefits have been demonstrated all over the world – for instance, in providing sanctuary zones for migratory species such as whales.

Marine reserves also help sedentary species such as seagrasses,
kelp and corals to grow, reproduce and disperse their highly mobile offspring across a wider region. This helps to restock depleted areas or even establish new populations. Careful integration of marine parks with terrestrial National Parks can also help wildlife such as nesting turtles.

Marine reserves are also extremely important in a changing environment. Increased sea surface temperatures, ocean acidification, increasing severity of storms and surges, and changing circulation patterns will all have significant impacts on marine and coastal ecosystems. This is on top of pre-existing stresses such as over-fishing, coastal developments and pollutants.

In 2011, for example, a marine heatwave impacted 1,500km of Western Australia’s coastline. It resulted in severe damage to many species and habitats, particularly macroalgae and seagrasses. This, in turn, led to higher death rates in the commercially important western rock lobster and abalone fisheries.

Events like this are set to increase in frequency and intensity over the coming century. Add to this the fact that 85% of Australia’s population lives within 50km of the coast and it is clear that management of marine ecosystems must account for climate-related impacts as an economic and social priority.

Here are some more reasons why marine reserves are valuable:

- The Great Barrier Reef Marine Park now generates an annual revenue of A$5.5 billion, 36 times more than the income from the commercial fishing industry.
- No-take marine reserves produce far greater biodiversity outcomes than partially protected areas where fishing continues, with benefits increasing exponentially in larger, more isolated reserves such as those proposed for Commonwealth waters.
- Long-term studies have shown that no-take reserves provide more resilience against unexpected events such as the 2011 Queensland floods, which dumped huge amounts of runoff into the ocean.
- The total number of marine species known to science is about 226,000, versus an estimated one million currently unknown. Many of these discoveries will come from largely unexplored areas such as deep canyons or under ice sheets, many of them in existing or proposed marine reserves. A recent exploration trip surveying the 4,000m deep Perth Canyon is expected to identify myriad new species.

Reaching a compromise between commercial and recreational fishers, other commercial users such as the resources and shipping industries, tourism and those who believe that conservation should be a priority is always going to be difficult.

- Thousands of kilometres of coastline around Australia are already being affected by rising sea levels and increased storm surges, causing coastal erosion. Globally, it is forecast that by 2100 losses from coastal flooding could cost up to 9.3% of gross domestic product per year.
- Seismic surveys used in petroleum exploration are known to influence the behaviour of some species of mammals, fish, squid, and plankton.

Holding the environment to ransom

The Abbott government’s decision to review the CMRs is yet another illustration of its harsh environmental agenda. The government has cited a lack of consultation and science as the reason for the review. But the release of Burke’s plans in 2012 came after more than 20 years of scientific, economic and social research, and years of consultation with commercial and recreational fishers, the oil and gas industry, conservationists and community groups.

It is important to remember that the overall CMR plan was not just about fisheries, but is part of a comprehensive system for managing all of Australia’s Commonwealth waters and safeguarding its ecosystems. We are concerned that the new review has a strong bias toward the fisheries industry.

The period of consultation has just closed, but we wonder if it will do little more than provide a voice for opponents to ecosystem-based management in general and more specifically conservation zoning using no-take marine reserves (MPAs). Reaching a compromise between commercial and recreational fishers, other commercial users such as the resources and shipping industries, tourism and those who believe that conservation should be a priority is always going to be difficult.

Surely Australia is smart enough to learn from other nations about the disastrous consequences of often irreversible collapses in fish stocks. Once they are gone, and the ecosystem is out of balance, it may not be possible to recover.

The signs are not encouraging. This week’s revelation that the Abbott government has granted petroleum exploration licences in a proposed marine reserve near Western Australia’s Abrolhos Islands does not inspire much confidence that conservation currently ranks high on the agenda.

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THE CONVERSATION

Chapter 2 Fisheries management and seafood sustainability

**FISHERIES**

Over 85% of the world’s fisheries are now overfished or fished to full capacity, cautions the Australian Marine Conservation Society

With over a billion people dependent on our global oceans for the delivery of animal protein, the seas are often thought of as our never-ending food basket. Here in Australia, our relationship with ocean produce is engrained in our national consciousness and most of our holidays – we love seafood to the point where we each consume around 25kg of seafood a year.

But we’ve known for some years now that the oceans aren’t an endless resource. The most recent figures indicate that over 85% of the world’s fish stocks are now fished up to full capacity, or are overfished (UN FAO 2012). In a world with an ever-expanding population, the question is how we can balance what we take from the seas and how we keep the ocean healthy, so we can ensure we have fish in the future.

We often hear the message that Australian fisheries are the best managed in the world, or packaged another way, that all Australian fisheries are sustainable. While it’s certainly true that we have better management in place than some other countries, international fisheries management is hardly stellar. And even though Australia has the third largest marine Exclusive Economic Zone (the area of ocean that we manage), our waters are quite low in nutrients and don’t hold a huge abundance of fish. This means we need to get the sustainability of our fisheries right the first time, and don’t have the luxury of trial and error.

Australian fisheries are managed by eight different jurisdictions, all of which are not equal in terms of the sustainability of their fisheries.

Fisheries from around 3 nautical miles out to the edge of Australia’s ocean realm are managed by the Commonwealth Government. Fisheries from the shoreline out to 3nm are managed by the state or the territory governments, although there is little consistency between how they all separately manage their resources. By value, the state fisheries are by far the most valuable, with Commonwealth managed fisheries only accounting for 15% of the total value of Australia’s $2 billion fishing industry.

**REFERENCES**


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Ocean Conservation and Management
AUSTRALIA’S SEAFOOD TRADE: FAST FACTS

Following is a brief summary from Australia’s Seafood Trade, a report produced by the Department of Agriculture

- Australia’s seafood comes from wild capture and aquaculture sources.
- The amount of seafood (edible and non-edible) produced in Australia has remained relatively stable over the last 20 or so years at around 230,000 tonnes per year.
  - Australia’s apparent consumption of seafood (processed weight) increased from 13 kilograms in 2000-01 to 15 kilograms in 2012-13 (Stephan and Hobsbawn 2014).
  - It is estimated that Australians consumed around 345,000 tonnes of edible seafood products in 2012-13 (Stephan and Hobsbawn 2014). By volume, imported seafood accounted for around 66 per cent of this consumption.
- The value of Australian fisheries and aquaculture production is around $2.4 billion each year.
  - Australia exports around $1.2 billion of seafood products annually.
  - In 2012-13, the Australian export value of fisheries products (edible and non-edible) declined by 4 per cent ($52 million) to $1.18 billion in 2012-13.
  - The total value of Australian imports of fisheries products (edible and non-edible) increased by 3 per cent ($42 million) to $1.65 billion in 2012-13.
- Australia has the world’s third largest Exclusive Economic Zone. However, the low productivity of our marine waters limits wild capture fisheries production.
- In developed countries, demand for seafood is often greater than domestic production can support. The United States, Japan and European Union, including the United Kingdom, are all net importers of seafood products.
- Australia differs from many other developed countries in that a significant proportion of Australian product, which could otherwise supply the domestic market, is sold to export markets due to price.
  - These products are generally still available in Australia, but Australian consumers are often unwilling to pay as high a price as export markets for the volumes produced.
  - Australia exports high value products such as rock lobster, abalone, and tuna.
  - Australia exports little of lower value staples such as white fish and canned fin fish products.
- Over the last six years aquaculture has expanded greatly in East Asia, particularly in China, Vietnam and Indonesia. Australia’s high dollar and labour costs means that farmed seafood can be imported at very low prices.
- Australian aquaculture production is growing, particularly in terms of volume, although it faces strong competition from cheap imports, particularly from Asia.
- Australia’s seafood imports largely consist of lower-value products such as frozen fillets, frozen prawns and canned fish.
  - Imported products, predominantly from Thailand, New Zealand, Vietnam and China, meet Australian consumers’ demand for low-cost seafood products.
- The canned fish consumed in Australia generally consists of low-value tuna products, such as skipjack tuna.
  - Almost all canned tuna sold in Australia comes from Thailand, which produces around half of the canned tuna traded in the world.
  - The low production and labour costs of canning in South-East Asian countries makes it difficult for Australia to compete. These countries also have geographical advantages over Australia, being closer to tuna stocks and having preferred access to major markets.
  - No significant canning of tuna has taken place in Australia since May 2010.
- In Australia, frozen and thawed basa (catfish) fillets from farms in Vietnam are now the most commonly and widely eaten import.
  - The low cost, white boneless flesh and neutral flavour of basa makes it attractive to a large cross section of the Australian community.

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Status of key Australian fish stocks

Summary of the latest report by the Fisheries Research and Development Corporation

The Status of key Australian fish stocks reports 2014 assess the biological sustainability of the key wild-caught fish stocks against a nationally agreed framework. The reports examine whether the abundance (biomass) of fish and the level of harvest from the stock are sustainable. National reporting on fish stock sustainability is the first step towards national fishery-wide reporting that will consider other aspects of ecologically sustainable development, such as the effects of fishing on the marine environment, economic and social performance and governance. Although these issues are not considered in the stock status classifications, the reports comment on the effects of fishing on the marine environment and the effects of the environment on the stocks.

Australia has one of the largest marine domains in the world, covering an area larger than the Australian mainland. Australia also has a long history of indigenous, commercial and recreational fishing (including charter fishing) in its waters. Over the past decade, Australia’s wild capture fisheries and aquaculture production has generated, on average, $2.5 billion a year. In the 2012-13 financial year, wild-capture fisheries contributed 58 per cent ($1.4 billion) of the total value of Australia’s fisheries production and produced more than 150,000 tonnes (t) of seafood, for local, domestic and export markets.

Australian seafood is diverse; it includes scallops, prawns, crabs, squid, coastal fish such as whiting and flathead, reef fish such as Coral Trout, and oceanic tuna and billfish. The fisheries that supply our seafood operate in estuaries and bays, across the continental shelf to oceanic waters and, in some cases, on the high seas. The fisheries and the wild fish stocks on which they are based are managed by eight jurisdictions (Figure 1). In general, the states and the Northern Territory manage fisheries that extend from the coast to a distance of 3 nautical miles, and the Commonwealth manages fisheries that extend from 3 nautical miles to the 200 nautical mile limit of the Australian Fishing Zone.

Australia has one of the largest marine domains in the world, covering an area larger than the Australian mainland.

The productivity and sustainability of wild-capture fisheries depend on the wild fish stocks and marine ecosystems that support the fish. Fish species tend to form relatively discrete populations in different geographical areas, which are referred to as biological stocks. Because separate biological stocks have limited interbreeding, fishing one biological stock may not directly affect others. The size and distribution of individual biological stocks vary greatly between species. For example, Southern Bluefin Tuna comprise a single biological stock that spans much of the world’s southern oceans, whereas hundreds to many thousands of separate biological stocks of Blacklip Abalone are thought to exist in Australia.

A key aim of fisheries management is to ensure that biological stocks are maintained at sustainable levels. Although state/territory and Commonwealth jurisdictional boundaries may be appropriate from a governance perspective, many biological stocks straddle these boundaries, spanning the waters of more than one jurisdiction.

The same fish species may be caught in several jurisdictions, in several fisheries and, in some cases, also outside Australian waters. The catch in the different jurisdictions may be from separate biological stocks of the species, which have little interaction, or from a single biological stock. Therefore, a national approach to assessing and reporting on the status of fish stocks is critical to understanding the state of wild-caught fish stocks and Australian fisheries management.

The stock status classifications presented in the Status of key Australian fish stocks reports are at the biological stock level wherever
A key aim of fisheries management is to ensure that biological stocks are maintained at sustainable levels. Although state/territory and Commonwealth jurisdictional boundaries may be appropriate from a governance perspective, many biological stocks straddle these boundaries, spanning the waters of more than one jurisdiction.

possible, even where a biological stock spans the waters of more than one Australian jurisdiction – that is, a shared stock. This recognises the biological boundaries of fish stocks rather than administrative boundaries of management units (for example, for individual fisheries, a group of fisheries or a region defined by management) or jurisdictions (i.e. the borders of the waters of the Commonwealth, the states or the Northern Territory).

Where insufficient information is available to determine biological stock structure (that is, where it is not known exactly where one stock finishes and the next begins), or where large numbers of small biological stocks make biological stock-based assessments impractical, stock status assessments are made at the level of management or jurisdiction.

In the reports, the term ‘stock status’ is applied generically to the status of biological stocks, management units and populations assessed at the jurisdictional level.

The Status of key Australian fish stocks reports 2014 are national reports on the status of Australian wild-caught fish stocks. In the inaugural 2012 edition, 49 wild-caught species (or, in some cases, species complexes) were considered. Many of the species included comprise multiple stocks, in total 150 stocks were assessed across the 49 species in 2012. In the 2014 edition, the number of wild-caught species has increased to 68, comprised of 238 separate stocks. These species and their stocks contributed around 85 per cent of the annual catch and 90 per cent of the value of Australian wild-capture fisheries in 2012-13.

Traditionally, fishery status reporting has been undertaken separately within each Australian jurisdiction for commercial wild-capture fisheries. In developing the Status of key Australian fish stocks reports, several jurisdictions have reviewed their status determination processes and are modifying their jurisdictional reports to follow the framework applied in the national reports, where possible.

As future editions of the Status of key Australian fish stocks reports are produced, increased coverage – including more species and reporting on fishery-level issues – may lead to a reduced requirement for separate jurisdictional reports.

NOTES
a. The term ‘fish’ is used to cover the animals caught by wild-capture fisheries; it includes crustaceans (such as crabs, lobsters and prawns), shellfish (such as scallops and abalone), squid and octopus, finfish and sharks.

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Responsibility for the management of Australia’s fisheries is shared between the Australian Government, the state and the Northern Territory governments under what are known as the Offshore Constitutional Settlement (OCS).

The state and Northern Territory governments are responsible for looking after fisheries in their territorial waters which, in most cases, extend from the coastline to 3 nautical miles (5.5 kilometres) from the shore. However, both the states and the Commonwealth manage fisheries that operate in Commonwealth waters – which cover waters from the boundary of state or territory waters to the edge of Australia’s Exclusive Economic Zone (EEZ). This means the new networks of Commonwealth marine reserves will affect state, Northern Territory and Commonwealth-managed fisheries.

Management arrangements

The way commercial fisheries are managed by the Commonwealth, states and the Northern Territory varies across fisheries. Some fisheries are managed under output-based management regimes which allow participants to fish a certain number of days/night, or catch fish up to a set quota. Others are managed by input-based management arrangements which may involve restrictions on the number of fishing licences available.

All fisheries also operate within defined management boundaries.

Impact of marine reserves on commercial fishing

According to research conducted by state agencies and the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), net economic returns across fisheries can vary markedly – from highly profitable, to marginal, or even negative.

At the national level, there are a number of export-based fisheries which, in general, are highly profitable and generate significant returns to the Australian economy. These include state-regulated fisheries – such as the Western and Southern Rock Lobster fisheries, pearl aquaculture fisheries, and Commonwealth-managed fisheries – such as the Southern Bluefin Tuna Fishery off South Australia and the Northern Prawn Fishery that operates, mainly, in the Gulf of Carpentaria.

There are many economic pressures faced by Australian fishers. The wild catch sector, in particular, has been under pressure over the past decade – with wild catch declining in both absolute dollar terms and as a proportion of total fisheries production as aquaculture emerges as a major sector. Fuel, labour and other operating costs are major factors in deciding where to set up fishing operations and the profitability of fishing businesses.

Fishing businesses, like other Australian businesses, are not homogenous. They vary from small-scale businesses employing a single operator in a single fishery to vertically-integrated companies employing a range of people in catching, processing and wholesaling, and operating across a range of fisheries. Given the seasonal nature of some fisheries and the economics of fishing, many fishers also hold multiple entitlements across fisheries.

The dependence of Australia’s regional economies on commercial fishing also varies widely. Some fisheries, though small in size, may be extremely important to the functioning of small regional economies. Other fisheries may not have the same regional economy connections as their operations are based in larger regional centres which have diversified economies.
Smooth sailing ahead for Australian seafood sector – industry report

The world’s rapidly-growing appetite for seafood is good news for Australia, with the local industry set to ride the surging wave of global demand, according to a new industry report from Rabobank.

The report, *Smooth sailing for Australian seafood* by agribusiness banking specialist Rabobank, says global consumption of seafood has grown by 26 per cent over the past 15 years, driven by increasing populations and the popularity of seafood in diets.

Seafood is the most consumed animal protein in the world – surpassing other meats including poultry, pork and beef – and consumption is expected to continue to surge, with forecasts suggesting the growth rate is not likely to slow down over the next 10 years.

“Rapid demand growth is outstripping supply, with an estimated 30 to 40 million tonnes of additional seafood required globally to meet consumer demand by 2030,” the report finds.

And Australia is in a ‘box seat’ to take advantage of this growing demand at the high-value premium end of the global market, it says.

Co-authored by Rabobank senior analyst Gorjan Nikolik, a specialist in the global seafood sector, and Australian animal proteins analyst Matt Costello, the report says although the Australian seafood industry accounts for only a small proportion of world seafood production and trade, it plays an important role globally, given the wide range of premium aquaculture and wild-catch products produced in this country.

Australia’s seafood sector – which is forecast to have a value of A$2.5 billion in 2014/15 – consists of a diverse range of sectors, including Australian rock lobster, southern bluefin tuna and Tasmanian salmon.

“With one of the strongest reputations globally for producing high-value, world-class, sustainable and environmentally-friendly seafood products, the Australian seafood industry is very well positioned to supply seafood hungry consumers internationally and domestically,” Mr Costello said.

Growth in consumption

With global consumption of seafood forecast to...
average just under 20 kilograms a head annually in 2014, rising consumption of seafood is a worldwide trend, the report says, but particularly pronounced in developing countries, including in Asia.

“Of particular note has been the rapid increase in demand from China, playing a significant role in global consumption and trade flows, while at the same time becoming a crucial export destination for Australian seafood,” Mr Costello said.

In 2014, Chinese per capita annual consumption of seafood is forecast to reach 37.7 kilograms per head, a rise of 57 per cent since 2000.

“Currently, most of the Chinese seafood consumption is still based on low-value domestically-raised product. But more significant is the expected growth in demand from Chinese consumers for higher-end seafood products, many of which will need to be imported. This is a key opportunity for export-oriented aquaculture and fisheries, such as in Australia, which can supply premium items,” Mr Costello said.

Globally, the major consumers of seafood include Korea, Norway and Japan with per capita per annum consumption in 2014 expected to reach 57.7 kilograms, 57.65 kilograms and 52.6 kilograms respectively.

**Demand drivers**

The Rabobank report says global growth in seafood consumption is being driven by a number of factors.

“Among western consumers there is growing demand due to the perceived health and wellbeing benefits of fish and other seafood, while there has also been a rapid rise in the popularity of Asian cuisine which is seafood-rich, such as sushi and sashimi,” Mr Costello said.

“For developing countries, increased consumption has primarily been driven by population growth, while overall the diverse range of seafood items offers options for different income groups.”

**Aquaculture v wild-catch**

The rise of aquaculture – farmed cultivation of seafood – is also playing a significant role in driving global growth in seafood consumption, the report says, powered by its ability to sustainably and efficiently convert feed to protein and keeping prices affordable.

“The ability to produce more with less is going to be the challenge to the future of food production and the aquaculture sector is the most efficient converter of feed in comparison to all animal proteins,” Mr Costello said.

Farmed salmon, for example, requires approximately 1.2 kilograms of feed to produce one kilogram of protein, while an estimated eight kilograms of feed are required to produce one kilogram of beef.

“With wild-catch seafood production growth remaining close to stagnant over the past 15 years, global seafood production is growing through increased aquaculture,” Mr Costello said.

“Between 1990 and 2012, wild-catch seafood production increased just eight per cent. And with rising environmental and sustainability pressures coming from all participants along the supply chain – including consumers, companies and governments – it is likely there will be no growth in wild-catch production in the future. Assuming that wild-catch remains at current levels, it is estimated that the extra 30 to 40 million tonnes of additional seafood will be required from aquaculture to meet global demand by 2030.”

Globally, aquaculture now accounts for more than 50 per cent of seafood produced for human consumption, surpassing wild-catch in 2012, the report says.

Here in Australia, seafood production is still dominated by wild-catch, accounting for 87 per cent of production in 2012, with aquaculture making up a relatively small, yet increasing, share of production.

Rabobank Australia & New Zealand is a part of the international Rabobank Group, the world’s leading specialist in food and agribusiness banking. Rabobank has more than 110 years’ experience providing customised banking and finance solutions to businesses involved in all aspects of food and agribusiness. Rabobank is structured as a cooperative and operates in 42 countries, servicing the needs of approximately 10 million clients worldwide through a network of more than 1,600 offices and branches. Rabobank Australia & New Zealand is one of Australasia’s leading rural lenders and a significant provider of business and corporate banking and financial services to the region’s food and agribusiness sector. The bank has 93 branches throughout Australia and New Zealand.
PIRATE FISHING STEALS FROM POOR AND WRECKS MARINE ENVIRONMENT

PIRATE FISHERS HARM ECONOMIES, ECOSYSTEMS, AND OFTEN THEIR CREW, ACCORDING TO EMILY WILLIAMS, HENRY APPLETON AND JULIE HAWKINS

When the Russian owned factoryship *Oleg Naydenov* was recently seized by armed Senegalese commandos for illegal fishing in Senegal’s exclusive territorial 12-mile fishing zone, it shone a much-needed spotlight on the problem of illegal, unreported and unregulated fishing, or ‘pirate fishing’ as it is commonly known.

The worldwide loss of fish stocks from pirate fishing costs legitimate fisheries between US$10-23.5 billion every year. Pirate fishers are also notorious for their involvement in smuggling drugs and firearms and for serious human rights abuses.

Developing countries with poor governance are particularly targeted by pirate fishers. For example, more than a third (37%) of all reported catches from the coast of West Africa are thought to be illegal. Since 2010, the Environmental Justice Foundation has documented more than 200 reports of illegal fishing there by Korean vessels alone. Such plundering of the seas deprives law-abiding fishers of earnings, and food.

From an environmental perspective, illegal fishing has a considerable impact on the replenishment of fish stocks. By using banned and harmful practices, pirates remove juvenile fish that have not had a chance to breed, and destroy vital fish habitats. A study from Guinea-Bissau reported that if all fishing nets of an illegal mesh size (and so small enough to catch juveniles) were eliminated, legal fishers would see their profits rise by perhaps 50-100%.

The human rights violations which occur aboard illegal fishing vessels are horrific. Poor people in search of work are routinely trafficked across borders then sold into illegal fishing by professional brokers. They then become trapped in a world of abuse, intimidation and work for little or no pay. Once trapped their chances for escape are limited.

To catch a pirate

Hi-tech tools are increasingly deployed against illegal fishers. For example, by following tracking transmitters on ships with satellites, authorities can identify if a vessel is fishing where it shouldn’t. In some regions the amount of illegal fishing has been reduced, for example in the Antarctic where it has dropped to less than 10% of previous levels. This has been possible due to well-funded surveillance and worldwide cooperation.

The worldwide loss of fish stocks from pirate fishing costs legitimate fisheries between US$10-23.5 billion every year.

In Europe, major trade sanctions were for the first time announced against countries operating flags of convenience. This practice allows boat owners to purchase the right to fly the flag of nations that have not signed the *UN Law of the Sea*. As such the boat does not need to recognise international fishing law.

Under the new sanctions, fish imports from Belize, Guinea and Cambodia will be banned from the European Union, while South Korea, Ghana and Curaçao have all been warned that they will have to show progress on tackling pirate fishing within six months or face a similar fish import ban.

Prevention, not cure

Although fishing vessels have names and other identifiers, these are not permanent and can be easily painted over and changed by their owners. This makes it incredibly difficult for authorities to recognise specific vessels engaged in illegal fishing and to track misconduct. Introducing mandatory, permanent ship registrations in accordance with standards of the International Maritime Organisation (IMO) has been recommended by organisations such as the Environmental Justice Foundation and Oceana.

The IMO's ship numbering system is already well recognised and the new records it could create would produce an independent audit trail for fishing vessels and their ownership. In November 2013, the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) became the first marine management organisation to require IMO numbers on all vessels fishing within its jurisdiction.

In the fight against illegal fishing, much could also be gained from tighter port controls. In Europe, Council Regulation (EC) 1005/2008 provides a framework that allows illegal fish to be seized in European ports. However, some countries implement this law more assiduously than others; Spain alone is believed to account for over 50% of consignment rejections across the whole of the EU.

Given that pirate fishing undoubtedly causes serious environmental problems and poses a threat to food security for some of the world’s poorest countries, it is an issue that needs urgent, co-ordinated international attention.

Emily Williams is MSc researcher at the University of York. Henry Appleton is MSc research student at the University of York. Julie Hawkins is Senior Lecturer at the University of York.

**THE CONVERSATION**

Is seafood sustainable in Australia?

How do we ensure the supply of seafood for future generations? In this article, Signe Cane from SBS talks to Tooni Mahto, a campaigner at the Australian Marine Conservation Society, about the environmental impacts of commercial fishing.

Whether it’s Atlantic salmon, tuna, shark or the humble prawn – Australia loves eating seafood. In fact each year we eat 16 kilograms of seafood per person.

But growing populations and increasing demand for protein-rich foods are putting our oceans, and this limited natural resource under pressure.

How do we ensure the supply of seafood for future generations?

This is one of the issues explored in the new SBS documentary series What’s the Catch?

Wildlife like the dodo and sea cow now belong to history – because humans hunted them to extinction.

Today the majority of food we consume comes from farmed animals and crops.

However, despite the farming of seafood being on the rise, most of the fish we eat is still caught in the wild.

Commercial fishing ranges from local, small-scale fisheries to international corporations.

Overfishing, or where fish stocks are depleted to unacceptable levels, is a serious threat to marine ecosystems.

Tooni Mahto is a campaigner at the Australian Marine Conservation Society, AMCS. She says overfishing can lead to permanent degradation of the environment.

“Marine ecosystems are in a delicate balance. If you remove too much of one species, then that can alter the natural balance of an ecosystem. And that can have quite severe consequences for marine ecosystems in general.”

As a result, Australian marine life is rich in biodiversity, but lower in overall numbers of fish.

With fewer fish to catch, our fisheries have stayed relatively smaller in scale.

Leading Australian fisheries expert and Emeritus Professor at the University of Canberra Dr Bob Kearney argues that in terms of sustainability, Australian fisheries are in a pretty good shape.

“There are very, very few fisheries in Australia now...
that are seriously overfished. Unfortunately, a lot of confusing terminology gets used, and people get the impression that overfishing – which can often mean just merely that they’ve taken too much fish in one year or that they’ve overcapitalised, that it represents a threat to the survival of the species. Australia has shown – that is not true.”

But our fisheries haven’t always been managed so tightly. Until the 1980’s there were few limits on fishing and stocks were depleting rapidly.

Over the past decades improved regulations, quotas and enforcement have seen fast recovery of Commonwealth managed fishing stocks. In 2004 most fish stocks were classified as overfished with the green light given to only 20 of stocks confirmed as not overfished. But by 2012 as many as 63 stocks out of almost 100 were considered in good condition, and the trend continues to rise.

Conservation campaigner Tooni Mahto argues that the public need to understand how fishing is regulated.

“There’s limited understanding amongst the public on how fisheries are managed, and indeed what species are fished, what the implications of fishing are. So our main goal is encouraging the consumer and the public in the debate about how their fisheries are managed.”

Bryan Skepper is the General Manager of the Sydney Fish Market, one of the largest fresh seafood markets in the world. He says the rules and regulations governing the daily catch are extensive. Fishermen are required to take out several licenses and report their takes. These are deducted from their quota, and once that is reached, they stop fishing.

Skepper also believes that our local fisheries are doing well.

“Australian fisheries are regarded internationally as being amongst the best managed in the world. Our fisheries management system that’s in place has rigorous scientific underpinning to it, and internationally we’re regarded as being amongst the top four in the world as to our fisheries management programs.”

If Australians ate only local seafood, this would be promising news, however up to 70 per cent of the seafood we eat is imported into Australia.

Bryan Skepper explains.

“The 70 per cent relates to seafood in all of its forms, so you’re talking about canned products, frozen, processed fish fingers and things like that, as well as your chilled fish fillet.”

Professor Kearney says that it’s not enough to have good local standards, because Australia is importing too much seafood, and doing so irresponsibly.

“The sustainability of our fisheries is really very good, but the sustainability of our seafood supply [is] appalling.”

Kearney explains that in Australia imported seafood often comes from countries where sustainability standards are looser.

He says many importers are based in developing countries that need the seafood to feed their own populations, but sell it to Australia because they can get higher market prices.

Professor Kearney believes that the way Australia uses its waters for fishing should be managed more effectively. We export premium products such as abalone and sashimi-grade tuna, while importing cheaper fare from less sustainable suppliers.

“I’m very optimistic about the sustainability of our fisheries, but unless we take a holistic approach to where seafood is going to come from, and we give it due priority, we will not get our management priorities right.”

“The sustainability of our fisheries is really very good, but the sustainability of our seafood supply [is] appalling.”

Dr Bob Kearney, Emeritus Professor, University of Canberra

Bryan Skepper from the Sydney Fish Markets says local fishermen also want sustainability.

“When you talk to the professional fishermen too, they want to have stocks there for the future. Many of them are family businesses, generations of fishermen, and they want to ensure that they’ve got an industry that’s in healthy condition to pass on to their sons and daughters.”

If you want buy sustainably too, there are consumer guides online, such as the Sustainable Seafood Guide by the Australian Marine Conservation Society, which uses a traffic light system to rate species.

Unfortunately it can be difficult to follow – due to the fact that Australia doesn’t have a mandatory labelling system in place.

AMCS’ Tooni Mahto explains.

“Labelling is a real issue because a single species is commonly marketed under a number of different names, or many different species are marketed under one name. So it can be incredibly confusing for a consumer that wants to make a real thoughtful choice about what it is they’re eating.”

However, there are things that we as consumers can do.

• Ask for the species and origin of the seafood you buy and order in restaurants.
• Choose local seafood rather than imported.
• If a certain fish at the fishmonger is cheap, chances are it is in season, so go for that.
• You can also try less commonly eaten species to give the slow-growing tuna and salmon stocks a break. Barramundi, flathead and silver perch are all good alternatives.

It seems responsible consumption is the key to ensure that future generations get to enjoy the abundance of seafood as much as we do.

For the average consumer, trying to make ethical choices when it comes to purchasing fish is a veritable minefield. Suppliers tell you what you want to hear, customer service staff are typically uninformed, government regulations vary from state to state and imported product with poor labelling floods the market. So how do you make the right choices without a degree in ichthyology?

“It’s quite a grey area, but the main thing is to try and educate yourself a bit better about it,” says Justin North, owner and head chef at Sydney’s Becasse restaurant and a vocal proponent of the issue of sustainability.

“If you wander around the fish markets and start talking to people it can be very confusing as sellers don’t usually have the answers and it’s not always sign-posted accurately. But people can look on government websites and brief themselves on what’s available in their area that’s seasonal and sustainable.”

“People don’t know where to go to find that information, though it’s fairly easy to do,” says author, chef and restaurateur Stefano Manfredi. “You can simply Google ‘sustainable seafood Australia’ and you’ll get lots of information. On a day-to-day basis, when you’re confronted with so much choice, I think it’s very difficult if you haven’t prepared yourself properly before you buy.”

Government regulations around fishery practices are tightening to some degree, but are still a long way from providing a perfect solution. As an example, Manfredi points to the closure of tuna canning facilities in South Australia as a result of Federal Government quotas. “It’s a double-edged sword. People aren’t going to stop buying canned tuna. Those canneries will defer production to places like Thailand. Unless you’re a serial label reader you won’t even realise it’s not locally produced.”

FARmed FISH OR FREE-RANGE?

“Generally speaking, the larger fish, such as tuna, are more of a problem because they tend to be on the end of a chain and take a lot longer, and a lot more, to grow. If people are going to choose these fish, they have farmed options here in Australia, such as ocean trout, salmon, kingfish and mulloway (formerly known as jewfish), which are probably better choices in terms of sustainability than wild fish. There are also some great fish that are inexpensive and sustainable, such as leatherjacket and garfish.”

In some cases, however, wild fish may be a better choice than farmed, depending on the species and methods of production. “In the past it was thought that if it was farmed it was sustainable and if it was wild it was not, but that’s not really the case,” says North. “There are aquaculture procedures out there that are not sustainable and certainly you can get some local wild catches that are, such as blue-eyed trevella and harpuka.”

While clear answers are still hard to come by, here are seven ways you can improve your odds of making better choices.

1. **Know which questions to ask**

   “The first thing to find out about the fish is its origin – its name and species. Not everyone knows what John Dory looks like. The second is where it’s from. Then, has it been sustainably caught, following the right quota guidelines,” says North.

   Manfredi also suggests employing your skills of investigation: “It’s not a stipulation by law here in Australia to actually display the origin of seafood like it is in Europe. Ask where it comes from. Here in Australia we have a much better regulatory framework about how aquaculture is produced than elsewhere.”

2. **Build relationships with suppliers**

   “Another part of the answer is to build a relationship with your fishmonger so you can have a bit of trust opening up a discussion about what is local and sustainable and what is not,” says North. “You can speak to anyone and they’ll tell you what you want to hear, but if you have a really nice relationship, like with your local butcher, you can trust them. If they’re any good, they’ll only sell sustainable produce anyway. But there are a few dodgy operators out there.”

3. **Buy from reputable suppliers**

   These days most of the produce at reputable fish markets, such as the Sydney Fish Markets, is fairly well policed in terms of license and quotas. Failing that, seek out the most reputable suppliers in your area. “It really comes down to customers and the general public to support those suppliers who are selling sustainable produce,” says Manfredi. However, he cautions that he doesn’t believe the average fishmonger knows much about sustainability. “As a consumer you need to be up on it. I would suggest if you’re going to the fish markets you still do some background research. If you have a really good relationship with your fishmonger so you can have a bit of trust opening up a discussion about what is local and sustainable and what is not,” says North. “You can speak to anyone and they’ll tell you what you want to hear, but if you have a really nice relationship, like with your local butcher, you can trust them. If they’re any good, they’ll only sell sustainable produce anyway. But there are a few dodgy operators out there.”

4. **Buy locally and seasonally**

   While buying seasonally doesn’t guarantee a fish is sustainable, price can be a pointer to fish that are fresher and more affordable. “Generally things that are at the peak of the quota system in terms of life cycle are more readily available and affordable. Very rarely would you find a massive abundance of something that has been illegally caught out of season,” says North.

   “If something is cheap and plentiful, it’s probably at the peak of its breeding season and good to buy,” says...
Manfredi. However, he cautions that it’s not a black and white solution. “Something like flathead used to be very cheap and a lot of it is sustainable. But a lot of people love it so now the price has gone up even when it’s in season.”

5. Be flexible
“We tend to have a set idea of what we want when we go to the fish markets. If people are doing a dinner party, they’ll look at a few cookbooks, get an idea what they want to do, perhaps tuna, and go find a nice piece of fish. So if the price is $50-60 a kilo they may not have any idea what to substitute that fish with,” says Manfredi. “But similar fish can be cooked in similar ways, so it’s always a good idea to be prepared with that information when you go shopping. For example, you could replace salmon, ocean trout or blue eye.”

6. Be adventurous
“If you go down to fish markets and see a fish you’ve never seen before and don’t know anything about, just get it and try it. What have you got to lose? You can get the fishmonger to fillet it for you, see if it is a soft fish or a firm fleshed fish, cook it up, and suddenly you’ve found a fish that you can add to your repertoire,” says Manfredi.

“People moan a lot about price of seafood but there’s a thousand different species out there. With the demand for the top half dozen, everyone forgets about all the others that are amazing and beautiful and are often also cheap and sustainable,” says North. “It comes down to having the knowledge and confidence to know how to cook those fish instead.”

A few great, sustainable fish you may not have tried: leatherjacket, garfish, gurnard, jackass morwong (also known as perch, sea bream or silver perch).

7. Make more sustainable choices
The Australian Marine Conservation Society (AMCS) publishes a guide to sustainable seafood, available through their website, which offers advice on sustainable seafood choices.

SAY NO TO ...
Among the species on their ‘Say No’ list are wild eastern gemfish (hake); wild orange roughy (also called deep sea perch); wild southern bluefin tuna; farmed snapper; farmed yellowtail kingfish; farmed Atlantic Salmon; farmed ocean trout and wild barramundi.

SAY YES TO ...
Fish species they recommend as better choices include: wild Australian salmon; wild bream; wild king george whiting (also called black whiting, South Australian whiting, spotted whiting); wild leatherjacket; wild mullet; wild trevally and wild whiting.
Australia’s Mini Sustainable Seafood Guide

A guide to choosing seafood wisely, from the Australian Marine Conservation Society

**BETTER CHOICE**

These species represent a BETTER CHOICE. Species in this group are not currently overfished. They are generally resilient to fishing pressure, have a history of stable catches and are caught or farmed using techniques that have low environmental impacts. Some of these species may still have minor conservation concerns, but have been assessed to be a better seafood choice.

<table>
<thead>
<tr>
<th>Australian wild caught fish</th>
<th>Marketed as/species considered</th>
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<tbody>
<tr>
<td>Australian Salmon</td>
<td>Australian Salmon</td>
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<tr>
<td>Crabs</td>
<td>Mud Crabs, Spanner Crabs</td>
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<tr>
<td>Goldband Snapper (WA &amp; NT)</td>
<td>Tropical Snapper</td>
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<tr>
<td>Flathead (NSW &amp; VIC)</td>
<td>Dusky Flathead</td>
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<tr>
<td>Bay Prawns</td>
<td>Prawns</td>
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<tr>
<td>Southern Calamari</td>
<td>Calamari</td>
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<tr>
<td>Whiting</td>
<td>King George &amp; Stout Whiting</td>
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<thead>
<tr>
<th>Australian farmed</th>
<th>Marketed as/species considered</th>
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<tbody>
<tr>
<td>Barramundi</td>
<td>Barra</td>
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<tr>
<td>Blue Mussel</td>
<td>Mussel</td>
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<tr>
<td>Prawns</td>
<td>Black Tiger, Kuruma &amp; Banana Prawns</td>
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<tr>
<td>Oysters</td>
<td>Sydney Rock, Native &amp; Pacific Oysters</td>
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<tr>
<th>Imported</th>
<th>Marketed as/species considered</th>
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<tr>
<td>Farmed Prawns</td>
<td>Pacific White, Whiteleg &amp; Black Tiger Prawn</td>
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<tr>
<td>Blue Grenadier</td>
<td>Hoki</td>
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<tr>
<td>Hake</td>
<td>Cod</td>
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<tr>
<td>Tuna</td>
<td>Albacore, Yellowfin, Bigeye Tuna</td>
</tr>
</tbody>
</table>

**EAT LESS**

EAT LESS of these species. Wild caught species in this group may be caught using fishing methods that cause some damage to marine habitats or are associated with significant levels of bycatch. There may be scientific uncertainty about the status of wild caught stocks and careful management will be needed to protect stock health. If farmed, the aquaculture methods used have some environmental impacts on our seas.

<table>
<thead>
<tr>
<th>Australian wild caught fish</th>
<th>Marketed as/species considered</th>
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<tbody>
<tr>
<td>Blue Warehou</td>
<td>Sea Bream</td>
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<tr>
<td>Gemfish</td>
<td>Hake</td>
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<tr>
<td>Mulloway</td>
<td>Jewfish</td>
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<tr>
<td>Orange Roughy</td>
<td>Deep Sea Perch</td>
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<tr>
<td>Shark</td>
<td>Flake</td>
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<tr>
<td>Snapper</td>
<td>Pink Snapper, Tropical Snapper</td>
</tr>
</tbody>
</table>

**SAY NO**

SAY NO to these species. Wild caught species in this group, whether Australian or imported, may be overfished or their capture heavily impacts our seas, e.g. killing threatened or protected species as bycatch or damaging sensitive habitats. Farmed species include those produced by methods that place significant stress on our oceans.

<table>
<thead>
<tr>
<th>Australian wild caught fish</th>
<th>Marketed as/species considered</th>
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<tbody>
<tr>
<td>Atlantic Salmon</td>
<td>Tasmanian/Smoked Salmon</td>
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<tr>
<td>Rainbow Trout</td>
<td>Ocean Trout</td>
</tr>
<tr>
<td>Imported</td>
<td>Marketed as/species considered</td>
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<tr>
<td>Basa</td>
<td>Freshwater fillet, Royal Basa &amp; Mekong Catfish</td>
</tr>
<tr>
<td>Nile Perch</td>
<td>Lake Victoria Perch</td>
</tr>
</tbody>
</table>

Note: Canned tuna sustainability is brand-dependent. Check our website, or smartphone apps for details.

**You can make a difference**

Be informed. Choose your seafood wisely. Consider its sustainability and always go for green where you can. Refer to the full guide for more information.

**Things to do ...**

Whether you are at a supermarket, fish merchant, dining out at a restaurant or simply getting takeaway, always ask ...

- Is the species overfished?
- How was it caught or farmed?
- Is it a deep-sea, slow-growing or long-lived species?

Tell your friends! Spread the word about how good it feels to eat sustainably.

Consult the website and get your hands on the full version of Australia’s Sustainable Seafood Guide or you can download the free Android or iPhone app for more information on each species. Freecall 1800 066 299, www.sustainableseafood.org.au

**Why do your choices matter?**

The fish we choose directly affects the health of our oceans. Worldwide demand for seafood is increasing, yet many populations of the fish we enjoy are overfished. Overfishing, destructive fishing gear and poor aquaculture practices impact significantly on our seas. Once considered inexhaustible, our oceans are now in a state of global crisis and they need our help.

Be part of the solution. Become a Sea Guardian today! www.marineconservation.org.au

Australian Marine Conservation Society.

In 1883, the eminent English biologist Thomas Henry Huxley made his now infamous proclamation on the infinite bounty of the sea:

*Probably all the great sea fisheries are inexhaustible; that is to say, that nothing we do seriously affects the numbers of fish. Any attempt to regulate these fisheries seems consequently, from the nature of the case, to be useless.*

A century later, numerous great fisheries had collapsed (including herring and cod, which Huxley specifically mentioned).

Despite Huxley’s awareness that new technology (“steam and refrigerating apparatus”) made it possible to “draw upon the whole world” for seafood, he could not foresee the immense increase in fishing capabilities – particularly from SONAR – that would occur during the 20th century.

Nor could Huxley account for the explosion in demand for seafood that would invariably follow a tripling of the human population in the 100 years following his 1883 prediction. Huxley’s “inconceivably great” sea fisheries could not support our yet greater appetite.

One hundred and thirty years on, and bad news outweighs the good. The Food and Agriculture Organisation of the United Nations reported in 2012 that 57% of marine fisheries are fully exploited and 30% are overfished. Asia’s fishing effort has increased 25-fold since the 1950s, yet their catch is steadily declining. And the world would need to mothball around 2.6 million commercial fishing boats to make fishing sustainable.

There is debate among scientists about the values of these statistics, and rightly so, but, much like the informed climate change debate, it is focused on not whether the news is bad, but how bad.

The good news is that some fish stocks are stable, some are recovering, and some are well managed (the West Australian coast rock...
lobster fishery is renowned for its sustainability). Indeed, if you’re in Australia, the doom-and-gloom of global seafood may seem far from your experience at the fish market or your local fish-and-chip shop. There is plenty of choice, and you can always walk away with a fish.

In part, this reflects Australia’s well managed fish stocks. Oceania is the region least affected by over-fishing, and if there continues to be an investment in fisheries research and management, the sustainability of Australian wild-caught seafood could be world-leading.

So does this mean we are a sustainable seafood nation?

Probably not. For one thing, Australia imports around 70% of its seafood, mostly as cans and frozen fillets. You may have come across basa in your local fish shop (a species of catfish farmed extensively in Asia). Basa is quickly becoming the most imported fish in many parts of the world, including Australia, and basa aquaculture could offer high sustainable production if carefully managed.

Without these imports, it is very unlikely Australia could sustainably satisfy current consumer markets with only Australian fish (even if we held on to our most popular exports – rock lobster and tuna). We must also remember that large ocean fisheries are harvested by many countries, and for fish like tuna, Australia’s contribution may only be part of a complicated international management effort.

What does this all mean for ‘seafood sustainability’?

Well firstly we must acknowledge that our demand for wild-caught seafood outstripped the ocean’s sustainable supply decades ago. If we rehabilitate the oceans, to the tune of $200 billion dollars, we could potentially increase our current harvest a little and keep it there sustainably. Even so, we would need more.

This brings us to the crucial point: there is no such thing as a sustainable type of seafood, only a sustainable harvest rate. If we are to demand truly sustainable fisheries, and we admit that harvests cannot continue to grow, then we conclude that what must change is our consumption. As long as humans demand ready access to seafood whenever they want it, there will be pressure to exceed these rates.

Can aquaculture fill this gap? Aquaculture already provides 47% of the world’s food fish production, and since 1990 has been the only thing fulfilling the increase in seafood consumption. It has not taken the pressure off our oceans, and significant improvements must be made before aquaculture becomes a predominantly sustainable industry. Nor is aquaculture likely to ever meet global demand for large ocean fish like tuna (over half of aquaculture production is freshwater fish).

We need to reevaluate what ‘sustainability’ really means in the current climate of global development and consumption. The local consumer still has options for selecting seafood harvested at sustainable rates, and much information exists online. But the consumer must acknowledge that a constant supply of wild-caught fish is not sustainable.

Ultimately, we should not demand sustainable seafood – we should demand sustainable consumption.

James Smith is Research Fellow in Fisheries at the UNSW Australia.

The Conversation

CHAPTER 3
Climate change, reef management and marine pollution

CLIMATE CHANGE IMPACTS ON THE MARINE ENVIRONMENT
A BRIEF OVERVIEW FROM WWF AUSTRALIA

Climate change is affecting ocean temperatures, the supply of nutrients, ocean chemistry, food chains, wind systems, ocean currents and extreme events such as cyclones. All of these, in turn, affect the distribution, abundance, breeding cycles and migrations of marine plants and animals that millions of people rely on for food and income.

Evidence is emerging that marine organisms may be responding faster to climate change than land-based plants and animals. As the climate warms, marine plants and animals are shifting towards the poles changing marine food webs and impacting the plants, and animals (including people) that depend on them. The slower ocean dynamics also means that some changes, such as ocean acidification, will be irreversible this century.

The key impacts of climate change on our marine environment include:

**Coral bleaching**
Coral bleaching is the whitening of corals, due to stress-induced expulsion or death of their symbiotic protozoa, zooxanthellae, or the loss of pigmentation within the protozoa.

Once bleaching begins, it tends to continue even without continuing stress. If the coral colony survives the stressful period, zooxanthellae often require weeks or months to return to normal density. New residents may be of a different species and change the make up of marine ecosystems dramatically. Often biological diversity is reduced making the reef even less resilient to future environmental change. Some species of zooxanthellae and corals are more resistant to stress than others.

Temperature change is the most common cause of coral bleaching. Large coral colonies, such as porites, are able to withstand extreme temperature shocks. Other, more fragile branching corals, such as table coral, are more susceptible to stress following temperature change.

Increasing ocean acidification likely exacerbates the bleaching effects of thermal stress. The Great Barrier
Reef experienced bleaching in 1980, 1982, 1992, 1994, 1998, 2002 and 2006. While most areas recovered with relatively low levels of coral death, some locations suffered severe damage, with up to 90% of corals killed. The most widespread and intense events occurred in the summers of 1998 and 2002, affecting about 42% and 54% of reefs, respectively. Under the Intergovernmental Panel on Climate Change’s (IPCC’s) moderate warming scenarios, corals on the Great Barrier Reef are very likely to regularly experience summer temperatures high enough to induce bleaching.

**Rising sea levels**

Global sea levels may rise by more than 60 centimetres during the next 100 years due to the melting of glaciers and polar ice, and thermal expansion of warmer water. Rising water levels will have serious impacts on marine ecosystems. The amount of light reaching offshore plants and algae dependent on photosynthesis could be reduced, while coastal habitats are already being flooded.

**Acidic oceans**

After absorbing a large proportion of the carbon dioxide released by human activities, our oceans are becoming acidic. In fact, the IPCC has reported that the uptake of anthropogenic carbon since 1750 has led to the oceans becoming more acidic. Increasing atmospheric carbon dioxide concentrations lead to further acidification. Projections estimate a reduction in average global surface ocean pH of between 0.14 and 0.35 units over the course of the 21st century.

While the effects of ocean acidification on the marine biosphere are not yet fully documented, the progressive acidification of our oceans is expected to have negative impacts on marine shell-forming organisms (e.g. corals) and their dependent species.

Fish, squid, and other gilled marine animals may also find it harder to ‘breathe’ as extracting the dissolved oxygen from acidic waters becomes more difficult.

**Altered lifestyles and locations**

Rising temperatures can directly affect the metabolism, life cycle, and behaviour of marine species. For many species, temperature is a cue for reproduction, so temperature changes could affect successful breeding. Temperatures also determine the number of male and female offspring born to marine turtles, as well as some fish and copepods (tiny, shrimp-like animals on which many other marine animals feed).

Changing climate could, therefore, skew sex ratios and threaten population survival. As the oceans warm, the location of the ideal water temperature may shift for many species. A study has shown that fish in the North Sea have moved further north or into deeper water in response to rising sea temperatures. Other species may lose their homes for other reasons. The distribution of penguin species on the Antarctic Peninsula, for example, is changing due to the reductions in sea ice caused by global warming.

**Stormy weather**

Most scientists believe that global warming will herald a new era of extreme and unpredictable weather. Tropical storms and heavier rainfall may increase, causing physical damage to coral reefs, other coastal ecosystems, and coastal communities. Hurricanes Hugo and Marilyn, which hit the US Virgin Islands National Park in 1989 and 1995, respectively, did massive damage to coral ecosystems.
The oceans are continuing to warm steadily despite an apparent slowdown in global warming at the earth’s surface, according to data collected by thousands of floating robots published today in *Nature Climate Change*.

Between 2006 and 2013, ocean waters shallower than 500 metres warmed by 0.005°C per year, while between 500 and 2,000 metres the ocean warmed by 0.002°C per year. While seemingly tiny, John Church, a sea level researcher at CSIRO and one of the study’s authors, said these numbers “represent a huge amount of heat”.

“It’s well over 90% of the total warming of the climate system. Although the whole climate system is warming, over this period and over earlier periods the majority of that heat is being stored in the ocean.”

Warming isn’t consistent throughout the oceans. Sea surface temperature has alternated between warming and cooling phases driven by El Niño, with no significant trend overall. However the data show that warming has continued in the waters below the surface.

“Global warming is still continuing,” said Shayne McGregor, a climate researcher at the University of New South Wales. “What we’re seeing is a momentary pause in the surface warming. Below the surface the ocean is still gaining heat at rates consistent with that expected.”

In 2014 McGregor and colleagues discovered a cause for the apparent slowdown in surface temperatures: trade winds over the Pacific Ocean have intensified, bringing cool waters to the surface and driving warm water into the deeper ocean.

McGregor said this would end when the Pacific Ocean warms up, an event that could be triggered by El Niño, although he noted at this stage this is “purely speculation”.

The increase in total heat was contributing to the rise of extreme heat in the oceans, said Thomas Wernberg, marine heatwave expert at the University of Western Australia. The frequency of extremely hot days in coastal waters has increased by more than a third over the past 30 years.

Marine heatwaves are causing dramatic changes in ocean ecosystems, including the disappearance of large seaweeds over very short periods, coral bleaching, and tropical species moving southwards.

Southern oceans, particularly the south Pacific and Indian oceans, have absorbed the majority of the extra heat. Church said there are two hypotheses for the warming in the Southern Hemisphere, particularly in the southern Pacific and Indian oceans. The Northern Hemisphere has more aerosols from pollution, which have a cooling effect. General ocean circulation may also be responsible, as winds push heat into the deep.

The data were collected as part of the international Argo program, which involves more than 3,500 floating robots collecting data on temperature and salinity. The floats rise and sink in the upper ocean, profiling the ocean once every 10 days. Since 2006 the program has achieved near-global coverage, and research is continuing to extend the floats into the deep ocean below 2,000 metres and under sea ice.

James Whitmore is Editor at *The Conversation*.  

**Argo floats measure temperature and salinity. Bio-Argo floats with other sensors are also being tested by CSIRO.**

*Source: CSIRO.*

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**MARINE LIFE SPAWNS SOONER AS OUR OCEANS WARM**

Warming oceans are affecting the breeding patterns and habitat of marine life, according to a three-year international study published in *Nature Climate Change*. This is effectively re-arranging the broader marine landscape as species adjust to a changing climate. Authors: **Anthony Richardson** and **Elvira Poloczanska**

Scientific and public attention to the impacts of climate change has generally focused on how biodiversity and people are being affected on land. In the last Intergovernmental Panel on Climate Change (IPCC) report in 2007, less than 1% of the synthesis information on impacts of climate change on natural systems came from the ocean. Yet marine systems cover 71% of Earth’s surface, and we depend on marine life for food, recreation and half the oxygen we breathe. A key unanswered question is whether marine life is buffered from climate change because of the much more gradual warming in our surface oceans – about one-third as fast as on land.

**What’s happening in our oceans?**

An international team of scientists from Australia, USA, Canada, UK, Europe and South Africa, and funded by the US National Center for Ecological Analysis and Synthesis, set out to answer this question. They conducted the first global analysis of climate change impacts on marine life, assembling a large database of 1,735 biological changes from peer-reviewed studies. Just as the medical profession pools information on the symptoms of individual patients from surgeries and hospitals to reveal patterns of disease outbreaks, we pooled information from many studies to show a global fingerprint of the impact of recent climate change on marine life. Changes were documented from studies conducted in every ocean, with an average timespan of 40 years.

Although there is a perception in the general public that impacts of climate change are an issue for the future, the pervasive and already observable changes in our oceans are stunning. Climate change has already had a coherent and significant fingerprint across all ecosystems (coastal to open ocean), latitudes (polar to tropical) and trophic levels (plankton to sharks). These fingerprints show that warming is causing...
Moving poleward, breeding earlier

As temperatures warm, marine species are shifting their geographic distribution toward the poles. Most intriguingly, though, they are doing so much faster than their land-based counterparts. The leading edge or front-line of marine species distributions is moving toward the poles at an average of 72km per decade – considerably faster than species on land that are moving poleward at an average of 6km per decade. Plankton and bony fish, many of which are commercially important, showed the largest shifts.

Warmer temperatures are also changing the timing of breeding, feeding, and migration events. For marine life, their spring events have advanced by more than four days, nearly twice the figure for land. The strength of response varied among species, but again, the research showed the greatest response – up to 11 days in advancement – was for plankton and larval bony fish.

Currents clearly play a role in the large distribution movements seen in the ocean, but there is a more subtle phenomenon also at work. Temperature gradients are more gentle in the ocean than over much of the land, and this has important implications for species movement.

Consider the complex topography on land. Many land plants and animals only need to move short distances up or down mountains to reach different temperature regimes. As the ocean surface is relatively flat, marine plants and animals must move greater distances to keep up with their preferred environments as oceans warm.

Seasonal cycles are also dampened in the ocean, meaning that for a set amount of warming, marine species need to shift their timing much earlier than on land.

Australian effect

Although the study reported global impacts, there is strong evidence of change in the Australian marine environment. Australia’s south-east tropical and subtropical species of fish, molluscs and plankton are shifting much further south through the Tasman Sea. In the Indian Ocean, there is a southward distribution of seabirds as well as loss of cool-water seaweeds from regions north of Perth.

Some of the favourite catches of recreational and commercial fishers are likely to decline, while other species, not previously in the area, could provide new fishing opportunities. Essentially, these findings indicate that changes in life events and distribution of species indicate we are seeing widespread reorganisation of marine ecosystems, with likely significant repercussions for the services these ecosystems provide to humans.

Anthony Richardson is a research scientist at CSIRO.
Elvira Poloczanska is a research scientist, Climate Adaptation Flagship at CSIRO.

Source: Department of the Environment, Ocean acidification experiment.

Ocean acidification fast facts

- When CO₂ dissolves from the atmosphere into the ocean it increases the acidity of the ocean.
- The Southern Ocean absorbs 40% of the global ocean uptake of CO₂.
- Cold water is able to absorb more CO₂ than warmer water. As a result, polar waters are acidifying at twice the rate of tropical waters.
- Changes in acidity are measured on a pH scale. Generally, pH 7 is neutral, while a range between 0 and 7 is considered acidic and between 7 and 14 is alkaline. While the ocean pH is currently above pH 8, it is gradually decreasing, thereby become more acidic.
- Ocean acidification disrupts the formation of calcium carbonate (CaCO₃), which is a major structural component of shells and similar hard structures made by some marine organisms, including phytoplankton and coral.
- Ocean acidification also affects the metabolic and physiological processes inside organisms including development, growth, reproduction and respiration.
- Ocean acidification will result in both winners and losers in future oceans. Some marine algae are expected to benefit from ocean acidification but most calcifying organisms are expected to suffer.
- The Intergovernmental Panel on Climate Change (IPCC) found that since pre-industrial times there has been an average decrease in ocean pH of 0.1 unit.
- Under a ‘business as usual’ CO₂ emissions scenario, ocean pH is projected to decrease by another 0.3 to 0.4 units by 2100.
- Current atmospheric CO₂ concentrations are about 416 parts per million (ppm), while ocean pH is about 8.1. By 2100 under ‘business as usual’ emissions, atmospheric CO₂ is predicted to be about 936 ppm and ocean pH 7.8.

Source: Department of the Environment, Ocean acidification experiment.
Summary of key observed impacts of climate change in Australian marine ecosystems, (locations of these impacts have been documented), main climate driver(s) implicated, and current management options available to support adaptation.

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<thead>
<tr>
<th>Observed impacts</th>
<th>Location of documented impacts</th>
<th>Climate driver</th>
<th>Management to support adaptation</th>
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<td>Giant kelp decline by up to 95%</td>
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<tr>
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<td>Declines in fish diversity after climate-related habitat disturbances (coral bleaching and storms)</td>
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<td>Loss of primary seabird nesting islands</td>
<td>Great Barrier Reef, northern Australia</td>
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<td>Reduce other stressors on seabird nesting islands; rehabilitate degraded islands; provide artificial nesting sites.</td>
</tr>
<tr>
<td>Declines in coral cover from 28% to 14% since 1985</td>
<td>Great Barrier Reef, northeast Australia</td>
<td>Marine heat waves and more intense storms (and crown-of-thorn starfish)</td>
<td>Maintain ecosystem connectivity; reduce other stressors on coral reefs.</td>
</tr>
<tr>
<td>Declines in seagrass meadows since 2009 with 94% of sites surveyed classified as being in ‘poor’ or ‘very poor’ condition</td>
<td>Great Barrier Reef, northeast Australia</td>
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<td>Maintain ecosystem connectivity; reduce other stressors on seagrass meadows; rehabilitate severely degraded habitats.</td>
</tr>
<tr>
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</tr>
<tr>
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<td>Great Barrier Reef, northeast Australia; Ningaloo Reef, northwest Australia; Torres Strait, northern point</td>
<td>Marine heat waves</td>
<td>Maintain ecosystem connectivity; reduce other stressors on coral reefs.</td>
</tr>
<tr>
<td>Marine turtle nesting failures</td>
<td>Northern Australia</td>
<td>Increasing sand temperature and inundation (greater storm surge and sea-level rise)</td>
<td>Reduce other stressors on turtle nesting islands; relocate nests; provide artificial shade at nest sites.</td>
</tr>
</tbody>
</table>

Coral reefs are known to be one of the most diverse ecosystems on the planet. Yet when people see a reef either personally or on the television they see only the fish and corals. On the Great Barrier Reef, we have 360 species of corals and 1,500 fish, yet many other groups are well represented on the reef such as crustaceans, molluscs, echinoderms and polychaetes amongst the macroinvertebrates and many groups of meiofauna.

The real diversity of these other groups can only be estimated (ascidians 330 species, bryozoans 330-500 species, barnacles 100 species, decapods 1,030 species, isopods 150 species, molluscs 8,000 species, echinoderms 500 species, flatworms 300 species, polychaetes 500-700 species and over 80 genera of octocorals) – and much of this fauna remains to be described (Lucas et al. 1997, and little has changed since then).

A recent program called Creefs, an Australian node of Census of Marine Life made extensive collections at three Australian coral reef sites (Ningaloo, Lizard and Heron) whereby experts from both Australia and overseas visited these reefs annually for 3 years and made extensive collections which are gradually being worked up revealing many new species and new records as well as highlighting that some supposedly widely distributed species represented suites of cryptic species. This was particularly common amongst the polychaetes and revealed by using molecular and morphological techniques.

So while these field trips made important collections they were predominantly from the reefal areas with the inter-reefal areas, the sandy/muddy substrates, being largely ignored, in part because of the difficulty of sampling these areas. In the case of the polychaetes, while all families were collected, selected families are being targeted as we have the relevant expertise in Australia to identify these ones, the remainder will be catalogued in several of the Australian museums awaiting other experts to identify them.

A similar scenario is being repeated for all the other groups. In part this reflects the lack of taxonomic expertise not only in Australia but worldwide but also the diminishing funds available for such research. Polychaetes of reefal areas in other parts of the world are also poorly known.

However there is another real disaster unfolding as reefs continue to be degraded around the world, we are in danger of losing much of this biodiversity before it is even described. This is because some species are dependent on live coral and as such colonies die, their associated fauna either also dies, or in some cases may be able to relocate to nearby healthy corals. This fauna was reviewed by Stella et al. (2011). Other species are dependent on dead coral for their survival with many species entombed within the framework such as boring bivalves, polychaetes and sipunculans. So while on ‘healthy’ reefs rates of accretion of reefs by coral growth equal rates of loss by bioerosion, on heavily impacted reef rates of loss far exceed those of accretion leading to loss of reefal framework and associated fauna. While the replaced reefs, be it an algal reef or a mud flat, will host a suite of marine invertebrates which will differ from that previously present in the dead and live coral substrate.

A significant proportion of the biodiversity of reefs is being ignored.

So what are the consequences of this loss of biodiversity, associated with loss of coral reefs? This suite of organisms occupy various levels of the food chains on the reef, they are important sources of food for many of the more conspicuous species of fish. They are important in recycling nutrients through the reefal system, in bioturbating the reefal sediments, with borers creating three dimensional habitats within the dead coral, to name just a few of their roles. But in reality we know little of how this largely hidden fauna functions and yet we are on track to loose it.

So while a considerable amount of time and funds has been spent on studying the corals and fish communities and which continues, a significant proportion of the biodiversity of reefs is being ignored, apart from some species which are commercially important such as some of the holothurians, giant clams or crayfish for example. A few groups are conspicuous such as the nudibranchs which glide over the coral apparently immune from predation and the crinoids hanging out in the current and the large holothurians mining the inter-reefal sediments but most are not.

So my plea is next time you go for a dive, look more carefully in between the corals, at the base of the reef or the surface of the inter-reefal sediments and observe conspicuous signs of life below, be it signs of tentacles, burrows or bioturbation and remember that reefs are home to many groups of organisms not just the corals and fish, all of which contribute to a healthy and dynamic coral reef systems.

**READ MORE**


WHAT AUSTRALIA IS DOING TO MANAGE THE GREAT BARRIER REEF

The new Reef 2050 Long-Term Sustainability Plan is the blueprint for Australia’s continuing efforts to preserve the Great Barrier Reef, building on our long history of successful management. The first of its kind for a property of this scale, the 35-year plan will strengthen the resilience of the Reef and maintain its Outstanding Universal Value.

**The reef’s outstanding universal value remains intact**

A maze of 3,000 coral reefs and 1,050 islands, the Great Barrier Reef covers an area the size of Italy and stretches 2,300km along Australia’s north-east coast. The Great Barrier Reef Marine Park Authority’s independent and scientifically robust Outlook Report 2014 found the Reef retains its Outstanding Universal Value and the overall integrity of this vast property also remains in good condition.

**Strong and decisive action to protect the Reef**

Australia has permanently banned the disposal of port-related capital dredge material in the entire World Heritage Area. The federal ban was announced at the World Parks Congress on 12 November 2014 and came into law on 2 June 2015.

In the past 18 months the number of capital dredging proposals to place dredge material in the marine park has been reduced from five to zero. Capital dredging for ports will be restricted to within the long established priority ports of Gladstone, Hay Point/ Mackay, Abbot Point and Townsville – and only within the legislated port limits. Legislation to this effect has been introduced into the Queensland Parliament.

We have doubled funding to control crown-of-thorns starfish, to further protect the Reef’s corals. Tough new penalties against poaching will provide extra protection for turtles and dugongs, as will increased funding to reduce marine debris.

**Reef 2050 Long-Term Sustainability Plan**

The new Reef 2050 Plan strengthens Australia’s management of the Reef to protect and preserve the living reef and its Outstanding Universal Value. By

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**Threats to the Great Barrier Reef**

There are growing threats to the Great Barrier Reef, with the most serious being climate change, catchment pollution, coastal development, and fishing. WWF is working hard to impress upon our governments the need for urgent action to address climate change globally. To help boost the Reef’s resilience to climate change we are also urging action on the local impacts of coastal development, such as ports, and polluted run-off from agriculture.

**Climate change**

Climate change is the biggest threat to the reef’s future. The Great Barrier Reef Marine Park Authority’s Outlook Report for the Great Barrier Reef in 2014 stated: “Climate change remains the most serious threat to the Great Barrier Reef. It is already affecting the reef and is likely to have far-reaching consequences in the decades to come.”

**Pollution**

Sediment, nutrient and pesticide pollution from catchment run-off is having a major impact on the health and resilience of the reef ecosystem. The amount of sediment flowing into the marine park has quadrupled over the past 150 years. This increase can largely be attributed to grazing and cropping expansion in the catchment, which has also resulted in the loss of native vegetation and wetlands. Nutrient loads have also increased, encouraging algal blooms, which, in turn, provide food for larvae of the devastating crown-of-thorns starfish. Since 1985 coral cover has declined by half along the Great Barrier Reef. Pollution-driven crown-of-thorns starfish are responsible for over 40% of this loss. The actions by farmers to implement more productive pollution cutting practices are commendable but they need much greater assistance, with billions not millions needed to get the scale of pollution cuts required.

**Outdated fishing practice**

Not only is the reef subject to high levels of fishing pressure. Fishing practices, such as trawling for prawns, are permitted in over one-third of the marine park, resulting in untargeted fish capture (bycatch), and damage to the seafloor and its resident plants and animals.

**Industrialisation**

The Great Barrier Reef is under threat from the most widespread, rapid and damaging set of industrial developments in Queensland’s history. The Queensland Government is fast-tracking dredging and dumping of millions of tonnes of seabed and rock, and encouraging increased shipping through the narrow straits between reefs. The Australian Government is considering approval of these developments, including the world’s biggest coal port at Abbot Point, 50km from the Whitsunday Islands.

working together, all levels of government, the community, traditional owners, industry and the scientific community will improve, enhance and maintain the Reef’s health and deliver ecologically sustainable development.

The Reef 2050 Plan is based on the best available scientific research, as well as lessons learnt from 40 years of cooperative management, and analysis of the entire Reef region from the comprehensive strategic assessment.

The plan has concrete targets and actions, and everyone with a stake in the Reef has clear responsibilities. Both the Australian and Queensland governments are committed to delivering the best possible outcomes for the future protection and management of the Reef.

Implementation of the Reef 2050 Plan is already underway and with ongoing scientific and community input we are focusing on prioritising investments and improving monitoring.

**Sustained investment into the future**

Australian and Queensland government investment in Reef management and research activities is projected at more than $2 billion over the coming decade. This includes:

- $140 million in funding for the Reef Trust – including the additional $100 million for improved water quality announced by Australia’s Prime Minister
- $100 million in addition to the current $35 million per year from the Queensland Government for improving water quality and further reducing the impacts of fishing.

We have finalised a baseline of all federal, state and local government investment in protecting the Reef, as well as private and philanthropic investment, as part of the Reef 2050 Plan’s investment framework. With the help of an Independent Expert Panel chaired by Australia’s Chief Scientist and a Reef Advisory Committee chaired by the former governor of Queensland, we will now determine investment priorities for the future and set out a strategy for boosting investment and diversifying resources over time.

**We are starting to see results**

Over recent years we have halted and reversed the decline in water quality in the Reef’s catchments. Based on state-of-the-art modelling and extensive monitoring, estimated annual average pesticide load has been reduced by 28 per cent, sediment load by 11 per cent, total nitrogen load by 10 per cent, and dissolved inorganic nitrogen by 16 per cent compared to a 2009 baseline.

Over $29 million has been allocated from the Reef Trust so far to improve the quality of water flowing into the Reef, enhance species protection and control outbreaks of crown-of-thorns starfish.

Queensland has established the Great Barrier Reef Water Science Taskforce to provide advice on the best approach to achieve up to 80 per cent reduction in nitrogen run-off and up to 50 per cent reduction in sediment run-off in key catchments by 2025.

We will continue working with landholders to reduce nutrient and sediment run-off into the Reef and improve the condition of native vegetation across the catchment.

We expect a lag time between interventions to reverse negative impacts and the emergence of evidence that they are having an effect. A reef-wide Integrated Monitoring and Reporting Program is being developed to monitor the success of the Reef 2050 Plan and inform adaptive management. Annual reporting will highlight progress in delivery. A full review will occur every five years to ensure the plan remains consistent with the best scientific advice and relevant to addressing pressures on the Reef.

**Our commitment into the future**

Australia is determined the Great Barrier Reef World Heritage Area remains internationally recognised for its Outstanding Universal Value. We are confident that we have the environmental protection and investment in place to ensure the Reef continues to be among the best managed and protected marine ecosystems in the world.
### Australia’s response to the World Heritage Committee

Australia has responded comprehensively to all of the requests of the World Heritage Committee and has taken unprecedented action to address concerns about the health and management of the Great Barrier Reef.

#### The need for a long-term plan

The ground-breaking **Reef 2050 Long-Term Sustainability Plan** is a 35-year plan for the management of the Reef based on the **strategic environmental assessment** of the Reef and the **Great Barrier Reef Outlook Report 2014**. The plan focuses on actions to address key threats and directly boost the health and resilience of the Reef so that it is best able to cope with pressures, including the effects of climate change. The plan is a schedule of the updated **Great Barrier Reef Intergovernmental Agreement**. This gives it the highest status available under Australia's federated system of government.


#### Managing development in Gladstone Harbour and on Curtis Island

The recommendations from the **Independent Review of the Port of Gladstone** will improve port operation and inform the work of the new **Gladstone Healthy Harbour Partnership** and other efforts to protect the Great Barrier Reef World Heritage Area.

- [rc.ghhp.org.au](http://rc.ghhp.org.au)

#### Water quality

The latest **report card** based on state-of-the-art modelling and informed by extensive monitoring shows water quality has improved. Estimated annual average sediment load has been reduced by 11 per cent, pesticide load by 28 per cent, and total nitrogen load by 10 per cent compared with 2009. This is the result of investments by the Australian and Queensland governments of more than $375 million over the past five years, complemented by substantial in-kind investment by industry. Water quality will also be a focus for the $140 million **Reef Trust** as well as the Queensland Government's additional $100 million over five years towards water quality initiatives, scientific research and better environmental practices in the primary production and fishing industries.


#### No development to impact individually or cumulatively on the Reef’s Outstanding Universal Value

Rigorous environmental assessment under the **Environment Protection and Biodiversity Conservation Act 1999** using the new **EPBC Act referral guidelines for the Outstanding Universal Value of the Great Barrier Reef World Heritage Area** ensures that Outstanding Universal Value is central to the protection of the property. Developments with an unacceptable impact on the Great Barrier Reef will not be approved. In response to commitments made in the strategic environment assessment, **Cumulative Impact Assessment Guidelines** and a **Net Benefit Policy** are being prepared to guide decision making.


#### Limiting the impact of ports and port development

The Australian Government has permanently banned the disposal of capital dredge material in the Great Barrier Reef Marine Park. In the past 18 months the number of capital dredging proposals to place dredge material in the marine park has been reduced from five to zero. The Queensland Government has introduced the **Sustainable Ports Development Bill 2015** to the Queensland Parliament, which complements the Australian Government's ban. Under this legislation, sea-based disposal of any port-related capital dredged material in the Great Barrier Reef World Heritage Area will be banned. Port-related capital dredging will be restricted to within the long established port limits of the regional priority ports of Gladstone, Hay Point/Mackay, Abbot Point and Townsville. The Bill mandates the beneficial reuse of dredged material. If beneficial reuse is not possible, the Bill mandates disposal on land where it is environmentally safe to do so.

Greenfield areas are protected from the impacts of port development. The Port of Rockhampton is not a priority port and is not included in the proposed boundary for the Gladstone port master planned area. This delivers on the Queensland Government’s commitment to protect the Fitzroy Delta, including North Curtis and Keppel Bay.

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Reef 2050 Long-Term Sustainability Plan

Outlook Report 2014

Great Barrier Reef Intergovernmental Agreement

will ensure that the Reef's Outstanding Universal Value is maintained

Reef 2050 Long-Term Sustainability Plan

measures will be given effect through the


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AUSTRALIA REPRIEVED – NOW IT MUST PROVE IT CAN CARE FOR THE REEF

Australia has persuaded UNESCO it has a plan to save the Great Barrier Reef – now the policies and funds must materialise, writes Ove Hoegh-Guldberg

UNESCO’s World Heritage Committee has decided not to add the Great Barrier Reef to the List of World Heritage in Danger, for now at least. In a draft decision released ahead of its annual meeting next month, it has welcomed Australia’s plan to save the Reef, but also demanded a progress report on its policies by the end of 2016, as well as a full update on the Reef’s conservation status by December 2019.

The move draws a temporary line underneath an issue that has loomed large for the past three years, bringing Australia’s stewardship of the Reef uncomfortably into the international spotlight.

During that time there has been copious input from scientists, politicians and campaigners, discussing threats such as climate change, dredging, pollution, shipping, and even the fate of the barramundi on our plates. It has got people talking all over the planet about whether or not the Australian and Queensland governments really care enough about one of the most recognisable symbols of Australia.

Not everyone has agreed with one another. As debated extensively on The Conversation and elsewhere, experts have advocated both for and against the idea of listing the Reef as endangered.

On one hand, the evidence is impossible to doubt that the Great Barrier Reef is in danger. Half of the corals on the Great Barrier Reef have disappeared since 1985, and the destruction of coastal habitat by rapid port development and other activities has been plain to see.

On the other hand, the recent ramping up of remedies by both federal and state governments shows that our leaders clearly want to honour the promises made when the Great Barrier Reef was first listed as World Heritage in 1981.

HAS UNESCO MADE THE RIGHT CALL?

I have previously argued that a decision to list the Great Barrier Reef as endangered would be premature. So UNESCO’s decision makes a lot of sense to me, for several reasons.

The first is that the decline of the Great Barrier Reef began as much as 100 years ago, and hence is not something that the government can turn around overnight. It requires a concerted, non-political...
Australia on probation over Great Barrier Reef health

- 1 July 2015, Bonn – The World Heritage Committee delivered a decision that places Australia on probation over the health of the Great Barrier Reef.
- The Australian Government has until 2016 to show that its rescue plan is working and until 2019 to demonstrate it has stopped the decline of the Reef. If the Reef’s World Heritage values continue to decline, an ‘in-danger’ listing will likely be delivered at the 2020 meeting.
- The World Heritage Committee expressed concern that the outlook for the Reef is poor and key habitats and species have continued to decline, and listed climate change, poor water quality, and coastal development impacts as the major threats.
- The Committee acknowledged the existing financial commitment to the Reef 2050 plan as an ‘initial’ amount – indicating that the WHC recognises the reef rescue plan as being underfunded.

Source: WWF 1 July 2015.

On the other hand, the recent ramping up of remedies by both federal and state governments shows that our leaders clearly want to honour the promises made when the Great Barrier Reef was first listed as World Heritage in 1981.

process that recognises and agressively solves the problems of pollution, sediments, and unsustainable fishing.

Given that we have not had an effective process for some time (water quality, for instance, has been an issue for decades; it didn’t just pop up in the past couple of years), it would seem counterproductive to list the Great Barrier Reef as “in danger” at a time when federal and state governments are finally beginning to take clear actions in response to the issue. It will take time to rethink coastal agriculture, fix eroded gullies, and address issues such as coastal herbicide and pesticide use.

The second reason is that the response of ecosystems to these policy changes will necessarily be complex and slow. As coral populations hopefully rebound, seagrasses regrow, and threatened populations such as dugong begin to recover, we will need to make careful long-term observations before we know if the actions taken now have been effective.

Short-term international manoeuvring won’t save the Great Barrier Reef. We need to think beyond politics and recognise that safeguarding the Reef will require a long-term commitment by Australia as a nation, not just a political process.

The third and final reason is that it would be rather perverse for UNESCO to ignore Australia’s clear intention to take this issue seriously. Given the effort that successive state and federal governments have made to avert an “in danger” listing, what incentive would remain if the listing was made anyway? It would hardly help to motivate future governments to fight the uphill battle of getting the listing removed again.

CRUNCH TIME

There is no doubt that federal environment minister Greg Hunt and his Queensland state counterpart Steven Miles will both be sighing with relief that the prospect of an “in danger” listing has been staved off for another five years. This is great for Australia and for the many people who believe that re-listing the reef as “in danger” would have been the wrong step to take at this time.

But the real work starts now. It’s time to vindicate UNESCO’s decision by showing that the Reef is truly being protected.

There are encouraging signs. The Queensland government has successfully introduced the Ports Bill, which restricts port development in Queensland to four so-called Priority Port Development Areas, and has restricted dredging for port facilities outside these areas for the next 10 years.

Meanwhile the federal government has banned port developers from dumping dredge spoil in the waters of the Great Barrier Reef, and both federal and state governments have committed to a long-term sustainability plan that acknowledges the major challenges from coastal development, pollution, and (in a somewhat less satisfactory way) climate change.

This is all well and good. But as pointed out before, the devil is in the detail. While still in process, much of these commitments still need to be legislated, and without legislation they are no more than hot air. We must also trust our science (and not private opinion), and ensure that we take real actions with a measurable outcome that safeguards the Reef.

It is also absolutely essential that loopholes, such as those within the Ports Bill, are removed so that we never again find ourselves engaging in activities that are ultimately at odds with the long-term future of the Great Barrier Reef. As it stands now, for example, the Ports Bill only prohibits “significant” port development. However, what is classified as “significant” is not defined by the Bill and is, at this point of time, entirely arbitrary. These problems need to be fixed if Australia’s apparent sincerity about solving the problems is to be believed.

Let’s hope that in 2020, when UNESCO assesses the progress that has been made, Australia passes with flying colours as a nation that has successfully turned around one of its most significant environmental problems.

Ove Hoegh-Guldberg is Director, Global Change Institute at the University of Queensland.

THE CONVERSATION


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Ocean Conservation and Management

Issues in Society | Volume 398

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**Marine Debris**

**Sources, Distribution and Fate of Plastic and Other Refuse – And Its Impact on Ocean and Coastal Wildlife. A Report from the CSIRO**

Marine debris is a globally recognised environmental issue of increasing concern. Marine ecosystems worldwide are affected by human-made refuse, much of which is plastic.

Marine debris comes from both land and sea-based sources and can travel immense distances. It can pose a navigation hazard, smother coral reefs, transport invasive species and negatively affect tourism. It also injures and kills wildlife, has the potential to transport chemical contaminants, and may pose a threat to human health.

CSIRO has completed a survey of sites approximately every 100km along the Australian coastline. Parts of this research engaged with thousands of students, teachers and Shell employees and has reached more than one million Australians, helping to educate them about, and increase their understanding of, the problems of marine debris.

**What is marine debris?**

Marine debris is defined as any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment.

Marine debris includes consumer items such as glass or plastic bottles, cans, bags, balloons, rubber, metal, fibreglass, cigarettes, and other manufactured materials that end up in the ocean and along the coast.

It also includes fishing gear such as line, ropes, hooks, buoys and other materials lost on or near land, or intentionally or unintentionally discarded at sea.

**What does CSIRO’s research tell us?**

CSIRO surveyed coastal sites approximately every 100km around the continent of Australia. This body of work represents the largest scale, integrated, rigorous data to have been collected anywhere in the world aimed at addressing the marine debris issue.

1. **What are the sources, distribution, and ultimate fate of marine debris?**

   We found that within Australia, approximately three-quarters of the rubbish along the coast is plastic. Most is from Australian sources, not from overseas, with debris concentrated near urban centres. In coastal and offshore waters, most floating debris is plastic. The density of plastic ranges from a few thousand pieces of plastic per square kilometre to more than 40,000 pieces of plastic per square kilometre. Debris is more highly concentrated around major cities, suggesting local sources.

2. **What is the exposure of marine wildlife to debris?**

   Litter impacts wildlife directly through entanglement and ingestion and indirectly through chemical affects. As the quantity of debris increases in the marine environment, so does the likelihood of impacts from debris to marine animals. Plastic production rates are intensifying, and the volume of refuse humans release into marine systems is growing at an exponential rate. Even toothpaste and personal care products can have plastic microbeads in them. These microplastics can be mistakenly eaten by a range of marine species.

**Marine Pollution and Debris**

Poor water and sediment quality are the most serious pollution threats to Australia’s coastal and marine environments. However, a staggering amount of solid garbage, and pollutants such as oil, fertilisers, sewage and toxic chemicals, also enter our coastal and marine environments each year. People once assumed that the ocean was large enough to disperse or dilute pollutants to safe levels. But some toxic man-made chemicals have become so concentrated that they have entered the food chain.

Oil enters the marine environment through drains and rivers, and from acute oil spills. Fertilisers are causing algae blooms and oxygen depletion in the coastal and marine environment and sewage can cause environmental and human health issues. Toxic chemicals are entering oceans through either illegal dumping or run-off from land-based activities. Harmful concentrations of pesticides have even been detected deep inside the Great Barrier Reef World Heritage Area – 60 kilometres from the coast.

The amount of human debris entering the marine environment is also of significant concern. Items such as plastic bottles and bags, food packaging, cigarette butts and fishing gear are commonly sighted and cause harm to protected birds, sharks, turtles and marine mammals. Injury or death through drowning, entanglement, internal injuries or starvation commonly follow ingestion of this debris.

3. Why do animals ingest debris, and what is the effect on marine wildlife populations?

Globally, approximately one third of marine turtles have likely ingested debris, and this has increased since plastic production began in the 1950s. Most items eaten by turtles are plastic and positively buoyant. Smaller oceanic turtles are more likely to ingest debris than coastal foragers; herbivores are more likely to ingest debris than carnivorous species; oceanic leatherback turtles and green turtles are at the greatest risk of ingested marine debris effects; and benthic turtles show a strong selectivity for soft, clear plastic that resembles natural prey such as jellyfish.

Around the world, nearly half of all seabird species are likely to ingest debris. Birds eat everything from balloons to glow sticks, industrial plastic pellets, hard bits of plastic, foam, metal hooks and fishing line. CSIRO researchers and colleagues found that 43 per cent of short-tailed shearwaters have plastic in their gut. Young birds were more likely to ingest debris and ate more pieces of debris than adult birds. A global hotspot for seabird impacts exists in the Tasman Sea south of Australia. CSIRO predicts that plastics ingestion in seabirds may reach 95 per cent of all species by 2050, taking into account the steady increase of plastics production.

4. What is the effect on marine wildlife populations that become entangled by debris?

Seabirds, turtles, whales, dolphins, dugongs, fish, crabs and crocodiles and numerous other species are killed and maimed through entanglement. We estimate that between 5,000 and 15,000 turtles have been killed in the Gulf of Carpentaria after becoming ensnared by derelict fishing nets, mostly originating from overseas. For pinnipeds in Victoria, the majority of seal entanglements involved plastic twine or rope, and seals become entangled in green items more than in any other colour. In general, young seals are entangled in greater numbers than adults.

What can be done?
By garnering the information needed to identify sources and hotspots of debris, we can better develop effective solutions to tackle marine debris.

The most effective way to reduce and mitigate the harmful effects of marine debris is to prevent it from entering the marine environment in the first place. This requires incorporating understanding of debris into local, regional and national decision-making; improved waste management efforts; education and outreach activities; development of technology solutions; anti-dumping campaigns; reducing losses of fishing gear at sea; and incentives to reduce debris, such as South Australia’s container deposit scheme (which has reduced the number of beverage containers, the dominant plastic item in the environment, by a factor 3).

Working together, scientists, industry, coastal managers and citizen scientists can make significant strides to reduce marine debris impacts in coastal areas and in the marine environment.
WORKSHEETS AND ACTIVITIES

The Exploring Issues section comprises a range of ready-to-use worksheets featuring activities which relate to facts and views raised in this book.

The exercises presented in these worksheets are suitable for use by students at middle secondary school level and beyond. Some of the activities may be explored either individually or as a group.

As the information in this book is compiled from a number of different sources, readers are prompted to consider the origin of the text and to critically evaluate the questions presented.

Is the information cited from a primary or secondary source? Are you being presented with facts or opinions?

Is there any evidence of a particular bias or agenda? What are your own views after having explored the issues?

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Brainstorm, individually or as a group, to find out what you know about ocean conservation and management.

1. What is ocean conservation, and why is it important?

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2. What is a Marine Protected Area, and do any exist in Australian waters? (If yes, include examples)

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3. What does the term ‘sustainable fishing’ mean? (include examples)

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4. What is marine debris, and what impact does it have on the ocean environment?

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________________________________________________________________________________________
Complete the following activities on a separate sheet of paper if more space is required.

Australia is an island continent, our land is ‘girt by sea’ and the health and productivity of those seas are critical to our nation’s future.

Consider the above statement. There are many factors that affect the health and productivity of the oceans surrounding Australia. Form into groups of two or more people, and using the spaces provided, address the challenges listed below. Include why they could be seen as challenges to our nation’s future, what impacts they may have and what can be done to minimise that impact. Discuss your ideas with the class.

**CLIMATE CHANGE**

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________________________________________________________________________

**POLLUTION**

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________________________________________________________________________

**FISHING PRACTICES**

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________________________________________________________________________

________________________________________________________________________
Complete the following multiple choice questionnaire by circling or matching your preferred responses. The answers are at the end of this page.

1. Approximately what percentage of the Earth’s territory is covered by oceans?
   a. 5%
   b. 10%
   c. 20%
   d. 50%
   e. 70%
   f. 90%

2. Approximately what percentage of oxygen in the atmosphere is produced by the Earth’s oceans?
   a. 5%
   b. 10%
   c. 20%
   d. 50%
   e. 70%
   f. 90%

3. In what year was the Great Barrier Reef first inscribed on the World Heritage List?
   a. 1901
   b. 1975
   c. 1981
   d. 1999
   e. 2007
   f. 2015

4. In what year was Australia’s *Environment Protection and Biodiversity Act* (EPBC Act) enacted?
   a. 1901
   b. 1975
   c. 1981
   d. 1999
   e. 2007
   f. 2015

5. What distance is the outer limit of Australia’s Exclusive Economic Zone?
   a. 3 nautical miles
   b. 20 nautical miles
   c. 30 nautical miles
   d. 200 nautical miles
   e. 300 nautical miles
   f. 2,000 nautical miles

MULTIPLE CHOICE ANSWERS

1 = e; 2 = d; 3 = c; 4 = d; 5 = d.
The oceans cover some 70% of Earth’s surface, and with an average depth approaching 4 km they make up 95% of our planet’s living space. Marine species are more threatened than we thought—and we’ve only looked at 3%. (p.1)

Marine extinction risk has ramped up rapidly in the past 50 years, to converge upon the level of risk seen on land. (ibid.) (p.2)

Oceans produce over 50% of the oxygen in the atmosphere. (IUCN, About the IUCN Global Marine and Polar Programme). (p.2)

As many as 100 million species—from the world’s biggest animal, the blue whale, to the tiniest bacteria—reside in our oceans. (WWF, Oceans & marine, Protecting Australia’s oceans and coasts). (p.3)

The amount of seafood (edible and non-edible) produced is over $2.4 billion each year. (ibid). (p.24)

Responsibility for the management of Australia’s fisheries is shared between the Australian Government, the state and the NT governments under what are known as the Offshore Constitutional Settlement (OCS) (Department of the Environment, Background information—Understanding Australian fisheries and marine reserve impacts). (p.27)

Seafood is the most consumed animal protein in the world—surpassing other meats including poultry, pork and beef. (Rabobank, Smooth sailing ahead for Australian seafood sector—industry report). (p.28)

Pirate fishing removes juvenile fish that have not had a chance to breed, and destroy vital fish habitats. (Williams, E, Appleton, H and Hawkins, J. Pirate fishing steals from poor and wrecks marine environment). (p.30)

Over the past decades improved regulations, quotas and enforcement have seen fast recovery of Commonwealth managed fishing stocks. (Cane, S, Is seafood sustainable in Australia?). (p.32)

Australian fisheries are regarded internationally as being amongst the best managed in the world. (ibid). (p.32)

Climate change is affecting ocean temperatures, the supply of nutrients, ocean chemistry, food chains, wind systems, ocean currents and extreme events such as cyclones. (WWF Australia, Climate change impacts on the marine environment). (p.38)


As temperatures warm, marine species are shifting their geographic distribution toward the poles. The leading edge or front-line of marine species distributions is moving toward the poles at an average of 72 km per decade—considerably faster than species on land that are moving poleward at an average of 6 km per decade. (Richardson, A and Poloczanska, E, Marine life spawns sooner as our oceans warm). (p.42)

The amount of sediment flowing into the Great Barrier Reef marine park has quadrupled over the past 150 years. This increase can largely be attributed to grazing and cropping expansion in the catchment. (WWF Australia, Threats to the Great Barrier Reef). (p.44)

Within Australia, approximately three-quarters of the rubbish along the coast is plastic. The density of plastic ranges from a few thousand pieces of plastic per square kilometre to more than 40,000 pieces of plastic per square kilometre. (CSIRO Australia, Marine debris). (p.51)
Ocean Conservation and Management

**Aquaculture**
The commercial growing of marine (mariculture) or freshwater animals and aquatic plants. Often termed ‘fish farming’ in relation to fish.

**Australian Fishing Zone**
Australia has proclaimed a zone 200 nautical miles wide around its mainland and territories coasts, within which it controls domestic and foreign access to fish resources.

**Biodiversity**
The variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems.

**Bycatch**
Species taken incidentally in a fishery where other species are the target. Some bycatch species are of lesser value than the target species, so are often discarded (‘trash’ species), but other bycatch species have some commercial value (‘byproduct’) and are retained for sale. Bycatch species may include fish, crustaceans, sharks, molluscs, marine mammals, reptiles and birds.

**Climate change**
Describes a global change in the balance of energy absorbed and emitted into the atmosphere. This imbalance can be triggered by natural or human processes. It can cause either regional or global changes in weather averages and frequency of severe climate events.

**Contiguous zone**
Australia’s contiguous zone is adjacent to its territorial sea, extending up to 24 nautical miles from its territorial sea baseline. In this zone, Australia may exercise the control necessary to prevent or punish infringements of its customs, fiscal, immigration or sanitary laws and regulations.

**Exclusive Economic Zone**
The EEZ is a 200 nautical mile zone declared in August 1994 by Australia in line with the provisions of the United Nations Convention on the Law of the Sea. Australia has the right to explore and exploit, and the responsibility to conserve and manage, the living and non-living resources within this area.

**Marine conservation**
The protection and preservation of ecosystems in oceans and seas, focussing on limiting human-caused damage to marine ecosystems, and on restoring damaged marine ecosystems.

**Marine debris**
Any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment.

**Marine pests**
Plants or animals that are not native to Australia and have a significant impact on human health, fisheries and aquaculture, shipping and ports, tourism, environmental values, biodiversity, ecosystem health and the economy. An estimated 170 exotic marine species have been introduced to Australian waters either intentionally, for aquaculture, or unintentionally in ballast water or by ships’ fouling.

**Marine protected area**
An area of sea especially dedicated to the protection and maintenance of biodiversity, and of natural and associated cultural resources, and managed through legal or other effective means. MPAs include marine parks, nature reserves and locally managed marine areas that protect reefs, seagrass beds, shipwrecks, archaeological sites, tidal lagoons, mudflats, saltmarshes, mangroves, rock platforms, underwater areas on the coast and the seabed in deep water, as well as open water.

**Maritime zones**
Under international law, Australia has rights and responsibilities over its adjacent waters. The main international agreement outlining these rights and responsibilities is the United Nations Convention on the Law of the Sea. In general, Australia has greater rights over the maritime zones closer to its coasts. Australia’s maritime zones are: internal waters; territorial sea; contiguous zone; exclusive economic zone; continental shelf.

**Overfishing**
When the extent of fishing is too high, and the fish stock are being caught faster than it can replenish itself through reproduction.

**Quota**
Amount of catch allocated to a fishery as a whole (total allowable catch) or to an individual fisher or company.

**Sustainable fishing**
When fishing can be conducted over the long term at an acceptable level of biological and economic productivity without leading to ecological changes that prevent options for future generations.

**Sustainable use**
Use of components of biodiversity in a way, and at a rate, that does not lead to the long-term decline of biodiversity.

**Territorial sea**
Australia’s territorial sea extends up to 12 nautical miles from the territorial sea baseline. Due to the proximity of Papua New Guinea, the territorial sea around certain Torres Strait islands is only 3 nautical miles wide, in accordance with the Torres Strait Treaty entered into with Papua New Guinea. Australia’s territorial sea is governed by the Commonwealth, states and territories in accordance with the offshore constitutional settlement.

An international agreement that defines the rights and responsibilities of nations with respect to their use of the world’s oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources.

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WEB LINKS

Websites with further information on the topic

Australian Conservation Foundation  www.acfonline.org.au
Australian Coral Reef Society  www.australiancoralreefsociety.org
Australian Fisheries Management Authority  www.afma.gov.au
Australian Institute of Marine Sciences  www.aims.gov.au
Australian Marine Conservation Society  www.marineconservation.org.au
Australia’s Sustainable Seafood Guide  www.sustainableseafood.org.au
Department of Agriculture and Water Resources – Fisheries  www.daff.gov.au/fisheries
Fight for the Reef  http://fightforthereef.org.au
Great Barrier Reef Marine Park Authority  www.gbrmpa.gov.au
Humane Society International Australia  www.hsi.org.au
IUCN – Marine and Polar  www.iucn.org/about/work/programmes/marine
Marine Education Society of Australasia  www.mesa.edu.au
Reef and Rainforest Research Centre  http://rrrc.org.au
Sea Shepherd Conservation Society  www.seashepherd.org
WWF Australia  www.wwf.org.au

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> Australian Marine Conservation Society.

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