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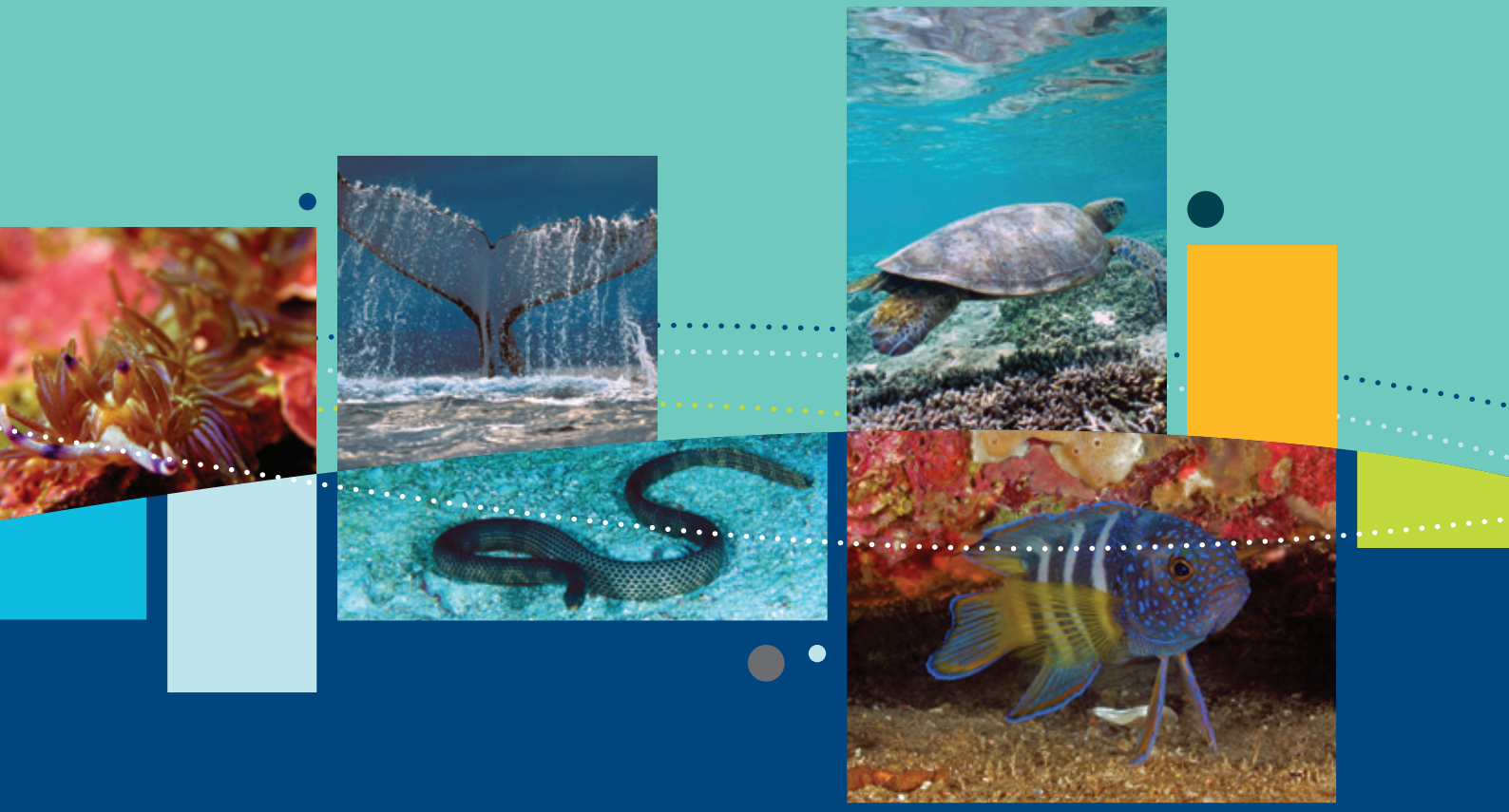

Marine bioregional plan for the Temperate East Marine Region

prepared under the *Environment Protection and Biodiversity Conservation Act 1999*

Disclaimer

Images:
A Green turtle swims in shallows over reef top – GBRMPA, Blue Devil – D.Harasti, Nudibranch – M.Lawrence, Dubois' Sea Snake – GBRMPA, Whale tail – D.Paton, Olive sea snake searching for food over coral and algae – GBRMPA, Flesh-footed shearwater and Balls Pyramid – I.Hutton, Runic wreck on Middleton Reef – Director of National Parks, Black-browed Albatross – M.Double, Acropora species – R.Chesher Ph.D, Red Sea Star – M.Lawrence

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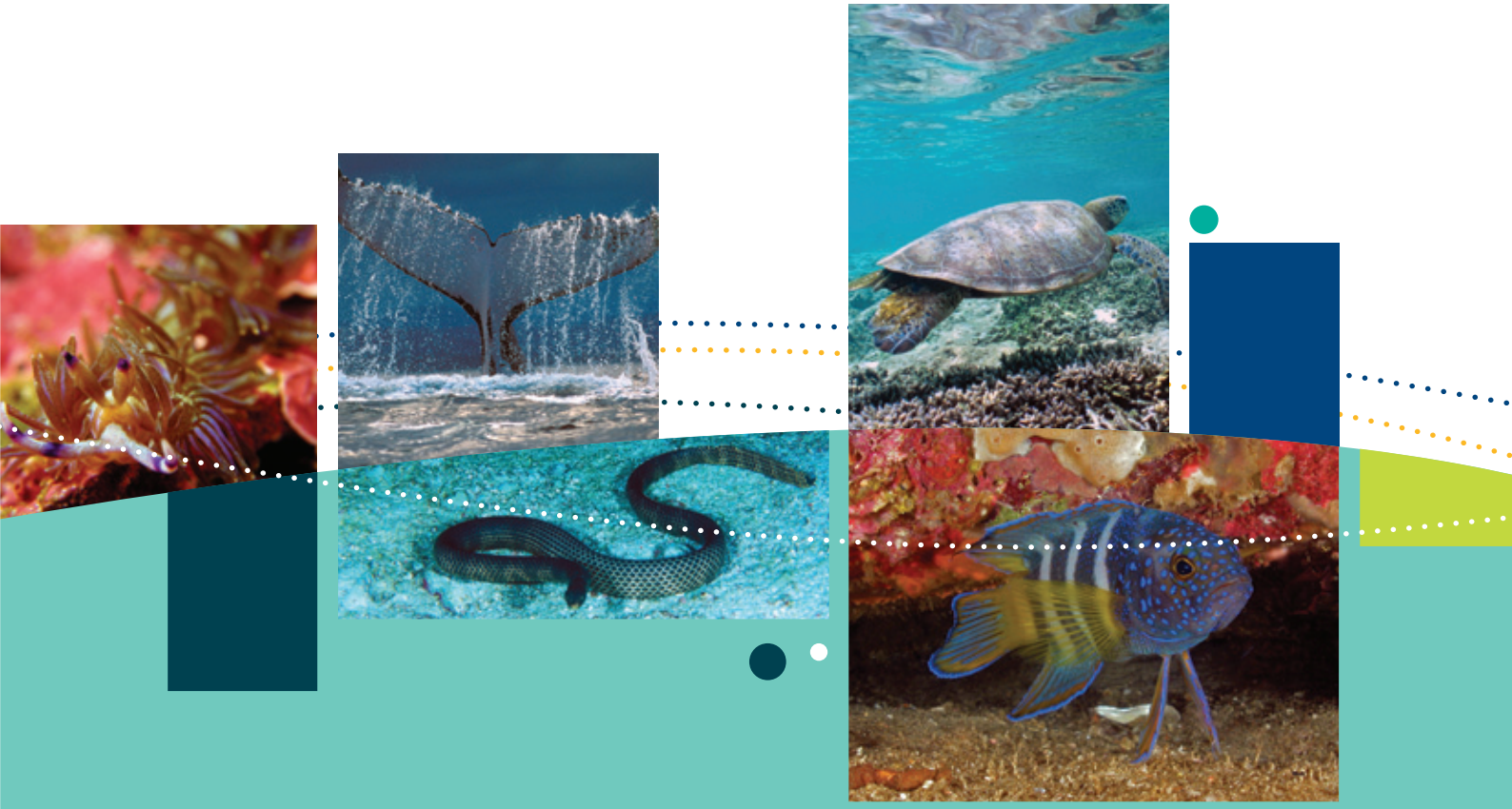

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MINISTERIAL FOREWORD

Temperate East Marine Bioregional Plan

For generations, Australians have enjoyed a unique relationship with the sea.

Our oceans play a massive role in Australian life – they provide us with fish to eat, a place to fish, business and tourism opportunities and a place for families to enjoy.

Australians know, better than anyone, how important it is that our oceans remain healthy and sustainable.

Right now, our iconic marine environment is coming under more and more pressure from industry, from pollution and, increasingly, from climate change.

That is why the Australian Government has committed to creating a network of Commonwealth marine reserves around the country. We will protect our precious ecosystems in our oceans as we have done on land with our national parks.

The Temperate East Marine Region runs from the southern boundary of the Great Barrier Reef Marine Park to Bermagui in southern New South Wales, and includes the waters surrounding Lord Howe and Norfolk Islands.

It is home to the critically endangered east coast population of grey nurse shark and has important offshore reef habitat at Elizabeth and Middleton Reefs and Lord Howe Island that support the threatened black cod.

It includes the southern-most extent of many reef-building coral species. A number of seamount chains run parallel to the coast in this region, and scientists have recently discovered that these features support hundreds of species, including some previously unknown to science.

These plans have been developed under the *Environment Protection and Biodiversity Conservation Act 1999* and backed by the best available science.

During the statutory consultation period, submissions were received from a wide range of stakeholders in the Temperate East Marine Region. The comments and information provided by communities and industries have informed the finalisation of the plan.

Our oceans contain a diversity of species and ecosystems which deserve protection. In this Temperate East Marine Bioregional Plan, you will find information about this extraordinary array of marine life and ecosystems.

Tony Burke
Minister for the Environment

CONTENTS

1 THE TEMPERATE EAST MARINE BIOREGIONAL PLAN

1.1 Introduction to Marine Bioregional Planning

Australia has one of the largest marine jurisdictions of any nation in the world. Australian waters cover 14.7 million square kilometres, including waters around the external territories of Cocos (Keeling), Christmas, Heard and McDonald Islands as well as waters adjacent to Australia's Antarctic Territory. Within that area, Commonwealth waters surrounding the Australian continent and Tasmania cover 7.4 million square kilometres. The biodiversity of Australia's vast marine jurisdiction has been recognised as globally significant. Australia's oceans provide a home to a diverse array of marine species including marine mammals and reptiles, more than 4000 species of fish and tens of thousands of species of invertebrates, plants and micro-organisms. Many of Australia's marine species are endemic, and therefore occur nowhere else in the world. Others utilise Australian waters as part of their global migrations.

As well as being home to an amazing diversity of marine environments, Australia's oceans support a range of marine industries, providing a significant contribution to the national economy. These industries include commercial fishing and aquaculture, petroleum and mineral exploration and production, shipping, ports, recreational and charter fishing, and tourism.

With 80 per cent of Australia's population living in the coastal zone, the marine environment has important social and cultural values, including recreational opportunities, amenity, cultural heritage, conservation and scientific significance. Many Aboriginal and Torres Strait Islander peoples have a close, long-standing relationship with coastal and marine environments and continue to rely on these environments and resources for their cultural identity, health and wellbeing, as well as their domestic and commercial economies.

Marine bioregional planning is about improving the way Australia's marine environment is managed and helping our oceans to remain healthy and productive. Marine bioregional plans have been prepared under section 176 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for the South-west, North-west, North and Temperate East marine regions in Commonwealth waters around Australia (Figure 1.1) and relate to a number of matters of national environmental significance (Box 1.1).

A draft marine bioregional plan was released for the Temperate East Marine Region in November 2011 for a 90 day statutory consultation period. This final plan has been informed by comments received from a range of stakeholders including Commonwealth and state government agencies, industry, recreational and conservation organisations and members of the public. The Australian Government will work with stakeholders to achieve the objectives of the plan.

The preparation of marine bioregional plans represents an important step towards a genuine "ecosystem approach" (Box 1.2) to biodiversity conservation and marine resource management. The plans provide a basis for the recognition and valuation of the many essential and largely irreplaceable ecosystem services provided by the Australian marine environment, including food production, waste management, climate stabilisation and recreation.

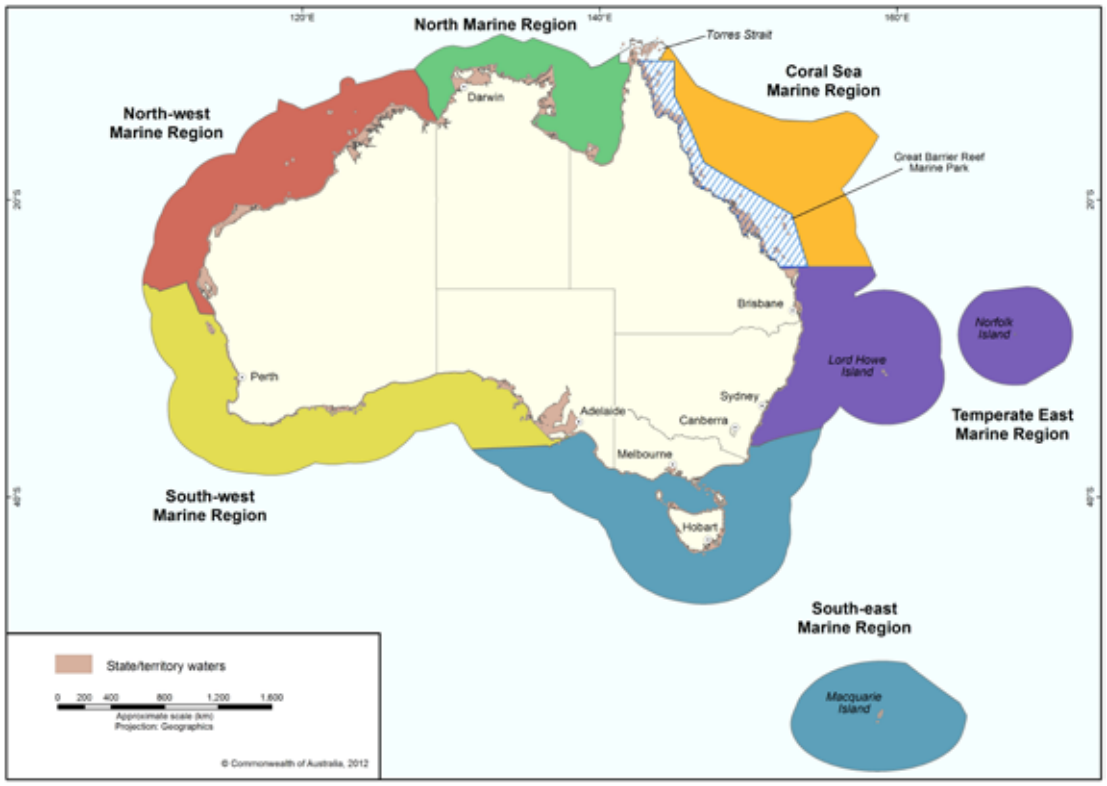


Figure 1.1: Australia's Marine Regions

Box 1.1 Matters of national environmental significance

Under the EPBC Act actions that have or are likely to have a significant impact on matters of national environmental significance require approval by the environment minister. There are currently eight matters of national environmental significance protected under the EPBC Act:

- world heritage properties
- national heritage places
- wetlands of international importance (listed under the Ramsar Convention)
- listed threatened species (except those listed as extinct or conservation dependent) and ecological communities (except those listed as vulnerable)
- migratory species protected under international agreements
- the Commonwealth marine environment
- the Great Barrier Reef Marine Park
- nuclear actions, including uranium mines.

Box 1.2 The ecosystem approach

What is it?

The ecosystem approach is one of the most important principles of sustainable environmental management. Essentially, it recognises that all elements of an ecosystem are interconnected and requires that the effects of actions on the different elements of an ecosystem be taken into consideration in decision-making.

Why do we do it?

Ecosystems are complex and interconnected—what affects one species or habitat will have cascading and possibly unpredictable implications for other species or habitats. In addition, different activities within a marine environment may affect different parts of the interconnected whole or amplify the impacts on particular parts of the natural system.

We wish to prevent problems rather than react to them. This is why we want to address the drivers of biodiversity loss, rather than their symptoms. A focus on building and maintaining the resilience of ecosystems is more efficient and effective than trying to address problems after they have occurred.

1.2 Goal and objectives of the plan

The Temperate East Marine Bioregional Plan aims to strengthen the operation of the EPBC Act in the region to help ensure that the marine environment remains healthy and resilient. The plan will be used by government and industry to improve the way the marine environment is managed and protected.

Consistent with the objectives of the EPBC Act, and in the context of the principles for ecologically sustainable development as defined in the Act, the plan sets the following objectives for the region:

- conserving biodiversity and maintaining ecosystem health
- ensuring the recovery and protection of threatened species
- improving understanding of the region's biodiversity and ecosystems and the pressures they face.

The marine bioregional plan will contribute to these objectives by:

- supporting strategic, consistent and informed decision-making under Commonwealth environment legislation in relation to Commonwealth marine areas
- supporting efficient administration of the EPBC Act to promote the conservation and ecologically sustainable use of the marine environment and its resources
- providing a framework for strategic intervention and investment by government to meet its policy objectives and statutory responsibilities.

The Temperate East Marine Bioregional Plan describes the marine environment and conservation values of the region, identifies and characterises the pressures affecting these conservation values, identifies regional priorities and outlines strategies to address them, and provides advice to decision-makers and people planning to undertake activities in the Temperate East Marine Region in relation to some of the region's conservation values.

1.3 Application of the plan

This plan is for the Temperate East Marine Region, which covers the Commonwealth marine area (Box 1.3) extending from the southern boundary of the Great Barrier Reef Marine Park to Bermagui in southern New South Wales, as well as the waters surrounding Lord Howe and Norfolk islands (Figure 1.2). The plan does not cover state or territory waters but, where relevant, does include information about inshore environments and the way they interact with species and habitats of the Commonwealth marine area.

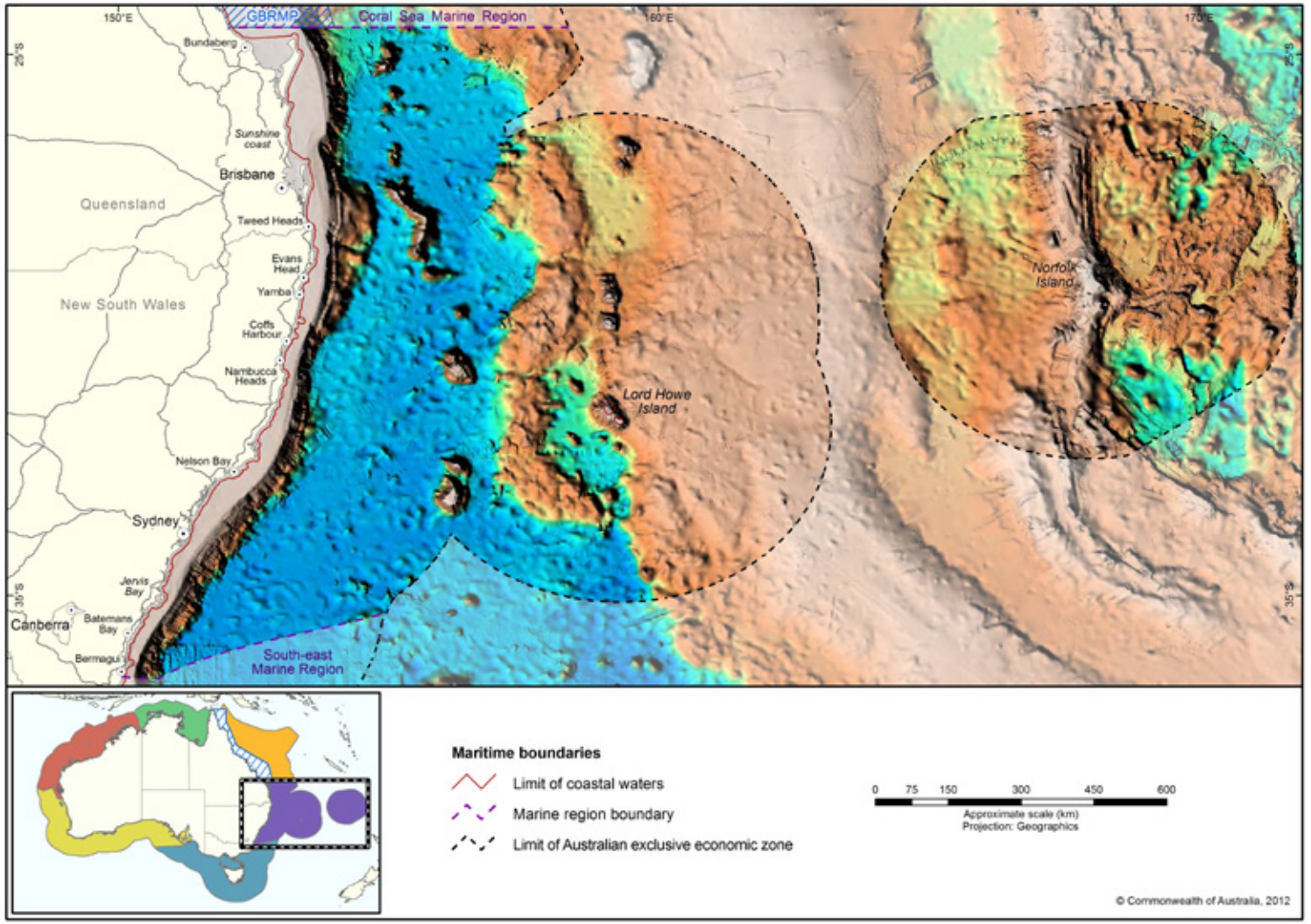


Figure 1.2: Temperate East Marine Region

Under section 176 of the EPBC Act, once a bioregional plan has been prepared, the minister responsible for the environment must have regard to it when making any decision under the Act to which the plan is relevant. The plan does not alter the scope of the minister's statutory responsibilities or narrow the matters the minister is required to take into account or may wish to take into account in making decisions. The EPBC Act provides that this plan is not a legislative instrument. This plan will commence six weeks after it is approved by the minister.

Box 1.3 Commonwealth marine areas

The Australian Government is responsible for the Commonwealth marine area (also known as Commonwealth waters) as defined in section 24 of the EPBC Act (glossary **www.environment.gov.au/marineplans**). The Commonwealth marine area extends beyond the outer edge of state/territory waters, generally some 3 nautical miles (or 5.5 kilometres) from the coast, to the boundary of Australia's exclusive economic zone, generally around 200 nautical miles (or 370 kilometres) from shore (Figure 1.3). In this plan, the Commonwealth marine environment refers to the environment in a Commonwealth marine area.

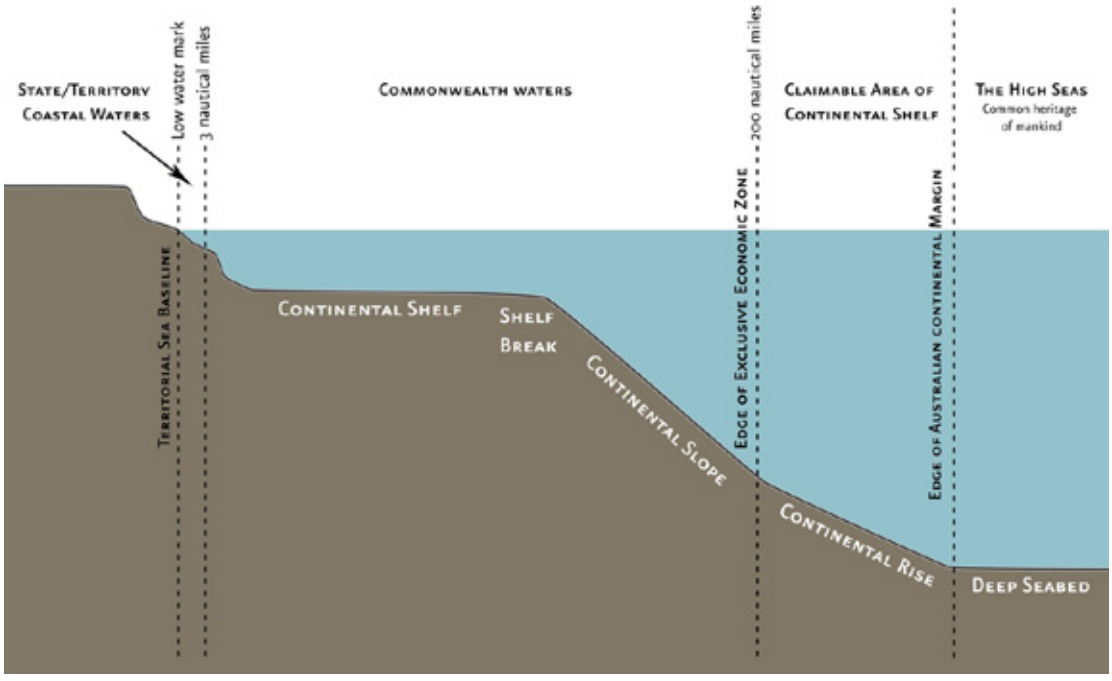


Figure 1.3: Australia's maritime zones

1.4 Key elements of the plan and supporting information

There were five key steps in the preparation of this marine bioregional plan.

1. Characterisation of the marine region

Currently available scientific and other information were used to describe the bio-physical environment and socio-economic characteristics of the marine region and its conservation values, including key ecological features, protected places and species and species groups protected by the EPBC Act. This information was combined in a Bioregional Profile for the region.

2. Regional analysis of the conservation values

The pressures potentially affecting conservation values were identified and characterised against a scale *of concern* in relation to their impacts on the values. The regional pressure analysis was informed by peer reviewed scientific literature, and its findings subject to external review by experts in the relevant fields. The outcomes of the regional pressure analysis are described in schedule 1 and informed both the identification of regional priorities (Part 4) and regional advice on matters of national environmental significance (Schedule 2).

3. Development of regional priorities

The regional pressure analysis assisted in the identification of conservation values that were, or potentially were, adversely affected by multiple pressures, as well as pressures that were impacting on multiple conservation values. Where warranted by the level *of concern*, these conservation values or pressures have been identified as regional priorities and consideration given to the strategies required to address them (Part 4).

4. Development of regional advice

The regional pressure analysis has also informed the development of regional advice in relation to matters of national environmental significance. This advice has been developed to assist people planning to undertake activities in Commonwealth marine areas to better understand and comply with their obligations under the EPBC Act, including helping them to decide whether to refer their proposed activity and determine what information would most usefully accompany any referral.

5. Public consultation on the draft marine bioregional plan

This marine bioregional plan was released in draft form for a 90 day public consultation period. The comments received have been taken into account in finalising this plan.

The plan is made up of a number of parts and is supported by a suite of information resources.

The plan

Part 1 (this part) of the plan provides context about marine bioregional plans. Part 2 of the plan describes the conservation values of the Temperate East Marine Region. Part 3 presents a summary of the analysis of pressures affecting conservation values in the region, undertaken to inform the development of regional priorities. Part 4 introduces the regional priorities and outlines strategies and actions to address them.

Schedules

Schedule 1 of the plan presents a full description of the pressures on conservation values of the Temperate East Marine Region that have been assessed as being *of concern* or *of potential concern*. Schedule 2 provides specific advice on matters of national environmental significance in the region. This regional advice will assist people who plan to undertake activities in, or potentially impacting on, the Commonwealth marine environment to better understand and meet their obligations under the EPBC Act. It will also assist in deciding whether a proposed action should be referred to the minister for assessment, and identify any information that is likely to be required as part of the referral.

Glossary

A glossary of terms used in this plan and relevant to marine bioregional planning is located at **www.environment.gov.au/marineplans**.

Conservation values report cards

The conservation values report cards contain comprehensive information about the conservation values of the Temperate East Marine Region. Conservation values include species and places protected under the EPBC Act and key ecological features. There are three types of conservation value report cards:

- protected species groups
- Commonwealth marine environment (including key ecological features)
- protected places.

The report cards support the information provided in this plan and are available at **www.environment.gov.au/marineplans/temperate-east**. They include:

- a description of the conservation values of the region
- an overview of the vulnerabilities and pressures on the conservation values (*of concern* and *of potential concern*)
- a list of relevant protection measures
- references.

Conservation Values Atlas

The Department of Sustainability, Environment, Water, Population and Communities, as the Australian Government department responsible for administering the EPBC Act, maintains a suite of interactive tools that allow users to search, find and generate reports on information and data describing matters of national environmental significance and other conservation values in the marine environment.

The Conservation Values Atlas is designed to provide a visual representation of the conservation values in each marine region. It shows the location and spatial extent of conservation values (where sufficient information exists) and is available at **www.environment.gov.au/cva**.

Other resources

A number of important reference documents for the Temperate East Marine Region are available at **www.environment.gov.au/marineplans**.

1.5 Who will use the plan?

People who have responsibility for, or interest in, management of marine based activities, environment protection and marine science

The Temperate East Marine Bioregional Plan is an important document for individuals and organisations with an interest in the region and the way national environmental law is administered within Commonwealth waters. The plan provides information that enables people to better understand the Australian Government's marine environment protection and biodiversity conservation responsibilities, objectives and priorities in the region.

People planning to undertake activities in Commonwealth waters, or planning to undertake activities that are likely to have a significant impact on the Commonwealth marine environment

The plan is not a legislative instrument and therefore does not alter the EPBC Act referrals process. People planning to undertake activities within the Temperate East Marine Region can use the plan and supporting information to help decide whether their proposal should be referred in accordance with the EPBC Act.

The minister and department administering the EPBC Act

The minister must have regard to the Temperate East Marine Bioregional Plan in making any decision under the EPBC Act to which the plan is relevant.

Other government agencies

The requirement to have regard to the Temperate East Marine Bioregional Plan in making decisions applies only to the Commonwealth minister administering the EPBC Act. However, the plan provides comprehensive information about the region that assists government decision-making relevant to the Commonwealth marine environment. The plan is underpinned by an ecosystem approach (Box 1.2). This approach requires government decision-makers to consider issues across jurisdictional, sectoral and disciplinary boundaries, so that actions are not considered in isolation from one another. The information provided in the plan assists decision-makers in the Australian Government and other jurisdictions to collaborate more effectively across jurisdictional and sectoral boundaries.

2 THE TEMPERATE EAST MARINE REGION AND ITS CONSERVATION VALUES

The Temperate East Marine Region comprises Commonwealth waters from the southern boundary of the Great Barrier Reef Marine Park to Bermagui in southern New South Wales. It also includes the waters surrounding Lord Howe and Norfolk islands (Figure 1.2). The region covers approximately 1.47 million square kilometres of temperate and subtropical waters and abuts the coastal waters of southern Queensland and New South Wales. It extends from shallow waters on the continental shelf, 3 nautical miles (5.5 kilometres) from shore, to the deep ocean environments at the edge of Australia's exclusive economic zone, 200 nautical miles from shore.

The main physical features of the region are:

- three seamount chains that run parallel to the East coast—the Tasmantid and Lord Howe seamount chains and the Norfolk Ridge
- the East Australian Current, which dominates the oceanography of the region. The East Australian Current brings warm waters from the Coral Sea south along the outer edge of the continental shelf until it moves offshore at approximately 33 degrees south (offshore from the central coast of New South Wales). Along its path, it gives rise to large eddy features that support important areas of enhanced productivity
- the Tasman Front, which forms between 20 and 30 degrees south and represents the meeting point for two distinct bodies of water—the warm, nutrient-poor Coral Sea and the cold, nutrient-rich Tasman Sea. Localised oceanographic processes along the Tasman Front trap nutrients and plankton, creating an important region of enhanced productivity and connectivity pathways
- the canyons of the eastern continental slope, which add critical habitat diversity to the region.

The remainder of this chapter describes the conservation values of the region, including the Commonwealth marine environment and its protected species and places.

2.1 Identification of conservation values

A range of conservation values have been identified in the Temperate East Marine Region. Conservation values are defined as those elements of the region that are:

- key ecological features of the Commonwealth marine area
- species listed under Part 13 of the EPBC Act that live in the Commonwealth marine area or for which the Commonwealth marine area is necessary for a part of their life cycle
- protected places including marine reserves, heritage places and historic shipwrecks in the Commonwealth marine area.

2.2 Conservation values—the Commonwealth marine environment

Biodiversity

The Temperate East Marine Region is characterised by a narrow continental shelf, significant variation in sea-floor features (including seamount chains and canyons), dynamic oceanography, and a unique mix of tropical and cold water reef systems. Temperate species dominate the southern parts of the region, and tropical species become progressively more common towards the north.

The region supports high levels of species richness and diversity, particularly among corals, crustaceans, echinoderms, molluscs, sea sponges and fish. Due to the latitudinal range of the region, this diversity includes both tropical and temperate species. Oceanography is a strong driver for the region's biodiversity. This is particularly true in places like Lord Howe Island and the Elizabeth and Middleton reefs where both warm and cold water species flourish alongside each other. These unusual communities are mainly supported by the tongue of warm water that is driven southwards by the East Australian Current, extending the geographic range of the tropical species.

Further offshore, the East Australian Current influences biodiversity by connecting remote communities, such as those found on the seamounts, through the transport of species between areas. Our understanding of these deeper areas is constantly developing; current data suggests that these areas support exceptional levels of species endemism (as high as 34 per cent) with little overlap in distribution across seafloor features. The varied sea-floor features in the region may function as isolated systems and could support species that may be new to science.

Key ecological features

Key ecological features (KEFs) are elements of the Commonwealth marine environment in the Temperate East Marine Region that, based on current scientific understanding, are considered to be of regional importance for either the region's biodiversity or ecosystem function and integrity.

The criteria used to identify KEFs in the region are:

- a species, group of species or community with a regionally important ecological role, where there is specific knowledge about why the species or species group is important to the ecology of the region, and the spatial and temporal occurrence of the species or species group is known
- a species, group of species or community that is nationally or regionally important for biodiversity, where there is specific knowledge about why the species or species group is regionally or nationally important for biodiversity, and the spatial and temporal occurrence of the species or species group is known
- an area or habitat that is nationally or regionally important for
  - enhanced or high biological productivity
  - aggregations of marine life
  - biodiversity and endemism
- a unique seafloor feature with ecological properties of regional significance.

KEFs were first described in the bioregional profile for each region and have since been modified as a result of further analysis and review by scientific experts.

Eight key ecological features have been identified in the Temperate East Marine Region (Figure 2.1 and Table 2.1). Further information on the KEFs can be found in the Commonwealth marine environment report card (**www.environment.gov.au/marineplans/temperate-east**). Understanding of KEFs may evolve as new scientific information emerges.

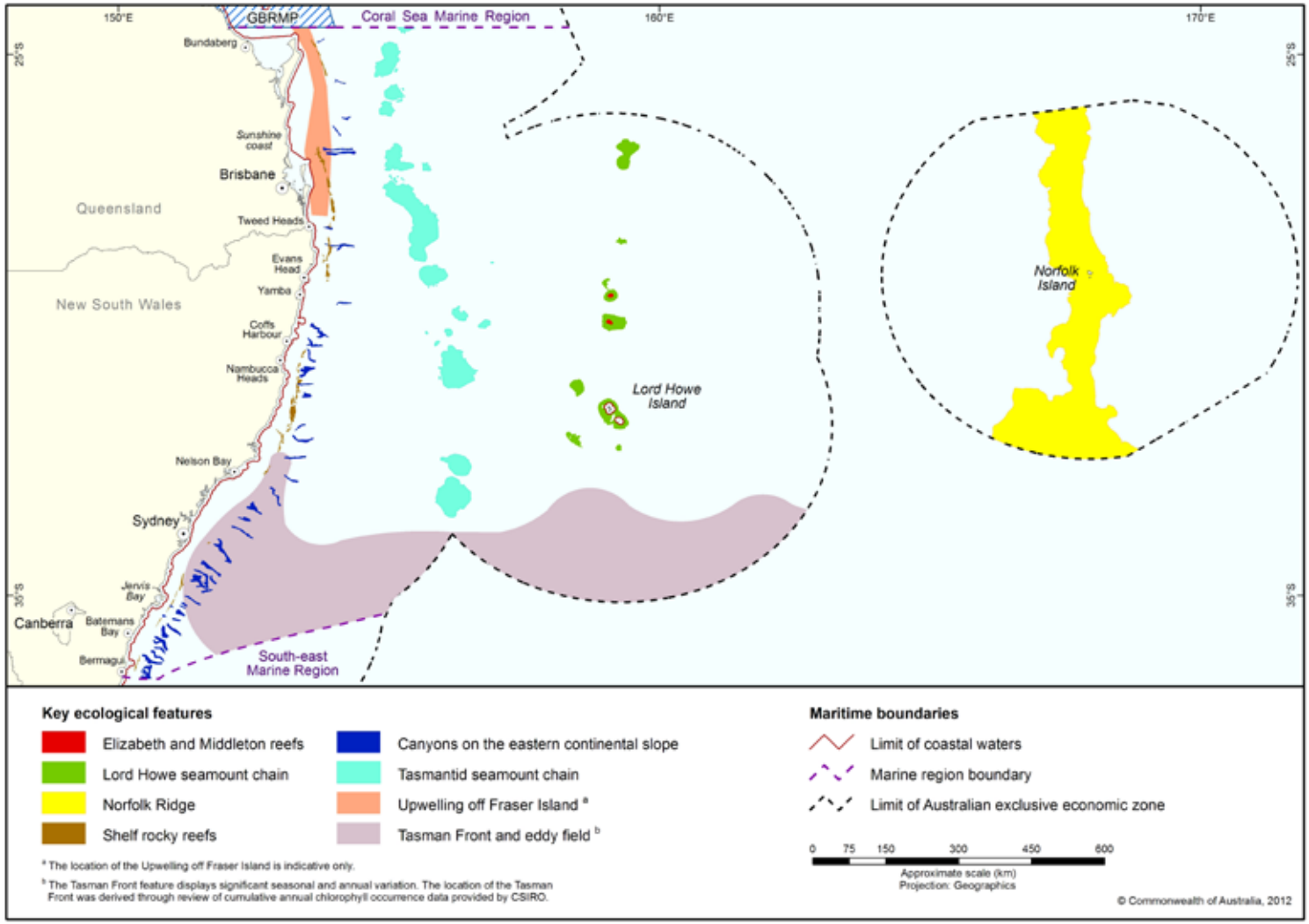


Figure 2.1: Key ecological features of the Temperate East Marine Region

Table 2.1: Key ecological features of the Temperate East Marine Region

Feature	Values	Description
Shelf rocky reefs	Unique sea-floor feature with ecological properties of regional significance	Along the continental shelf south of the Great Barrier Reef, communities associated with the shift from algae-dominated sea-floor communities to those dominated by attached invertebrates (including large sponges, moss animals and soft corals). This shift generally occurs at a depth of 45 m. These invertebrates create a complex habitat that supports a multitude of animals including crabs, snails, worms and starfish. The habitats also contain a diverse assemblage of bottom-dwelling fishes that show distinct patterns of association with shelf-reef habitats.
Canyons on the eastern continental slope	Unique sea-floor feature with ecological properties of regional significance	Canyon systems have a marked influence on the diversity and abundance of species, driven by the combined effects of steep and rugged topography, ocean currents, sea-floor types and nutrient availability. They significantly contribute to the overall habitat diversity of the sea floor, by providing hard surfaces in depth zones where soft sediment habitats prevail. Large benthic animals such as sponges and feather stars are abundant, with particularly high diversity found in the upper slope regions (150–700 m). Canyons also create localised changes in productivity in the water column above them, providing feeding opportunities for a range of species, many of which are commercially important or threatened.
Tasman Front and eddy field	High productivity; aggregations of marine life; biodiversity and endemism	The Tasman Front is a region of intermediate productivity that separates the warm, nutrient-poor waters of the Coral Sea from the cold, nutrient-rich waters of the Tasman Sea. The front is located between 27° S and 33° S, moving north during winter and south in summer. It is associated with warm-core eddies, a number of which are semipermanent features.

Feature	Values	Description
Upwelling off Fraser Island	High productivity; aggregations of marine life	In two areas near Fraser Island, upwellings of cold, deep waters mix with surface waters. Tides, wind and currents draw these nutrient-rich waters onto the shelf, where they generate blooms of phytoplankton that support animals higher in the food chain, including a number of commercially valuable and threatened species.
Tasmantid seamount chain	High productivity; aggregations of marine life; biodiversity and endemism	The Tasmantid seamount chain is a prominent chain of underwater volcanic mountains, plateaux and terraces that runs north–south at approximately 155° E, extending into the Tasman Basin. At the deepest point of the chain, features rise to a depth of 1400–900 m below sea level. At the northernmost extent, features rise to a depth of 400–150 m below sea level, with some breaking the surface to form islands. The Tasmantid seamount chain contains a range of habitats, from deep sea sponge gardens to near-pristine tropical coral reef systems. Collectively, these are biological hotspots with high species diversity. They are also known feeding and breeding grounds for a number of open ocean species (e.g. billfish, marine turtles, marine mammals) and have high species endemism.
Lord Howe seamount chain	High productivity; aggregations of marine life; biodiversity and endemism	The Lord Howe seamount chain runs for approximately 1000 km along the western margin of the Lord Howe Rise, extending from Lord Howe Island in the south to Nova Bank in the north. It supports tropical shallow coral reefs and deep cold water corals.

Feature	Values	Description
Norfolk Ridge	High productivity; aggregations of marine life; biodiversity and endemism	The Norfolk Ridge occurs in a region of remnant volcanic arcs, plateaux, troughs and basins. The ridge runs southward from New Caledonia to New Zealand, between the New Caledonia Trough to the west and the Norfolk Basin to the east. There are likely to be high levels of diversity in seamount communities, caused by relatively productive sea-floor habitats that support population densities far higher than surrounding areas. Benthic habitats along the Norfolk Ridge are also thought to act as 'stepping stones' for animal dispersal, connecting deep water species from New Caledonia to New Zealand.
Elizabeth and Middleton reefs	Aggregations of marine life; biodiversity and endemism	Elizabeth and Middleton reefs are small, isolated, oceanic platform reefs that occur on top of the volcanic seamounts of the Lord Howe seamount chain. The reefs are impacted by the East Australian Current, exposing the area to its warm waters as well as the surrounding cooler ocean. This key ecological feature supports tropical and temperate marine life, including both warm and cold water corals and over 300 fish species. The lagoons of both reefs are important areas for populations of black cod and the Galapagos shark.

2.3 Conservation values—protected species

The Temperate East Marine Region is an important area for protected species. Species listed under the EPBC Act are commonly referred to as protected species and can be listed as threatened species (critically endangered, endangered, vulnerable, conservation dependent), migratory species, cetaceans and marine species (see glossary for a full definition). An individual species may be listed under more than one category.

Threatened species are, in broad terms, those species that have been identified as being in danger of becoming extinct. Species may be listed in the following categories:

- conservation dependent
- vulnerable
- endangered
- critically endangered
- extinct in the wild
- extinct.

(see the glossary for further explanation of these categories).

Migratory species are those species that are listed under:

- the *Convention on the Conservation of Migratory Species of Wild Animals 1979* (CMS or Bonn Convention)
- the *Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment 1974* (JAMBA)
- the *Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment 1986* (CAMBA)
- the *Agreement between the Government of Australia and the Government of the Republic Of Korea on the Protection of Migratory Birds 2007* (ROKAMBA)
- any other international agreement, or instrument made under other international agreements approved by the environment minister.

Further information on the CMS, JAMBA, CAMBA and ROKAMBA is provided at **www.environment.gov.au/biodiversity/migratory/index.html**

Cetaceans (whales, dolphins and porpoises) are all are protected under the EPBC Act in the Australian Whale Sanctuary and, to some extent, beyond its outer limits.

Marine species belong to taxa that the Australian Government has recognised as requiring protection to ensure their long-term conservation (in accordance with sections 248–250 of the EPBC Act). (Refer to Table A in Schedule 2 for listed marine species in the region).

The lists of protected species established under the EPBC Act are updated periodically. This plan refers to the lists of protected species in the region and includes detailed information about species distribution and ecology in the Temperate East Marine Region. Species groups identified as conservation values in the Temperate East Marine Region are:

- bony fishes (10 species)
- cetaceans (9 species)
- marine reptiles (families Cheloniidae, Dermochelyidae, Hydrophiidae and Laticaudidae) (24 species)
- seabirds—(i.e. bird species that occur naturally in Commonwealth marine areas) (34 species)
- sharks (6 species).

Report cards describe the protected species (as of May 2012) and include detailed information about species distribution and ecology in the Temperate East Marine Region.

Biologically important areas have been identified for some of the region's protected species. These are areas that are particularly important for the conservation of protected species and where aggregations of individuals display biologically important behaviour such as breeding, foraging, resting or migration. They have been identified using expert scientific knowledge about species' distribution, abundance and behaviour in the region. The presence of the observed behaviour is assumed to indicate that the habitat required for the behaviour is also present. The selection of species for which biologically important areas have been identified was informed by the availability of scientific information, the conservation status of listed species and the importance of the region for the species. The range of species for which biologically important areas are identified will continue to expand as reliable spatial and scientific information becomes available.

The process for identifying biologically important areas involves mapping proposed areas digitally, based on expert advice and published literature, then obtaining independent scientific review of the maps and descriptions of the proposed areas.

Biologically important area maps and descriptions are available in the Temperate East Marine Region Conservation Values Atlas (**www.environment.gov.au/cva**).

2.4 Conservation values—protected places

Protected places are those places protected under the EPBC Act as matters of national environmental significance—places listed as World Heritage, National Heritage, or wetlands of international importance. Protected places may also include Commonwealth marine reserves and places deemed to have heritage value in the Commonwealth marine environment such as places on the Commonwealth heritage list or shipwrecks under the *Historic Shipwrecks Act 1976*.

Protected places in the region are shown in Figure 2.2 and described in Table 2.2.

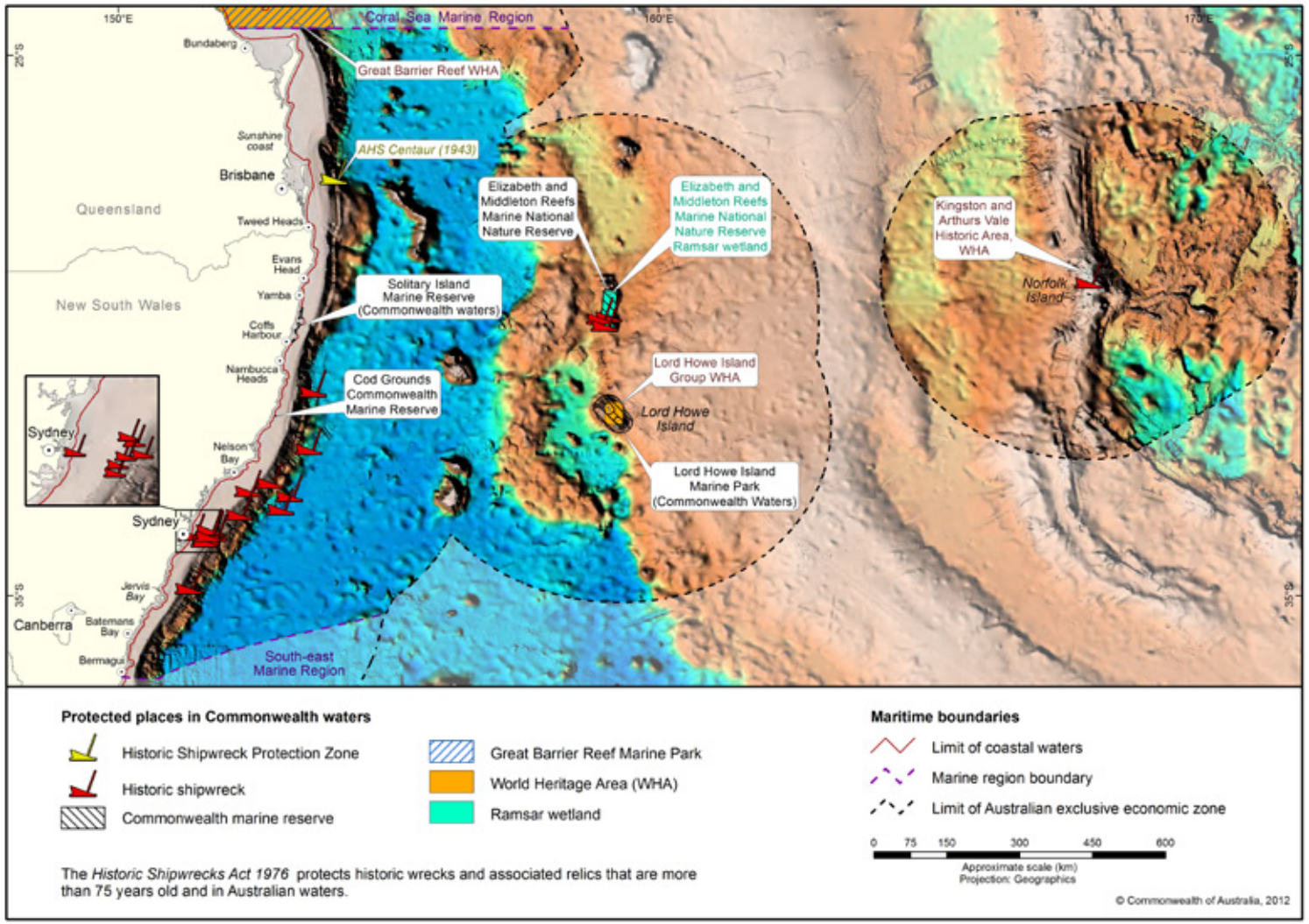


Figure 2.2: Protected places in the Temperate East Marine Region as of May 2012

Table 2.2: Protected places in the Temperate East Marine Region as of May 2012

Protected place	Protection measure	Relevant key ecological feature
Elizabeth and Middleton Reefs Marine National Nature Reserve	Commonwealth marine reserve Ramsar site	Elizabeth and Middleton Reefs
Solitary Islands Marine Reserve (Commonwealth waters)	Commonwealth marine reserve	
Cod Grounds Commonwealth Marine Reserve	Commonwealth marine reserve	
Lord Howe Island Marine Park (Commonwealth waters)	Commonwealth marine reserve World Heritage List National Heritage List	Lord Howe seamount chain

Commonwealth marine reserves are relevant in EPBC Act decision making on referred matters and explicitly referenced in the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines*.

3 PRESSURES AFFECTING CONSERVATION VALUES

3.1 Analysis of pressures on conservation values

The pressure analysis assessed present and emerging pressures affecting conservation values in the Temperate East Marine Region and the effectiveness of mitigation and management arrangements that are currently in place to address these pressures. The analysis enabled pressures to be categorised in terms of their relative importance or concern, and has informed the identification of regional conservation priorities and the development of regional advice. For the purpose of this plan, pressures are defined broadly as human-driven processes and events that do or can detrimentally affect the region's conservation values.

The analysis considered pressures affecting all key ecological features and protected places and a number of species belonging to the species groups bony fishes, cetaceans, reptiles, seabirds and sharks. Considerations used for selecting the species for analysis were specific to the biological characteristics of the species groups, but broadly centred on the relative significance of the region to the conservation of the particular species. In assessing the significance of the region for a species' conservation, key considerations included the species' conservation status, distribution, population structure within the region and life history characteristics, and the potential for the population(s) in the region to be genetically distinct from populations elsewhere. Table 3.1 lists and provides an explanation of the species selected for inclusion in the pressure analysis for the Temperate East Marine Region.

A range of pressures from a range of sources was considered in the pressure analysis. Table S1.1 in Schedule 1 provides a list of the type and source of pressures available for inclusion in the analysis. Not every type and source of pressure in this list was assessed against every conservation value. Only those pressures relevant to the conservation value being analysed were considered.

The analysis included a review of scientific and expert literature, and was informed by the findings of relevant environmental and impact assessment studies, risk assessments and expert opinion. The pressure analysis considered, for each selected conservation value, information derived from available reports and research about:

- the spatial location and intensity of the pressure(s), both current and anticipated
- the location of the conservation value—that is, its distribution and the location of areas important to it

- current understanding of impacts (at relevant scales) resulting from the interaction between the pressure(s) and the conservation value
- the effectiveness of current management and impact mitigation measures.

Table 3.1: Protected species selected for the pressure analysis

Species group	Group-specific considerations for selection	Species selected for detailed pressure analysis
Bony fishes	Species were selected on the basis of their occurrence in the region, their listing under the EPBC Act, and the importance of the region to their survival.	**Eastern gemfish** **Orange roughy** **Black cod** **Big-bellied or pot-bellied seahorse** **Bullneck seahorse** **Duncker's pipehorse** **Great (Kellogg's) seahorse** **Hardwick's pipehorse** **Sad seahorse** **Weedy seadragon**
Cetaceans	Species were selected on the basis of their occurrence in the region, their listing as threatened and/or migratory and/or cetacean species under the EPBC Act, and the importance of the region to their survival. The two inshore dolphin species selected, although generally coastal species, also occur in the Commonwealth marine environment of the Temperate East Marine Region. The Indo-Pacific humpback dolphin occurs in a variety of habitats, usually less than 20 m deep, including inshore reefs, tidal and dredged channels, mangroves and river mouths. The Indo-Pacific bottlenose dolphin occurs in riverine and coastal waters, shallow waters on the continental shelf and around oceanic islands.	**Blue whale** **Dwarf minke whale** **Humpback whale** **Killer whale** **Fin whale** **Sei whale** **Southern right whale** **Indo-Pacific (coastal) bottlenose dolphin** **Indo-Pacific humpback dolphin**

Species group	Group-specific considerations for selection	Species selected for detailed pressure analysis
Marine Reptiles	Marine turtle species were selected on the basis of their occurrence in the region, their listing as threatened species under the EPBC Act, and the presence of important breeding or foraging areas for the species in and adjacent to the region. Sea snake species were selected on the basis of their occurrence in the region, and their listing under the EPBC Act as marine species.	**Green turtle** **Hawksbill turtle** **Leatherback turtle** **Loggerhead turtle** **Beaked seasnake** **Blue-lipped sea krait** **Colubrine sea krait** **Dubois' seasnake** **Elegant seasnake** **Horned seasnake** **Laboute's seasnake** **Little file snake** **Marbled or spine-tailed seasnake** **Olive-headed seasnake** **Olive seasnake** **Plain-banded seasnake** **Small-headed seasnake** **Spectacled seasnake** **Spotted seasnake** **Stokes' seasnake** **Turtle-headed seasnake** **White-bellied mangrove snake** **Yellow seasnake** **Yellow-bellied seasnake**

Species group	Group-specific considerations for selection	Species selected for detailed pressure analysis
Seabirds	Seabird species were selected on the basis of their occurrence in the region, their listing as threatened and/or migratory and/or marine species under the EPBC Act, and the presence of important breeding or foraging areas for the species in and adjacent to the region. The Lord Howe Island group and Norfolk Island group support internationally and nationally significant breeding sites for a number of seabirds in the region.	**Black noddy** **Common noddy** **Crested tern** **Roseate tern** **Sooty tern** **White tern** **Grey ternlet** **Flesh-footed shearwater** **Little shearwater** **Short-tailed shearwater** **Sooty shearwater** **Wedge-tailed shearwater** **Black petrel** **Black-winged petrel** **Gould's petrel** **Great-winged petrel** **Kermadec petrel** **Providence petrel** **White-bellied storm-petrel** **White-faced storm-petrel** **White-necked petrel** **Wilson's storm-petrel** **Northern giant-petrel** **Southern giant-petrel** **Antipodean albatross** **Black-browed albatross** **Campbell albatross** **Indian yellow-nosed albatross** **Salvin's albatross** **Wandering albatross** **White-capped albatross** **Little penguin** **Masked booby** **Red-tailed tropicbird**

Species group	Group-specific considerations for selection	Species selected for detailed pressure analysis
Sharks	Shark species were selected on the basis that they were protected under the EPBC Act and have or are presumed to have important feeding, breeding or nursery areas within the region. They include species under consideration for listing under the EPBC Act known to occur in the Temperate East Marine Region.	**Grey nurse shark** **Porbeagle shark** **Longfin mako shark** **Shortfin mako shark** **Whale shark** **White shark**

3.2 Outcome of pressure analysis

Human pressures on marine ecosystems and biodiversity in the Temperate East Marine Region are, by global standards, low. However, the region is adjacent to the highly populated coasts of New South Wales and southern Queensland, and parts of the region closest to the coast will be subject to higher impact. These pressures are addressed, in part, by Australia's generally sound management of the marine environment.

A number of sources of pressures nevertheless exist in the region. The main drivers and sources of anthropogenic pressure on conservation values in the region are:

- climate change and associated large-scale effects, including shifts in major currents, rising sea levels, ocean acidification, and changes in the variability and extremes of climatic features (e.g. sea temperature, winds, storm frequency and intensity)
- extraction of living resources
- increasing urban and industrial development in areas adjacent to the region
- increasing shipping and port activities.

The findings of the pressure analysis are presented in Schedule 1 of the plan and in the Temperate East Marine Region conservation value report cards (**www.environment.gov.au/marineplans/temperate-east**).

4 REGIONAL PRIORITIES, STRATEGIES AND ACTIONS

4.1 Regional priorities

Regional priorities are key areas of focus that have been identified to inform decision-making about marine conservation and planning, as well as industry development and other human activities. The regional priorities provide context for implementing the government's statutory responsibilities, such as recovery planning for threatened species and the development and implementation of threat abatement measures. They also point to where future government initiatives and future investments in marine conservation, including in research and monitoring, would be best directed.

The identification of regional priorities for the Temperate East Marine Region has been guided by the outcomes of the pressure analysis. In identifying regional priorities, consideration has been given to the following:

- conservation values that are subject to
  - a pressure considered *of concern* for the conservation value, and
  - pressures that together are likely to result in cumulative impacts on the value, and/or
  - pressure(s) that are likely to increase substantially in intensity and extent over the next 5–10 years
- pressures that are considered *of concern* for multiple conservation values
- areas where better knowledge would improve the government's capacity to meet conservation and ecologically sustainable use objectives
- Australian Government policy priorities for the marine region.

Only a subset of conservation values and pressures assessed as being *of concern* or *of potential concern* has been identified as regional priorities. Generally, when a pressure affects multiple values and its effects are *of concern* for at least some of these values, then the pressure is identified as a regional priority. Similarly, if a conservation value is, or is likely to be, affected detrimentally by multiple pressures, and at least one of the pressures has been assessed as *of concern*, it is considered to be a regional priority. Other key considerations in determining pressure-based regional priorities included issues of scale, legislative responsibility, conservation status, effectiveness of existing management arrangements, and level of uncertainty about distribution, abundance and status of conservation values and the pressures acting on them.

Temperate East Marine Region priorities

This plan identifies 16 regional priorities for the Temperate East Marine Region: 12 conservation values and four pressures, which are further discussed in Tables 4.1 and 4.2 respectively. The strategies and actions to address these priorities are detailed in Section 4.2.

Building on the identification of regional priorities, available information and existing administrative guidelines, this plan provides advice to assist decision-makers, marine industries and other users to understand and meet the obligations that exist with respect to these priorities under the EPBC Act (Schedule 2).

Table 4.1: Conservation values of regional priority for the Temperate East Marine Region

	Conservation value	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
1	**Inshore dolphins** Indo Pacific humpback dolphin (EPBC Act listed as cetacean and migratory) Indo Pacific bottlenose dolphin (EPBC Act listed as cetacean)	The Indo-Pacific humpback dolphin and Indo-Pacific bottlenose dolphin are known to occur in the Temperate East Marine Region. Both species are listed as cetacean, while the Indo-Pacific humpback is also listed as migratory under the EPBC Act. The Temperate East Marine Region and adjacent waters are known breeding and foraging/feeding areas for both species. Dolphins are particularly vulnerable to impacts from human activities because of the overlap between their preferred inshore habitats and the highly populated coastal fringe. This vulnerability is compounded by biological characteristics such as late-age sexual maturation and low reproduction rates. Inshore dolphin species in the Temperate East Marine Region are subject to a number of pressures assessed as *of concern*: physical habitat modification (urban and coastal development), bycatch (commercial fishing) and bycatch (bather protection). A further suite of pressures are *of potential concern*. These are physical habitat modification (dredging and dredge spoil), climate change (ocean acidification, sea level rise, changes in sea temperature, changes in oceanography, changes in hydrological regimes), oil pollution (shipping), chemical pollution (onshore activities e.g. agriculture) and nutrient pollution (onshore activities e.g. agriculture), noise pollution (shipping, urban development), collision with the vessels and marine debris.	Strategy A, Action 3 and 6 Strategy B, Action 1 Strategy C, Action 3 Strategy D, Action 1 and 5 Strategy E, Action 3

	Conservation value	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
2	**Marine turtles** Green turtle Hawksbill turtle (EPBC Act listed as vulnerable, migratory and marine) Leatherback turtle Loggerhead turtle (EPBC Act listed as endangered, migratory and marine)	Four of the world's seven marine turtles are known to inhabit the Temperate East Marine Region. All four species are listed as threatened under the EPBC Act. The region and adjacent areas are known to support important nesting and/or foraging areas for all four species. The varied use of the marine environment by marine turtles across different developmental stages (e.g. juvenile, young adult) means that they are exposed to a wide range of pressures. In the Temperate East Marine Region, marine turtles are subject to a number of pressures assessed as *of concern* and *of potential concern*, with differences in the two ratings varying between the four species. For example, bycatch was assessed as *of concern* to green, loggerhead and leatherback turtles, and *of potential concern* to hawksbill turtles. Climate change, including sea level rise, changes in sea temperatures and sand temperatures was assessed as *of concern* to loggerhead turtles. Changes in sea temperatures and oceanography are *of potential concern* to green, hawksbill and leatherback turtles, while sea level rise is *of potential concern* to green turtles. Other pressures, such as chemical pollution/ contaminants, nutrient pollution, marine debris, light pollution, physical habitat modification, extraction of living resources, invasive species and oil pollution were rated *of potential concern* to one or more of the four species assessed. The conservation status of marine turtles, the significance of the Temperate East Marine Region to their recovery, and the pressures facing them in the region make this species group a priority for conservation effort.	Strategy A, Actions 2, 3 and 6 Strategy B, Action 1 Strategy C, Action 3 Strategy D, Action 1 and 5 Strategy E, Actions 1 and 2 Strategy G, Action 1
3	**Grey nurse shark** *(east coast population)* (EPBC Act listed as critically endangered)	The Temperate East Marine Region and adjacent state waters are known to support aggregation, mating and pupping areas for the grey nurse shark. The Cod Grounds and Solitary Islands are also recognised as important areas for this species in Commonwealth waters. The eastern grey nurse shark population is subject to bycatch from both the commercial and recreational sectors; these pressures are assessed as *of concern*. Pressures *of potential concern* include climate change (changes in sea temperature, changes in oceanography) and human presence at sensitive sites. The grey nurse shark is a regional priority because of the species' conservation status, the importance of the region to the species and the pressures impacting the population in the region.	Strategy A, Actions 2 and 3 Strategy B, Action 1 Strategy C, Action 3 Strategy D, Action 1 Strategy E, Actions 1 and 2

	Conservation value	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
4	**White shark** (EPBC Act listed as vulnerable)	The Temperate East Marine Region and adjacent waters are known to support aggregations of the white shark. White sharks move seasonally along the coast between temporary residence sites which typically correspond to regions of high prey density. The Stockton Beach–Hawks Nest area and Fraser Island are recognised as aggregation areas. The white shark is vulnerable to a number of pressures. Bycatch from the recreational fishing sector is considered *of concern*, while a range of additional pressures are considered *of potential concern*. These include bycatch (commercial fishing), extraction of living resources (non-domestic commercial fisheries), extraction of living resources (illegal, unreported and unregulated fishing) and climate change (changes in sea temperature and oceanography). The white shark is a regional priority because of the species' conservation status, the importance of the region to the species and the pressures impacting the population in the region.	Strategy A, Actions 2, 3 and 6 Strategy B, Action 1 Strategy C, Action 3 Strategy D, Action 1 Strategy E, Actions 1 and 2

	Conservation value	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
5	**Seabirds breeding on islands in the Temperate East Marine Region** **Terns *(including noddies)*** Black noddy Common noddy Crested tern Sooty tern White tern Grey ternlet **Shearwaters** Flesh footed shearwater Little shearwater Short-tailed shearwater Wedge-tailed shearwater **Petrels** Black-winged petrel	A number of islands across the region support globally important nesting sites, most notably the Lord Howe and Norfolk Island groups, as well as a series of smaller islands along the NSW coast, including Cabbage Tree, Broughton, Little Broughton and Montague islands. In addition to nesting activity, the surrounding waters support foraging areas for parents to provide food for chicks. Seabirds breeding in the region are subject to a range of pressures. Invasive species are considered to be *of concern*. Pressures rated *of potential concern* are: climate change (changes in sea temperature and oceanography, ocean acidification), oil and chemical pollution and contaminants (shipping), marine debris, light pollution (for selected petrel and shearwater species), bycatch (for selected shearwater species) associated with commercial and recreational fishing and human presence at sensitive sites. The analysis of these pressures varied across the twenty species, and these rating examples have not been applied uniformly. Breeding seabirds are a regional priority because of their conservation status, the importance of the region in the provisioning of young, the pressures impacting populations in the region, and their status as an Australian Government policy priority.	Strategy A, Actions 2, 3 and 6 Strategy B, Action 1 Strategy C, Action 3 Strategy D Actions 1 and 5 Strategy E, Actions 1 and 2 Strategy G, Action 1

	Conservation value	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
5	Gould's petrel (EPBC Act listed as endangered) Kermadec petrel Providence petrel White-bellied storm-petrel (EPBC Act listed as vulnerable) White-faced storm-petrel White-necked petrel Other Little penguin Masked booby Red-tailed tropicbird	A number of islands across the region support globally important nesting sites, most notably the Lord Howe and Norfolk Island groups, as well as a series of smaller islands along the NSW coast, including Cabbage Tree, Broughton, Little Broughton and Montague islands. In addition to nesting activity, the surrounding waters support foraging areas for parents to provide food for chicks. Seabirds breeding in the region are subject to a range of pressures. Invasive species are considered to be *of concern*. Pressures rated *of potential concern* are: climate change (changes in sea temperature and oceanography, ocean acidification), oil and chemical pollution and contaminants (shipping), marine debris, light pollution (for selected petrel and shearwater species), bycatch (for selected shearwater species) associated with commercial and recreational fishing and human presence at sensitive sites. The analysis of these pressures varied across the twenty species, and these rating examples have not been applied uniformly. Breeding seabirds are a regional priority because of their conservation status, the importance of the region in the provisioning of young, the pressures impacting populations in the region, and their status as an Australian Government policy priority.	Strategy A, Actions 2, 3 and 6 Strategy B, Action 1 Strategy C, Action 3 Strategy D Actions 1 and 5 Strategy E, Actions 1 and 2 Strategy G, Action 1
6	**Shelf rocky reefs**	Shelf rocky reefs of the Temperate East Marine Region support a range of complex benthic habitats that, in turn, support diverse benthic communities. The ecosystem functioning and integrity of Temperate East shelf rocky reefsare subject to a number of pressures rated as *of potential concern*: bycatch and extraction of living resources (commercial fishing), physical habitat modification (fishing gear), climate change (ocean acidification, changes to sea temperature and oceanography) and marine debris. It has been identified as a regional priority on the basis of its important contribution to the region's biodiversity. Its selection also acknowledges the need to prioritise research to further understand its ecological functioning.	Strategy A, Actions 3 and 4 Strategy B, Action 1 Strategy C, Action 3 Strategy D, Actions 1 and 2 Strategy F, Action 1

	Conservation value	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
7	**Canyons on the eastern continental slope**	The canyons on the eastern continental slope provide habitat (through changes in topography and productivity) that supports a diverse range of benthic, demersal and pelagic species. The ecosystem functioning and integrity of the canyons are subject to a number of pressures rated as *of potential concern*: physical habitat modification, bycatch and extraction of living resources (commercial fishing), climate change (changes to sea temperature and oceanography), marine debris, and oil and chemical pollution/ contaminants (shipping). The canyons on the eastern continental slope have been identified as a regional priority on the basis of their important contribution to the region's biodiversity. This selection also acknowledges the need to prioritise research to further understand its ecological functioning.	Strategy A, Actions 3 and 4 Strategy B, Action 1 Strategy C, Action 3 Strategy D, Actions 1 and 2 Strategy F, Action 1
8	**Tasman Front and eddy field**	The Tasman Front and eddy field contains complex and dynamic oceanographic processes support transient patches of enhanced productivity that, in turn, attract aggregations of species across trophic levels, including top predators such as tuna and sharks. This feature also supports biological connectivity with seamount habitats further offshore. The ecosystem functioning and integrity of this key ecological feature is subject to a number of pressures rated as *of potential concern*: bycatch and extraction of living resources (commercial fishing), climate change (changes to sea temperature and oceanography), marine debris, and shipping-related oil and chemical pollution/ contaminants. This key ecological feature has been identified as a regional priority on the basis of its important contribution to the region's biodiversity. Its selection also acknowledges the need to prioritise research to further understand its ecological functioning.	Strategy A, Actions 3 and 4 Strategy B, Action 1 Strategy C, Action 3 Strategy D, Actions 1 and 2 Strategy F, Action 1

	Conservation value	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
9	**Upwelling off Fraser Island**	The upwelling off Fraser Island provides nutrient-rich waters which support a range of species, including a number of commercially valuable and protected species. The ecosystem functioning and integrity of the upwelling are subject to a number of pressures rated as *of potential concern*: bycatch and extraction of living resources (commercial fishing), climate change (changes to sea temperature and oceanography), marine debris, and ship-related oil and chemical pollution. The upwelling has been identified as a regional priority on the basis of its important contribution to the region's biodiversity. Its selection also acknowledges the need to prioritise research to further understand its ecological functioning.	Strategy A, Actions 3 and 4 Strategy C, Action 3 Strategy D, Actions 1 and 2 Strategy F, Action 1
10	**Tasmantid seamount chain**	The Tasmantid seamount chain supports aggregations of marine life, biodiversity and endemism. The feature supports a range of habitats in temperate and subtropical waters, significant demersal and pelagic diversity, important feeding and breeding sites for a number of open ocean species (e.g. billfish, marine turtles, marine mammals) and high levels of endemism. The ecosystem functioning and integrity of this key ecological feature is subject to a number of pressures rated as *of potential concern*: bycatch and extraction of living resources (commercial fishing), climate change (changes to sea temperature and oceanography), marine debris, and shipping-related oil and chemical pollution. This key ecological feature has been identified as a regional priority on the basis of its important contribution to the region's biodiversity and endemism. Its selection also acknowledges the need to prioritise research to further understand its ecological functioning.	Strategy A, Actions 3 and 4 Strategy B, Action 1 Strategy C, Action 3 Strategy D, Actions 1 and 2 Strategy F, Action 1

	Conservation value	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
11	**Lord Howe seamount chain**	The Lord Howe seamount chain supports aggregations of marine life, biodiversity and endemism. It provides important benthic habitat diversity and is thought to act as an important biological 'stepping stone', connecting deepwater fauna from New Caledonia to New Zealand. The ecosystem functioning and integrity of the seamount chain are subject to a number of pressures rated *of potential concern*: bycatch and extraction of living resources (commercial fishing activities), climate change (ocean acidification, changes to sea temperature and oceanography), marine debris, and shipping-related oil and chemical pollution. The Lord Howe seamount chain has been identified as a regional priority on the basis of its important contribution to the region's biodiversity and endemism. Its selection also acknowledges the need to prioritise research to further understand its ecological functioning.	Strategy A, Actions 3 and 4 Strategy B, Action 1 Strategy C, Action 3 Strategy D, Actions 1 and 2 Strategy F, Action 1
12	**Elizabeth and Middleton reefs**	The Elizabeth and Middleton reefs support aggregations of marine life, biodiversity and endemism. A small and isolated area, the reefs supports a diverse range of tropical and temperate marine life, including both warm water and cold water corals, and over 300 fish species. The lagoons of both reefs are strongholds for populations of black cod and the Galapagos shark. The ecosystem functioning and integrity of the reefs are vulnerable to climate change impacts, particularly changes in sea temperature and ocean acidification, pressures that have been rated as *of concern*. Pressures rated *of potential concern* are: sea level rise, changes in oceanography, marine debris, and shipping-related oil, chemical and light pollution. The Elizabeth and Middleton reefs are identified as a regional priority on the basis of their important contribution to the region's biodiversity and endemism, the pressures impacting on those values, and its status as an Australian Government priority as an existing Commonwealth marine reserve.	Strategy A, Actions 3 and 4 Strategy B, Action 1 Strategy C, Action 3 Strategy F, Action 1

Table 4.2: Pressures of regional priority for the Temperate East Marine Region

	Pressure	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
13	**Climate change**	Climate change-related pressures including changes in sea temperature and oceanographic processes, ocean acidification, sea level and storm intensity, are predicted to increase in the Temperate East Marine Region, with the potential to impact the region's conservation values (key ecological features and protected species) to varying extents. There is considerable variation in the ratings *of concern* and *of potential concern* across the conservation values. Overall, changes in sea temperatures and oceanography were considered *of potential concern* to many of the key ecological features and species, with ocean acidification of greater significance for deep and shallow water reef features, cetaceans and seabirds and sea level rise more important for habitats associated with inshore dolphins and some breeding seabirds. Increasing sand temperature was identified as a pressure for nesting marine turtles. Climate change has been identified as a priority because of the extent of predicted impacts on conservation values in the region, particularly the cumulative nature of these impacts. Its selection also acknowledges the need to prioritise research to further understand the nature and extent of climate change impacts in the region.	Strategy A, Action 3 Strategy B, Action 2 Strategy E, Action 1 Strategy G, Action 1

	Pressure	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
14	**Marine debris**	The EPBC Act lists *'injury and fatality to vertebrate marine life caused by the ingestion of, or entanglement in, harmful marine debris'* as a key threatening process. Information on the extent and impact of marine debris in the Temperate East Marine Region is limited; however, a number of activities in and adjacent to the region increase the likelihood of the prevalence of marine debris, including commercial and recreational fishing, shipping, and urban and industrial development along the coast. In the Temperate East Marine Region, marine debris has emerged as a pressure with the potential to impact on many of the region's conservation values to varying extents. It has been assessed as *of concern* for marine turtles (green and loggerhead) and *of potential concern* for cetaceans, seabirds, school shark and all key ecological features. Marine debris has been identified as a priority because of its interaction with a range of conservation values across the region, and its status as an Australian Government policy priority. Its selection also acknowledges the need to prioritise research to further understand the nature and extent of its impacts in the region.	Strategy A, Action 5 Strategy B, Action 2 Strategy E, Actions 1 and 4 Strategy G, Action 1

	Pressure	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
15	**Bycatch**	Bycatch associated with fishing activities is one of the most pervasive pressures on conservation values in the region. Bycatch refers to marine life that is accidentally caught during fisheries operations and cannot be retained, thereby impacting on species populations and the diversity associated with key ecological features. The Temperate East Marine Region supports a significant commercial fishing industry and bycatch from commercial fishing activities has been assessed as *of concern* for inshore dolphins, killer whale, marine turtles (green, loggerhead and leatherback), the grey nurse shark and foraging seabirds (selected petrel, albatross and shearwater species). It is considered *of potential concern* for hawksbill turtle, white shark, , foraging seabirds (selected shearwater, albatross and petrel species) and a number of key ecological features (Tasman Front and eddy field, upwelling off Fraser Island, Norfolk Ridge, Tasmantid and Lord Howe seamount chains, shelf rocky reefs and canyons). Bycatch from recreational fishing has also been identified as *of concern* for grey nurse and white sharks, and *of potential concern* for the fleshfooted shearwater. In addition, bycatch from bather protection schemes is *of concern* for the Indo-Pacific (coastal) bottlenose dolphin and the Indo-Pacific humpback dolphin and bycatch from illegal fishing activities is *of concern* to four turtle species, and *of potential concern* for the humpback whale. Bycatch has been identified as a priority because of its interaction with a high number of priority conservation values across the region.	Strategy A, Action 5 Strategy B, Action 2 Strategy D, Action 1 Strategy E, Actions 1 and 4

	Pressure	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
16	**Extraction of living resources**	A number of conservation values in the Temperate East Marine Region are vulnerable to the extraction of living resources by commercial and recreational fishing and illegal, unregulated and unreported fishing. Commercial fishing effort overlaps with seven of the eight key ecological features in the region, and was assessed as *of potential concern* for these features. Currently, it is difficult to quantify the exact impacts of target and by-product species take at these features, however, depending on the intensity of effort and composition of catch, the extraction of living resources from these key ecological features has the potential to affect trophic structures and ecological functioning. Extraction of living resources has been identified as a priority because it interacts with multiple conservation values, and because there is a limited understanding of its impacts on ecosystem function.	Strategy A, Action 5 Strategy B, Action 2 Strategy D, Action 2 Strategy E, Action 1 and 4 Strategy G, Action 1

4.2 Strategies and actions

The Temperate East Marine Bioregional Plan includes seven strategies to address its priorities:

Strategy A: Increase collaboration with relevant research organisations to inform and influence research priorities and to increase the uptake of research findings to inform management and administrative decision-making.

Strategy B: Establish and manage a Commonwealth marine reserve network in the Temperate East Marine Region as part of a national representative system of marine protected areas.

Strategy C: Provide relevant, accessible and evidence-based information to support decision-making with respect to development proposals that come under the jurisdiction of the EPBC Act.

Strategy D: Increase collaboration with relevant industries to improve understanding of the impacts of anthropogenic disturbance and address the cumulative effects on the region's key ecological features and protected species.

Strategy E: Develop targeted collaborative programs to coordinate species recovery and environmental protection efforts across Australian Government and state and territory agencies with responsibilities for the marine environment.

Strategy F: Improve monitoring, evaluation and reporting on ecosystem health in the marine environment.

Strategy G: Participate in international efforts to manage conservation values and pressures of regional priority.

Within each strategy, actions have been designed to address one or more of the regional priorities. A few actions are not linked directly to regional priorities but have been included as enabling actions—that is, they provide the necessary foundation and/or mechanisms for addressing the regional priorities in a coordinated, effective and efficient way.

Actions under the strategies are classified in terms of their implementation timeframe:

- **immediate actions** are those expected to be implemented within 6–12 months (these usually relate to priorities where the level *of concern* is high and management responses are either under way or expected to begin in the near future)
- **short-term actions** are those expected to be implemented within 2 years
- **medium-term actions** are those expected to be implemented within 3–5 years
- **long-term actions** are those expected to be implemented within 8–10 years, and usually relate to research into ecological effects that involves observational studies requiring long timeframes
- **ongoing actions** commonly cover routine administrative decision-making under the EPBC Act (e.g. administration of the fisheries assessment provisions).

The actions identified to address the Temperate East Marine Region's priorities are listed under each strategy (in no particular order) below:

Strategy A: Increase collaboration with relevant research organisations to inform and influence research priorities and to increase the uptake of research findings to inform management and administrative decision-making

1. Improve existing mechanisms and establish new mechanisms to facilitate the uptake of marine research findings so that they can inform administrative and management decisions (short term).

2. Support research undertaken through relevant recovery plans for marine turtles, seabirds, white shark and grey nurse shark (regional priorities 2–5— short term).

3. Support research to improve information on the impacts of climate change on protected species and key ecological features; in particular, their vulnerability and adaptive capacity to predicted changes (regional priorities 1–13—medium to long term).

4. Improve knowledge of the processes driving biodiversity and ecosystem functioning of priority key ecological features of the Temperate East Marine Region (regional priority 6–12—medium to long term).

5. Improve knowledge on the pressures of marine debris, bycatch and extraction of living marine resources on conservation values in the Temperate East Marine Region (regional priorities 14–16—short to medium term).

6. Improve information on biologically important areas for protected species and species considered under pressure within the Temperate East Marine Region, with priority given to:

- inshore dolphin (regional priority 1—short to medium term)
- marine turtles (regional priority 2—short to medium term)
- white shark (regional priority 4—short to medium term)
- seabirds (regional priority 5—short to medium term).

Strategy B:
Establish and manage a Commonwealth marine reserve network in the Temperate East Marine Region as part of the national representative system of marine protected areas

1. Ensure that management arrangements for marine reserves contribute to the protection and conservation of the region's biodiversity and ecosystem function and integrity (regional priorities 1–8 and 10–12—medium to long term).

2. Ensure that management arrangements for the reserves minimise, where appropriate, the risk and impacts of pressures rated as being *of concern* or *of potential concern* in the Temperate East Marine Region (regional priorities 13–16—medium to long term).

Strategy C:
Provide relevant, accessible and evidence-based information to support decision-making with respect to development proposals that come under the jurisdiction of the EPBC Act

1. Improve access to information, particularly spatial data, on the region's key ecological features and protected species and the pressures on them (short to medium term).

2. Assess the need for—and, if appropriate, promote—strategic assessments under the EPBC Act of coastal and inshore marine environments adjacent to the region that are expected to experience rapid change and have the potential to increase pressure on the Commonwealth marine environment (short to medium term).

3. Provide regional advice to assist in assessing and determining the significance of potential impacts on the region's conservation values to the extent that they are (or are components of) matters of national environmental significance (see Schedule 2) (regional priorities 1–12—immediate).

4. Evaluate the role of the plan and its supporting information resources in streamlining the decision-making under the EPBC Act at all levels (i.e. the environment minister, the environment department, or persons proposing to take actions likely to impact on matters of national environmental significance in the Temperate East Marine Region (short to medium term).

Strategy D:
Increase collaboration with relevant industries to improve understanding of the impacts of anthropogenic disturbance and address the cumulative effects on the region's key ecological features and protected species

1. Collaborate with relevant fisheries management organisations and industry to support research, information exchange and the development of improved management initiatives to address bycatch of protected species—particularly marine turtles, inshore dolphins, grey nurse shark, white shark, killer whale and breeding seabirds—focusing on improving information on the cumulative effects of bycatch across multiple fisheries and the establishment of ongoing monitoring indicators (regional priorities 1–4, 6–11 and 15—short to medium term).

2. Collaborate with relevant fisheries management organisations and industry to support research into the impacts of the extraction of living marine resources on key ecological features and improve management initiatives where appropriate (regional priorities 6–11 and 16—short to medium term).

3. Collaborate with industry and research organisations to improve mechanisms for data collection, management and reporting of interactions between industries and biodiversity (short to medium term).

4. Pursue, where feasible, collaborative agreements authorising the shared use of industry-gathered marine information, particularly spatial data (short to medium term).

5. Collaborate with industry to improve understanding of the effects of: vessel collision and marine debris on marine turtles; invasive species on breeding seabirds; and physical habitat modification arising from urban and coastal development on inshore dolphins (regional priorities 1, 2 and 5—short to medium term).

Strategy E:
Develop targeted collaborative programs to coordinate species recovery and environmental protection efforts across Australian Government, state and territory agencies and coastal communities with responsibilities for the marine environment

1. Collaborate with relevant government agencies and coastal communities to implement mitigation measures to address the key pressures on marine turtles, seabirds, grey nurse and white shark, and assess their effectiveness in reducing the risk to the species' recovery (regional priorities 2–5, 13–16—short to medium term).

2. Collaborate with the Queensland and New South Wales governments and coastal communities to develop protection measures to limit disturbances during the nesting season for marine turtles and seabirds, the pupping season for grey nurse shark, and seasons of aggregation for white shark, focusing on areas in proximity to inhabited areas or areas where sources of disturbance exist or are emerging (regional priorities 2–5—short to medium term).

3. Collaborate with the Queensland and New South Wales governments to develop protection measures to minimise the impacts of bather protection programs on inshore dolphins (regional priority 1—short to medium term).

4. Increase information on the sources and impacts of marine debris, bycatch and extraction of living resources on the region's marine life and ecosystems, including supporting monitoring of these pressures at selected locations in and adjacent to the Temperate East Marine Region (regional priorities 14–16—short to medium term).

Strategy F:
Improve monitoring, evaluation and reporting on ecosystem health in the marine environment

1. Collate information on the ecosystem components, functioning, pressures and potential cumulative impacts on key ecological features in the region and develop effective ecological indicators that will facilitate future monitoring, evaluation and reporting of marine ecosystem health (medium to long term).

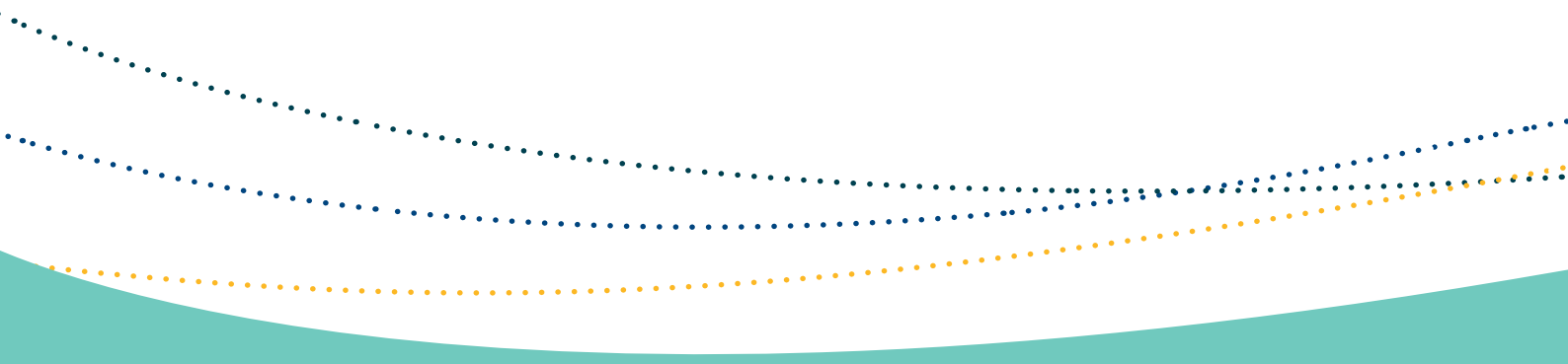
   Key ecological features to be investigated are:

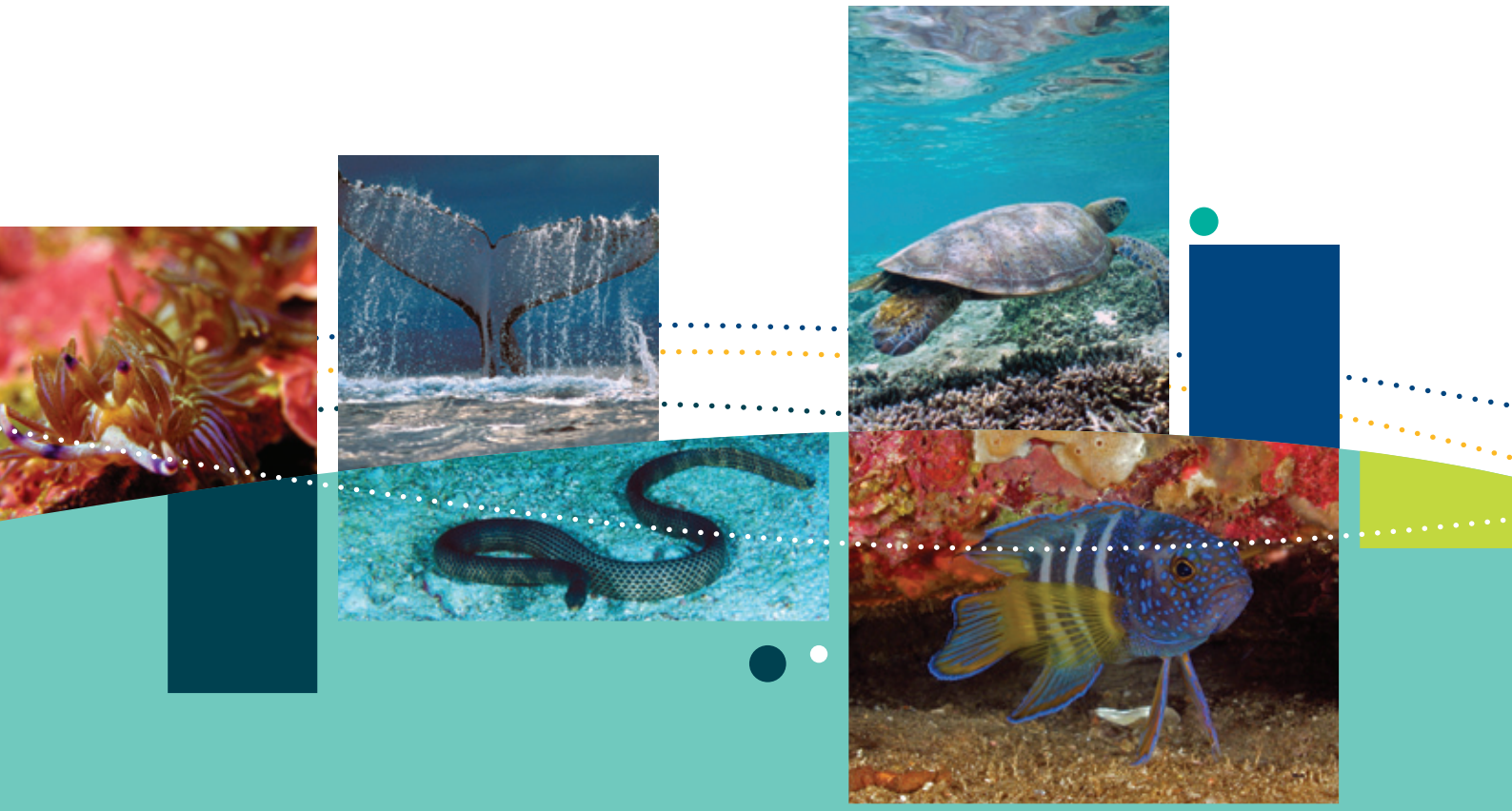
   – shelf rocky reefs (regional priority 6)
   – canyons on the eastern continental slope (regional priority 7)
   – Tasman Front and eddy field (regional priority 8)
   – upwelling off Fraser Island (regional priority 9)
   – Tasmantid seamount chain (regional priority 10)
   – Lord Howe seamount chain (regional priority 11)
   – Elizabeth and Middleton reefs (regional priority 12).

Strategy G:
Participate in international efforts to manage conservation values and pressures of regional priority

1. Collaborate with government and non-government organisations through regional and international initiatives to protect conservation values and address pressures of regional priority (regional priority 2, 5, 13, 14, 16—ongoing).

The Australian Government will work towards implementing these strategies and actions in order to address the regional priorities for conservation effort identified for the Temperate East Marine Region.





SCHEDULE 1

Analysis of pressures affecting conservation values of the Temperate East Marine Region

SCHEDULE 1 ANALYSIS OF PRESSURES AFFECTING CONSERVATION VALUES OF THE TEMPERATE EAST MARINE REGION

This schedule summarises the methods and findings of the regional pressure analysis undertaken for the Temperate East Marine Region.

S1.1 How were the pressures on conservation values analysed?

The pressure analysis process considered the impact of pressures on the region's conservation values, with a focused evaluation of the effectiveness of current mitigation and management arrangements in place to respond to those pressures. For the purpose of this plan, pressures are defined broadly as human-driven processes and events that do or can detrimentally affect the region's conservation values. Table S1.1 lists the type and source of pressures available for inclusion in the analysis. Only those pressures relevant to the conservation value being analysed were considered.

The analysis enabled pressures to be categorised in terms of their relative importance and has contributed to identification of regional priorities for the Temperate East Marine Region. Regional priorities are described in section 4.1 of the plan. The conservation values selected for the pressure analysis are discussed in Part 3 of the plan.

Table S1.1: Pressures and sources of pressures available for selection in the Temperate East Marine Region pressure analysis

Pressure	Source
Sea level rise	Climate change
Changes in sea temperature	Climate change
	Urban development
Changes in oceanography	Climate change
Ocean acidification	Climate change
Changes in terrestrial sand temperature	Climate change
Chemical pollution/contaminants	Shipping
	Vessels (other)
	Aquaculture operations
	Renewable energy operations
	Urban development (urban and/or industrial infrastructure)
	Agricultural activities
	Onshore and offshore mining operations
Nutrient pollution	Aquaculture operations
	Agricultural activities
	Urban development
Changes in turbidity	Dredging (spoil dumping)
	Land-based activities
	Onshore and offshore mining operations
	Climate change (changes in rainfall, storm frequency)
Marine debris[1]	Land-based activities
	Fishing boats
	Shipping
	Vessels (other)
	Oil rigs
	Aquaculture infrastructure
	Renewable energy infrastructure
	Urban development

Pressure	Source
Noise pollution	Seismic exploration
	Urban development
	Defence/surveillance activities
	Shipping
	Vessels (other)
	Aquaculture infrastructure
	Renewable energy infrastructure
	Onshore and offshore mining operations
	Onshore and offshore construction
Light pollution	Oil and gas infrastructure
	Fishing boats
	Vessels (other)
	Land-based activities
	Onshore and offshore activities
	Renewable energy infrastructure
	Onshore and offshore mining operations
Physical habitat modification	Fishing gear (active and derelict)
	Dredging (and/or dredge spoil)
	Shipping (anchorage)
	Defence/surveillance activities
	Telecommunications cables
	Offshore construction and installation of infrastructure
	Onshore and offshore construction
	Offshore mining operations
	Ship grounding
	Tourism (diving, snorkelling)
	Climate change (changes in storm frequency etc.)
	Urban/coastal development

Pressure	Source
Human presence at sensitive sites	Aquaculture operations
	Seismic exploration operations
	Tourism
	Recreational and charter fishing (burleying)
	Research
	Defence/surveillance activities
	Aircraft
Nuisance species[2]	Aquaculture operations
Extraction of living resources[3]	Commercial fishing (domestic or non-domestic)
	Recreational and charter fishing
	IUU fishing (domestic or non-domestic)
	Indigenous harvest
	Commercial fishing—prey depletion
	Commercial, recreational and charter fishing—fisheries discards
Bycatch[4]	Commercial fishing
	Recreational and charter fishing
	IUU fishing (domestic or non-domestic)
Oil pollution	Shipping
	Vessels (other)
	Oil rigs
	Onshore and offshore mining operations
Collision with vessels	Shipping
	Fishing
	Tourism
Collision/entanglement with infrastructure	Aquaculture infrastructure
	Renewable energy infrastructure
	Oil and gas infrastructure

Pressure	Source
Disease	Aquaculture operations
	Fishing
	Shipping
	Tourism
Invasive species	Shipping
	Fishing vessels
	Vessels (other)
	IUU fishing and illegal immigration vessels
	Aquaculture operations
	Tourism
	Land-based activities
Changes in hydrological regimes	Land-based activities
	Aquaculture infrastructure
	Renewable energy infrastructure
	Climate change (e.g. changes in rainfall, storm frequency)

IUU = illegal, unreported and unregulated

1 Marine debris is defined in the Threat Abatement Plan for the impacts of marine debris on vertebrate marine life May 2009 (**www.environment.gov.au/biodiversity/threatened/publications/tap/marine-debris.html**) and refers to 'land-sourced plastic garbage, fishing gear from recreational and commercial fishing abandoned into the sea, and ship-sourced, solid non-biodegradable floating materials disposed of at sea'. In concordance with International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78), plastic material is defined as bags, bottles, strapping bands, sheeting synthetic ropes, synthetic fishing nets, floats, fiberglass, piping, insulation, paints and adhesives.

2 Nuisance species are opportunistic native species (e.g. seagulls) whose populations boom when humans modify the ecosystem by increasing food supply.

3 Extraction of living resources includes the removal of target and byproduct species.

4 Bycatch includes all non-targeted catch from fishing operations, including by-product, discards and gear interactions. By-product refers to the unintended catch that may be kept or sold by the fisher. Discards refer to the product that is returned to the sea. Gear interactions refer to all species and habitat affected by the fishing gear.

Levels of concern for the interactions between pressures and conservation values

Based on a review of scientific and expert literature, and informed by the findings of relevant environmental and impact assessment studies, risk assessments and expert opinion, the interaction between selected conservation values and each pressure was assigned a level *of concern*. The levels *of concern* are:

- *of concern*
- *of potential concern*
- *of less concern*
- *not of concern*.

A pressure is *of concern* for a conservation value when:

- there is evidence that it interacts with the conservation value within the region and there are reasonable grounds to expect that it may result in a **substantial impact** (Box S1.1), and
- there are no management measures in place to mitigate the impact(s), or there is inadequate or inconclusive evidence of the effectiveness of management measures within the region.

A pressure is *of potential concern* for a conservation value when:

- there is evidence that the conservation value is vulnerable to the type of pressure, although there is limited evidence of a **substantial impact** within the region, and
- the pressure is widespread or likely to increase within the region, and
- there are no management measures in place to mitigate potential or future impacts, or there is inadequate or inconclusive evidence of the effectiveness of management measures.

A pressure is *of less concern* for a conservation value either when:

- there is evidence of interaction with the conservation value within the region and there are reasonable grounds to expect that the impacts are unlikely to be substantial, or
- there is evidence of interaction with the conservation value within the region and there are reasonable grounds to expect that current management measures in place are effective in minimising or mitigating the impact.

A pressure is *not of concern* for a conservation value when:

- the pressure is rare or absent from the region, or
- there are reasonable grounds to expect that the impacts are minimal or the pressure does not interact with the conservation value, or
- there is evidence that the pressure is managed effectively through routine management measures.

In some instances, where a pressure operating outside of the region is having a substantial impact on a region's conservation value, consideration has been given to it.

Only those interactions between conservation values and pressures assessed as being *of concern* and *of potential concern* are described in this Schedule. Further information on the findings of the pressure analyses can be found in the conservation value report cards (**www.environment.gov.au/marineplans/temperate-east**).

Box S1.1 What is a substantial impact?

A pressure was considered likely to cause a substantial impact on a conservation value if there was a reasonable possibility that it would have any of the following effects:

- introduction of a known or potential pest or invasive species
- extensive modification, destruction, fragmentation, isolation or disturbance of habitat, which results in changes to community composition and/or trophic relationships and/ or ecosystem services
- modification, destruction, fragmentation, isolation or decline in availability of quality habitat important for a species of conservation value, to the extent that the species' conservation status is affected or its recovery is hindered
- substantial change in air or water quality, which may adversely impact biodiversity, ecological function or integrity, social amenity or human health
- introduction of persistent organic chemicals, heavy metals or potentially harmful chemicals, which adversely impact on biodiversity, ecosystem function or integrity, social amenity or human health
- change in community dynamics or structure that results in adverse impacts on biodiversity, ecological function or integrity, social amenity or human health
- increase in mortality of conservation values to an extent that may affect their conservation status or hinder recovery
- reduction in the area of occupancy of a species of conservation value, which may affect its conservation status or hinder recovery
- fragmentation of populations of conservation value
- reduced breeding success of a species or population of conservation value
- extensive or prolonged disturbance that affects the conservation status of a species or population of conservation value.

Note that the criteria above for defining substantial impact have been informed by *EPBC Act Policy Statement 1.1—Significant Impact Guidelines*.

S1.2 Findings of the analysis

A summary of the pressure analysis findings on the key ecological features and historic shipwrecks of the Temperate East Marine Region is presented in Table S1.2. A summary of the pressure analysis findings on selected protected species in the Temperate East Marine Region is presented in Table S1.3.

A more detailed overview of the pressures assessed as *of concern* and *of potential concern* for these conservation values is presented in Tables S1.4–S1.14:

- Key ecological features of the Temperate East Marine Region
  - Pressures *of concern*—Table S1.4
  - Pressures *of potential concern*—Table S1.5
- Selected bony fish species
  - Pressures *of potential concern*—Table S1.6
- Selected cetacean species
  - Pressures *of concern*—Table S1.7
  - Pressures *of potential concern*—Table S1.8
- Selected marine reptile species
  - Pressures *of concern*—Table S1.9
  - Pressures *of potential concern*—Table S1.10
- Selected seabird species
  - Pressures *of concern*—Table S1.11
  - Pressures *of potential concern*—Table S1.12
- Selected shark species
  - Pressures *of concern*—Table S1.13
  - Pressures *of potential concern*—Table S1.14

Further information on the pressure analyses and their findings are provided in the conservation value report cards.

Table S1.2: Summary of pressures on key ecological features and historic shipwrecks of the Temperate East Marine Region

Key ecological feature	Pressure[5]								
	Sea level rise	Changes in sea temperature	Change in oceanography	Ocean acidification	Chemical pollution / contaminants	Nutrient pollution	Marine debris	Noise pollution	Light pollution
1. Shelf rocky reefs	not of concern	of potential concern	of potential concern	of potential concern	of less concern	of less concern	of potential concern	not of concern	not of concern
2. Canyons on the eastern continental slope	not of concern	of potential concern	of potential concern	of less concern	of potential concern	of less concern	of potential concern	not of concern	not of concern
3. Tasman Front and eddy field	not of concern	of potential concern	of potential concern	of less concern	of potential concern	not of concern	of potential concern	not of concern	of less concern
4. Upwelling off Fraser Island	not of concern	of potential concern	of potential concern	of less concern	of potential concern	of less concern	of potential concern	not of concern	of less concern
5. Tasmantid seamount chain	not of concern	of potential concern	of potential concern	of potential concern	of potential concern	not of concern	of potential concern	not of concern	not of concern
6. Lord Howe seamount chain	not of concern	of potential concern	of potential concern	of potential concern	of potential concern	not of concern	of potential concern	not of concern	not of concern
7. Elizabeth and Middleton reefs	of potential concern	of concern	of potential concern	of concern	of potential concern	not of concern	of potential concern	not of concern	of potential concern
8. Norfolk Ridge	not of concern	of potential concern	of potential concern	of potential concern	of less concern	of less concern	of potential concern	not of concern	not of concern
Historic Shipwrecks									
On shelf shipwrecks	data deficient or not assessed	of potential concern	data deficient or not assessed	data deficient or not assessed	of less concern	data deficient or not assessed	data deficient or not assessed	data deficient or not assessed	data deficient or not assessed
Off shelf shipwrecks	data deficient or not assessed	of less concern	data deficient or not assessed	data deficient or not assessed	not of concern	data deficient or not assessed	data deficient or not assessed	data deficient or not assessed	data deficient or not assessed

Legend of concern; of potential concern; of less concern; not of concern; data deficient or not assessed

5 Some pressures considered in this analysis are made up of more than one category but are presented in this summary table under one heading. For example, some conservation values were assessed against the pressures of *bycatch from commercial fishing* and *bycatch from recreational fishing*; however these categories are presented in the summary table under *bycatch*. Where the ratings for a conservation value differ across the pressures in a category, the highest rating has been listed in the table. For example, if *bycatch from commercial fishing* is rated *of potential concern* and *bycatch from recreational fishing* is rated *of less concern*, the pressure of *bycatch* will be rated *of potential concern* for the conservation value in the table. More information about the pressure analyses for key ecological features and heritage places can be found in the conservation value report cards.

Table S1.2 continued: Summary of pressures on key ecological features and historic shipwrecks of the Temperate East Marine Region

Key ecological feature	Pressure[5]							
	Physical habitat modification	Human presence at sensitive sites	Extraction of living resources	Bycatch	Oil pollution	Collisions with vessels	Invasive species	Changes in hydrological regimes
1. Shelf rocky reefs								
2. Canyons on the eastern continental slope								
3. Tasman Front and eddy field								
4. Upwelling off Fraser Island								
5. Tasmantid seamount chain								
6. Lord Howe seamount chain								
7. Elizabeth and Middleton reefs								
8. Norfolk Ridge								
Historic Shipwrecks								
On shelf shipwrecks								
Off shelf shipwrecks								

Legend of concern; of potential concern; of less concern; not of concern; data deficient or not assessed

5 Some pressures considered in this analysis are made up of more than one category but are presented in this summary table under one heading. For example, some conservation values were assessed against the pressures of *bycatch from commercial fishing* and *bycatch from recreational fishing*; however these categories are presented in the summary table under *bycatch*. Where the ratings for a conservation value differ across the pressures in a category, the highest rating has been listed in the table. For example, if *bycatch from commercial fishing* is rated *of potential concern* and *bycatch from recreational fishing* is rated *of less concern*, the pressure of *bycatch* will be rated *of potential concern* for the conservation value in the table. More information about the pressure analyses for key ecological features and heritage places can be found in the conservation value report cards.

Table S1.3: Summary of pressures on selected protected species in the Temperate East Marine Region

Species group	Protected species	Pressure[6]								
		Sea level rise	Changes in sea temperature	Changes in oceanography	Ocean acidification	Changes in terrestrial sand temperatures	Chemical pollution/ contaminants	Nutrient pollution	Marine debris	Noise pollution
Bony fishes	Eastern gemfish									
	Orange roughy									
	Black cod									
	Seahorses, pipehorses and sea dragons									
Cetaceans	Blue whale									
	Dwarf Minke whale									
	Humpback whale									
	Killer whale									
	Fin whale									
	Sei whale									
	Southern right whale									
	Indo-Pacific (coastal) bottlenose dolphin									
	Indo-pacific humpback dolphin									
Marine reptiles *Marine turtles* *Sea snakes*	Green turtle									
	Hawksbill turtle									
	Leatherback turtle									
	Loggerhead turtle									
	Sea snakes									

Legend of concern; of potential concern; of less concern; not of concern; data deficient or not assessed

6 Some pressures considered in this analysis are made up of more than one category but are presented in this summary table under one heading. For example, some conservation values were assessed against the pressures of *bycatch from commercial fishing* and *bycatch from recreational fishing*; however these categories are presented in the summary table under *bycatch*. Where the ratings for a conservation value differ across the pressures in a category, the highest rating has been listed in the table. For example, if *bycatch from commercial fishing* is rated *of potential concern* and *bycatch from recreational fishing* is rated *of less concern*, the pressure of *bycatch* will be rated *of potential concern* for the conservation value in the table. More information about the pressure analyses for key ecological features and heritage places can be found in the conservation value report cards.

Table S1.3 continued: Summary of pressures on selected protected species in the Temperate East Marine Region

Species group	Protected species	Pressure[6]								
		Light pollution	Physical habitat modification	Human presence at sensitive sites	Extraction of living resources	Bycatch	Oil pollution	Collision with vessels	Invasive species	Changes in hydrological regimes
Bony fishes	Eastern gemfish	not of concern	not of concern	not of concern	of less concern	of less concern	of less concern	not of concern	not of concern	data deficient or not assessed
	Orange roughy	not of concern	of potential concern	not of concern	of less concern	of less concern	of less concern	not of concern	not of concern	data deficient or not assessed
	Black cod	not of concern	of potential concern	not of concern	of potential concern	of potential concern	of less concern	not of concern	not of concern	data deficient or not assessed
	Seahorses, pipehorses and sea dragons	not of concern	of potential concern	not of concern	of less concern	of potential concern	of less concern	not of concern	of less concern	data deficient or not assessed
Cetaceans	Blue whale	not of concern	not of concern	not of concern	not of concern	not of concern	of less concern	not of concern	not of concern	not of concern
	Dwarf Minke whale	not of concern	not of concern	of less concern	not of concern	not of concern	of less concern	not of concern	not of concern	not of concern
	Humpback whale	not of concern	not of concern	of less concern	not of concern	of potential concern	of less concern	not of concern	not of concern	not of concern
	Killer whale	not of concern	not of concern	not of concern	not of concern	of concern	of less concern	not of concern	not of concern	not of concern
	Fin whale	not of concern	not of concern	not of concern	not of concern	not of concern	of less concern	not of concern	not of concern	not of concern
	Sei whale	not of concern	not of concern	not of concern	not of concern	not of concern	of less concern	not of concern	not of concern	not of concern
	Southern right whale	not of concern	not of concern	not of concern	not of concern	not of concern	of less concern	not of concern	not of concern	not of concern
	Indo-Pacific (coastal) bottlenose dolphin	not of concern	of concern	of less concern	not of concern	of concern	of potential concern	of potential concern	not of concern	of potential concern
	Indo-pacific humpback dolphin	not of concern	of concern	of less concern	not of concern	of concern	of potential concern	of potential concern	not of concern	of potential concern
Marine reptiles *Marine turtles* *Sea snakes*	Green turtle	of potential concern	of potential concern	of less concern	of potential concern	of concern	of potential concern	of concern	of potential concern	of less concern
	Hawksbill turtle	of less concern	of less concern	of less concern	of potential concern	of potential concern	of potential concern	of concern	of less concern	of less concern
	Leatherback turtle	of less concern	of less concern	not of concern	not of concern	of concern	of potential concern	of less concern	not of concern	not of concern
	Loggerhead turtle	of potential concern	of potential concern	of less concern	of less concern	of concern	of potential concern	of concern	of potential concern	of less concern
	Sea snakes	not of concern	of potential concern	not of concern	not of concern	of potential concern	of potential concern	of less concern	not of concern	data deficient or not assessed

Legend of concern; of potential concern; of less concern; not of concern; data deficient or not assessed

6 Some pressures considered in this analysis are made up of more than one category but are presented in this summary table under one heading. For example, some conservation values were assessed against the pressures of *bycatch from commercial fishing* and *bycatch from recreational fishing*; however these categories are presented in the summary table under *bycatch*. Where the ratings for a conservation value differ across the pressures in a category, the highest rating has been listed in the table. For example, if *bycatch from commercial fishing* is rated *of potential concern* and *bycatch from recreational fishing* is rated *of less concern*, the pressure of *bycatch* will be rated *of potential concern* for the conservation value in the table. More information about the pressure analyses for key ecological features and heritage places can be found in the conservation value report cards.

Table S1.3 continued: Summary of pressures on selected protected species in the Temperate East Marine Region

Species group	Protected species	Pressure[6]								
		Sea level rise	Changes in sea temperature	Changes in oceanography	Ocean acidification	Changes in terrestrial sand temperatures	Chemical pollution/ contaminants	Nutrient pollution	Marine debris	Noise pollution
Seabirds	Black noddy									
	Common noddy									
	Crested tern									
	Roseate tern									
	Sooty tern									
	White tern									
	Grey ternlet									
	Flesh-footed shearwater									
	Little shearwater									
	Short-tailed shearwater									
	Sooty shearwater									
	Wedge-tailed shearwater									
	Black petrel									
	Black-winged petrel									
	Gould's petrel									
	Great-winged petrel									
	Kermadec petrel									
	Providence petrel									
	White-bellied storm petrel									
	White-faced storm petrel									
	White-necked petrel									

Legend of concern; of potential concern; of less concern; not of concern; data deficient or not assessed

6 Some pressures considered in this analysis are made up of more than one category but are presented in this summary table under one heading. For example, some conservation values were assessed against the pressures of *bycatch from commercial fishing* and *bycatch from recreational fishing*; however these categories are presented in the summary table under *bycatch*. Where the ratings for a conservation value differ across the pressures in a category, the highest rating has been listed in the table. For example, if *bycatch from commercial fishing* is rated *of potential concern* and *bycatch from recreational fishing* is rated *of less concern*, the pressure of *bycatch* will be rated *of potential concern* for the conservation value in the table. More information about the pressure analyses for key ecological features and heritage places can be found in the conservation value report cards.

Table S1.3 continued: Summary of pressures on selected protected species in the Temperate East Marine Region

Species group	Protected species	Pressure[6]								
		Light pollution	Physical habitat modification	Human presence at sensitive sites	Extraction of living resources	Bycatch	Oil pollution	Collision with vessels	Invasive species	Changes in hydrological regimes
Seabirds	Black noddy	not of concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Common noddy	not of concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Crested tern	not of concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Roseate tern	not of concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of potential concern	data deficient or not assessed
	Sooty tern	not of concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	White tern	not of concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Grey ternlet	not of concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Flesh-footed shearwater	of potential concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Little shearwater	of potential concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Short-tailed shearwater	of potential concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Sooty shearwater	of potential concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Wedge-tailed shearwater	of potential concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Black petrel	of potential concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Black-winged petrel	of potential concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Gould's petrel	of potential concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Great-winged petrel	of potential concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of potential concern	data deficient or not assessed
	Kermadec petrel	of potential concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Providence petrel	of potential concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	White-bellied storm petrel	of potential concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	White-faced storm petrel	of potential concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	White-necked petrel	of potential concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of concern	data deficient or not assessed

Legend of concern; of potential concern; of less concern; not of concern; data deficient or not assessed

6 Some pressures considered in this analysis are made up of more than one category but are presented in this summary table under one heading. For example, some conservation values were assessed against the pressures of *bycatch from commercial fishing* and *bycatch from recreational fishing*; however these categories are presented in the summary table under *bycatch*. Where the ratings for a conservation value differ across the pressures in a category, the highest rating has been listed in the table. For example, if *bycatch from commercial fishing* is rated *of potential concern* and *bycatch from recreational fishing* is rated *of less concern*, the pressure of *bycatch* will be rated *of potential concern* for the conservation value in the table. More information about the pressure analyses for key ecological features and heritage places can be found in the conservation value report cards.

Table S1.3 continued: Summary of pressures on selected protected species in the Temperate East Marine Region

Species group	Protected species	Pressure[6]								
		Sea level rise	Changes in sea temperature	Changes in oceanography	Ocean acidification	Changes in terrestrial sand temperatures	Chemical pollution/ contaminants	Nutrient pollution	Marine debris	Noise pollution
Seabirds	Wilson's storm petrel	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Northern giant-petrel	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Southern giant-petrel	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Antipodean (Gibson's) albatross	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Black-browed albatross	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Campbell albatross	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Indian yellow-nosed albatross	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Salvin's albatross	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Wandering albatross	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	White-capped albatross	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Little penguin	of less concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Masked booby	of potential concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Red-tailed tropicbird	of potential concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
Sharks	Grey nurse shark	not of concern	of potential concern	of potential concern	of less concern	data deficient or not assessed	of less concern	not of concern	of less concern	not of concern
	Porbeagle shark	not of concern	of potential concern	of potential concern	not of concern	data deficient or not assessed	of less concern	not of concern	of less concern	not of concern
	Longfin mako shark	not of concern	of potential concern	of potential concern	not of concern	data deficient or not assessed	of less concern	not of concern	of less concern	not of concern
	Shortfin mako	not of concern	of potential concern	of potential concern	not of concern	data deficient or not assessed	of less concern	not of concern	of less concern	not of concern
	Whale shark	not of concern	of potential concern	of potential concern	not of concern	data deficient or not assessed	of less concern	not of concern	of less concern	not of concern
	White shark	not of concern	of potential concern	of potential concern	not of concern	data deficient or not assessed	of less concern	not of concern	of less concern	of less concern

Legend of concern; of potential concern; of less concern; not of concern; data deficient or not assessed

6 Some pressures considered in this analysis are made up of more than one category but are presented in this summary table under one heading. For example, some conservation values were assessed against the pressures of *bycatch from commercial fishing* and *bycatch from recreational fishing*; however these categories are presented in the summary table under *bycatch*. Where the ratings for a conservation value differ across the pressures in a category, the highest rating has been listed in the table. For example, if *bycatch from commercial fishing* is rated *of potential concern* and *bycatch from recreational fishing* is rated *of less concern*, the pressure of *bycatch* will be rated *of potential concern* for the conservation value in the table. More information about the pressure analyses for key ecological features and heritage places can be found in the conservation value report cards.

Table S1.3 continued: Summary of pressures on selected protected species in the Temperate East Marine Region

Species group	Protected species	Pressure[6]								
		Light pollution	Physical habitat modification	Human presence at sensitive sites	Extraction of living resources	Bycatch	Oil pollution	Collision with vessels	Invasive species	Changes in hydrological regimes
Seabirds	Wilson's storm petrel									
	Northern giant-petrel									
	Southern giant-petrel									
	Antipodean (Gibson's) albatross									
	Black-browed albatross									
	Campbell albatross									
	Indian yellow-nosed albatross									
	Salvin's albatross									
	Wandering albatross									
	White-capped albatross									
	Little penguin									
	Masked booby									
	Red-tailed tropicbird									
Sharks	Grey nurse shark									
	Porbeagle shark									
	Longfin mako shark									
	Shortfin mako									
	Whale shark									
	White shark									

Legend of concern; of potential concern; of less concern; not of concern; data deficient or not assessed

6 Some pressures considered in this analysis are made up of more than one category but are presented in this summary table under one heading. For example, some conservation values were assessed against the pressures of *bycatch from commercial fishing* and *bycatch from recreational fishing*; however these categories are presented in the summary table under *bycatch*. Where the ratings for a conservation value differ across the pressures in a category, the highest rating has been listed in the table. For example, if *bycatch from commercial fishing* is rated *of potential concern* and *bycatch from recreational fishing* is rated *of less concern*, the pressure of *bycatch* will be rated *of potential concern* for the conservation value in the table. More information about the pressure analyses for key ecological features and heritage places can be found in the conservation value report cards.

Table S1.4: Pressures *of concern* to key ecological features of the Temperate East Marine Region

Key ecological features assessed = 8		
Pressure	**KEF**	**Rationale**
Changes in sea temperature (climate change)	Elizabeth and Middleton reefs	Sea temperatures have warmed by 0.7 °C between 1910–1929 and 1989–2008, and current projections estimate ocean temperatures will be a further 1 °C warmer by 2030 (Lough 2009). Elizabeth and Middleton reefs are valued for their aggregations of marine life and biodiversity. Ocean warming is expected to alter food web dynamics (Hoegh-Guldberg & Bruno 2010), potentially increase the frequency or severity of coral bleaching events and result in southerly distribution shifts of pelagic fish species (Hobday et al. 2006). The reefs are at risk from these expected impacts, however, the overall implications for ecosystem processes and responses are not known, and will be influenced by species tolerance and adaptive capacity.
Ocean acidification (climate change)	Elizabeth and Middleton reefs	Driven by increasing levels of atmospheric CO_2 and subsequent chemical changes in the ocean, ocean acidification is already under way and detectable. Since pre-industrial times, acidification has lowered ocean pH by 0.1 units (Howard et al. 2009). Climate models predict this trend will continue, with a further 0.2–0.3 unit decline by 2100 (Howard et al. 2009). Elizabeth and Middleton reefs are valued for their aggregations of marine life and biodiversity, and expected impacts of acidification include a reduction in coral growth rates and resilience, which may make the reef systems more vulnerable to erosion and disturbance from storms (Anthony & Marshall 2009) and affect the ability of molluscs, echinoderms and some planktonic organisms to form skeletal material (Doney et al. 2009). Corals provide structural habitat complexity for a range of invertebrates and fish (Althaus et al. 2009); therefore, any impact on coral reef habitat is likely to result in changes to the distribution and abundance of species that depend on the reefs for food and shelter.

Table S1.5: Pressures *of potential concern* to key ecological features of the Temperate East Marine Region

Key ecological features assessed = 8		
Pressure	**KEFs**	**Rationale**
Sea level rise (climate change)	Elizabeth and Middleton reefs	Global sea levels rose by 20 cm between 1870 and 2004, and predictions estimate a further rise of 5–15 cm by 2030, relative to 1990 levels (Church et al. 2009). Longer term predictions estimate increases of 0.5–1 m by 2100, relative to 2000 levels (Climate Commission 2011). Elizabeth and Middleton reefs are shallow water reefs valued for their aggregations of marine life and biodiversity. Over time, rising sea levels are expected to decrease the amount of light that reaches the corals, thereby reducing coral growth rates (Anthony & Marshall 2009). Any impact on coral reef habitat is likely to change the distribution and abundance of species that depend on the reefs for food and shelter (Chambers et al. 2009b).
Changes in sea temperature (climate change)	Shelf rocky reefs Canyons on the eastern continental slope Tasman Front and eddy field Upwelling off Fraser Island Tasmantid seamount chain Lord Howe seamount chain Norfolk Ridge	Sea temperatures have warmed by 0.7 °C between 1910–1929 and 1989–2008, and current projections estimate ocean temperatures will be a further 1 °C warmer by 2030 (Lough 2009). Ocean warming is *of potential concern* for all of the region's key ecological features, except the Elizabeth and Middleton reefs, where it is *of concern* **(see Table S1.4**). Expected impacts include changes to food web dynamics (Hoegh-Guldberg & Bruno 2010), potentially increasing the frequency or severity of coral bleaching events, and a southerly shift in the distribution of pelagic fish species (Hobday et al. 2006). For features located in the deeper waters of the region (such as the shelf rocky reefs, seamounts and ridges), the impacts of rising sea temperatures are more complex. Rising temperatures drive changes such as thermal expansion (Hoegh-Gulberg & Bruno 2010), resulting in greater stratification in the water column, reducing mixing in some parts of the ocean, and consequently affecting nutrient availability and primary production at depth (Hoegh-Gulberg & Bruno 2010).

Key ecological features assessed = 8		
Pressure	**KEFs**	**Rationale**
Changes in oceanography (climate change)	Shelf rocky reefs Canyons on the eastern continental slope Tasman Front and eddy field Upwelling off Fraser Island Tasmantid seamount chain Lord Howe seamount chain Elizabeth and Middleton reefs Norfolk Ridge	Changes in oceanography include consideration of circulation patterns; current intensities; wind strength and direction; the location and strength of eddy and upwelling events; and climatic oscillations such as the El Niño–Southern Oscillation. In the region, changes in oceanography will be primarily influenced by the East Australian Current, which is one of the key drivers of the region's biological productivity, species distribution and abundance (Dambacher et al. 2011). The East Australian Current has been strengthening, pushing warmer, saltier water further southward along the east coast (for up to 350 km) (Ridgway & Hill 2009). Changes in the strength and extent of the current are likely to impact on productivity, shifting trophic webs, and changing migration patterns and reef and shelf habitats, all of which have implications for marine species (Chin et al. 2010). Offshore, the current is partly responsible for the unique mix of warm and cold water species associated with Elizabeth and Middleton reefs and the Tasmantid and Lord Howe seamount chains (Dambacher et al. 2011).

Key ecological features assessed = 8		
Pressure	**KEFs**	**Rationale**
Ocean acidification (climate change)	Shelf rocky reefs Tasmantid seamount chain Lord Howe seamount chain Norfolk Ridge	Driven by increasing levels of atmospheric CO_2 and subsequent chemical changes in the ocean, ocean acidification is already under way and detectable. Since pre-industrial times, acidification has lowered ocean pH by 0.1 units (Howard et al. 2009). Furthermore, climate models predict this trend will continue, with a further 0.2–0.3 unit decline by 2100 (Howard et al. 2009). The key ecological features listed here are particularly vulnerable to ocean acidification because they support a range of shallow and deepwater coral reef systems. The direct impacts of ocean acidification are expected to be most marked for organisms with calcareous skeletons, such as corals, plankton, molluscs and echinoderms (Doney et al. 2009). Increasing acidity reduces the ability of these organisms to form skeletal structures, which is likely to affect not only their ability to function within the ecosystem, but the functioning of the ecosystem as a whole (Kleypas & Yates 2009). For example, research on coral cores in the Great Barrier Reef identified a 14% decline in coral calcification rates between 1990 and 2005 (De'ath et al. 2009), which the authors attribute to excessive temperature increases, ocean acidification, or a combination of the two. For this region, increased ocean acidification and sea surface temperatures are predicted to have combined impacts, prompting reef conditions to shift from 'marginal' (Kleypas et al. 1999) to 'extremely marginal' by the middle of this century (Noreen 2010). For the subtropical regions of the Tasmantid and Lord Howe seamount chains, it is likely that increased ocean acidity will reduce coral growth rates and resilience, making the reef systems more susceptible to erosion and disturbance from storms (Anthony & Marshall 2009). Predictive climate models indicate that the unique, deep, cold water reefs and sponge gardens of the Norfolk Ridge, shelf edge and seamount chains are also at risk from a similar range of impacts (Cohen & Holcomb 2009; Howard et al. 2009; Hyder Consulting 2008). Corals provide structural habitat complexity for a range of invertebrates and fish (Althaus et al. 2009). Consequently, any impact on coral reef habitat is likely to change the distribution and abundance of species that depend on them for food and shelter.

Key ecological features assessed = 8		
Pressure	**KEFs**	**Rationale**
Chemical pollution	Canyons on the eastern continental slope Tasman Front and eddy field Upwelling off Fraser Island Tasmantid seamount chain Lord Howe seamount chain Elizabeth and Middleton reefs	Chemical pollution/contaminants is *of potential concern* for key ecological features with values that make them particularly vulnerable to the impacts of a chemical spill, such as important aggregations of marine life at or near the sea surface. Vulnerable key ecological features include the Tasman Front and eddy field; the Fraser upwelling; the Tasmantid and Lord Howe seamount chains; canyons on the eastern continental slope; and Elizabeth and Middleton reefs. As is the case with oil spills, chemical spills are unpredictable events and their likelihood is low in the context of the international and domestic regulatory mitigation measures that apply in Australia. The effects of a major chemical spill can be similar to those of oil spills (GBRMPA 2009), particularly in areas and at times of biological significance for important or threatened species. The impacts vary depending on the toxicity of chemicals, how the materials are packaged and transported, the quantity spilled, the site and ecological sensitivity.

Key ecological features assessed = 8		
Pressure	**KEFs**	**Rationale**
Marine debris	Shelf rocky reefs Canyons on the eastern continental slope Tasman Front and eddy field Upwelling off Fraser Island Tasmantid seamount chain Lord Howe seamount chain Elizabeth and Middleton reefs Norfolk Ridge	Marine debris is defined as any persistent, manufactured or processed solid material that has been disposed of, or abandoned, in the marine and coastal environment (UNEP 2005). This includes a range of materials from plastics (e.g. bags, bottles, ropes, fibreglass and insulation) to derelict fishing gear, and ship-sourced, solid, non-biodegradable floating materials (DEWHA 2009a). Although region-specific marine debris data is limited, key sources for the introduction and spread of debris (such as shipping, commercial fishing and major current systems) are present across the region. This suggests that all key ecological features will experience a high degree of overlap with this pressure (Katsanevakis 2008). Marine debris has been listed as a key threatening process under the EPBC Act, in recognition of its negative impacts on substantial numbers of Australia's marine wildlife, including protected species of birds, turtles and marine mammals. Therefore, this pressure has implications for key ecological feature values such as biodiversity and aggregations of marine life. The Australian Government has developed a threat abatement plan that provides a coordinated national approach to prevent and mitigate the effects of harmful marine debris on marine life (DEWHA 2009a).
Light pollution	Elizabeth and Middleton reefs	Light pollution is *of potential concern* to Elizabeth and Middleton reefs as they are known to support important aggregations of marine life that are vulnerable to light (e.g. turtles). Light quality is important for turtles (Salmon 2003) and lighting from shipping and fishing vessels offshore can attract hatchlings to vessel hulls, exposing them to predation. Shipping traffic, including fishing vessels anchoring in close proximity to Elizabeth and Middleton reefs, have the potential to negatively impact turtles that forage in these areas.

Key ecological features assessed = 8		
Pressure	**KEFs**	**Rationale**
Physical habitat modification (fishing gear)	Shelf rocky reefs Canyons on the eastern continental slope	Physical habitat modification due to fishing gear can result in loss or significant degradation of key ecological features that are subject to bottom trawl activities or are inherently vulnerable to habitat modification, including the shelf rocky reefs and canyons on the eastern continental slope. Both of these features are characterised by complex communities of benthic species that are highly vulnerable to the impacts of demersal trawl fishing, which removes, modifies or disturbs seabed flora and fauna (Furlani et al. 2007). These communities, particularly the deepwater coral species, are highly fragile, long lived and therefore susceptible to disturbance (Williams et al. 2010). Potential impacts include declines in the richness, diversity and density of benthic species and the range of invertebrates and fish that depend on these habitats for prey opportunities and shelter (Althaus et al. 2009).
Extraction of living resources (commercial fishing)	Shelf rocky reefs Canyons on the eastern continental slope Tasman Front and eddy field Upwelling off Fraser Island Tasmantid seamount chain Lord Howe seamount chain Norfolk Ridge	The ecosystem effects of fishing are not well understood. The key ecological features highlighted here are considered valuable for their aggregations of marine life and unique features which support ecological properties of regional significance. The rating *of potential concern* is primarily driven by the impact of the targeted take of commercial fisheries on top-order predators, which are considered to be a key functional species group within these features. The extraction of top predators by fishing activities has implications for ecological communities as it influences the abundance, recruitment, species composition, diversity and behaviour of prey species. Removal of top predators can have a 'cascading' effect on all the components of a food web (Baum & Worm 2009; Ceccarelli & Ayling 2010). Reef sharks, cod and groupers are important for coral reef communities, while tuna and billfish are important for pelagic systems (Ceccarelli & Ayling 2010). In the context of active fisheries management and the steady move towards ecosystem-based management of fisheries by all jurisdictions in Australia, the *of potential concern* rating is considered a conservative assessment. This rating highlights the limited understanding of both the ecosystem effects of individual fisheries and the cumulative effects of a number of fisheries on protected species, marine communities, habitats and ecosystems.

Key ecological features assessed = 8		
Pressure	**KEFs**	**Rationale**
Bycatch (commercial fishing—domestic)	Shelf rocky reefs Canyons on the eastern continental slope Tasman Front and eddy field Upwelling off Fraser Island Tasmantid seamount chain Lord Howe seamount chain Norfolk Ridge	Commercial fishing operations are a key activity in the region and overlap, to varying extents, with these ecological features (e.g. Eastern Tuna and Billfish Fishery, Southern and Eastern Scalefish and Shark Fishery). In the context of active fisheries management and the steady move towards ecosystem-based management of fisheries by all jurisdictions in Australia, the *of potential concern* rating is considered a conservative assessment. For example, a recent review of all Commonwealth fisheries found that the current numbers of independent observers are not sufficient to allow a cumulative assessment of the catch of non-target species (Phillips et al. 2010). The review stated that such assessment is important to understand the environmental performance of fisheries more broadly and to underpin a holistic approach to the management of ecosystem impacts (Phillips et al. 2010). Generally, there is also a need to increase our understanding of the effectiveness of bycatch mitigation measures (Bensley et al. 2010).

Key ecological features assessed = 8		
Pressure	**KEFs**	**Rationale**
Oil Pollution	Canyons on the eastern continental slope Tasman Front and eddy field Upwelling off Fraser Island Tasmantid seamount chain Lord Howe seamount chain Elizabeth and Middleton reefs	Oil pollution is *of potential concern* for key ecological features with values that make them particularly vulnerable to the impacts of an oil spill, such as important aggregations of marine life at or near the sea surface. Vulnerable key ecological features include the Tasman Front and eddy field; upwelling off Fraser Island; Tasmantid and Lord Howe seamount chains; canyons on the eastern continental slope; and Elizabeth and Middleton reefs. These key ecological features are highlighted because of their characteristics that make their ecosystems and communities vulnerable to the effects of an oil spill; for example, features that include regions of high productivity that attract aggregations of marine life. Australia has a strong system for regulating industry activity that is the potential source of oil spills and this system has been strengthened further in response to the Montara oil spill. While oil spills are unpredictable events and their likelihood is low based on past experience, their consequences, especially for threatened species at important areas can be severe. The level of impact that actually occurs depends on a number of factors including the concentration of oil; chemical and physical properties of the oil (or oil and dispersant mixture). Also influencing the impact of an oil spill event are the timing of breeding cycles and seasonal migrations of species, the amount of contact, the susceptibility of particular species; and the health, age and reproductive status of the individuals (AMSA 2011a). Particular ecological values associated with the KEFs that may be impacted by such an event include seasonal feeding aggregations of pelagic invertebrates, fish and mammals associated with the Tasman Front and eddy field and the upwelling off Fraser Island, seabirds and turtles that forage at Elizabeth and Middleton reef and the tropical and temperate demersal and pelagic fish assemblages supported by these reefs; fish that seek refuge on seamounts; and predatory fish and seabirds that forage in waters surrounding seamounts. Both the intensity and distribution of activities that might lead to oil spills (such as transport) are expected to increase in the region.

Table S1.6: Pressures *of potential concern* to bony fishes of the Temperate East Marine Region

Species assessed = 10 (seahorses, pipehorses and sea dragons assessed as a group)		
Pressure	**Species**	**Rationale**
Changes in sea temperature (climate change)	Eastern gemfish Orange roughy Black cod Seahorses, pipehorses and sea dragons	Sea temperatures have warmed by 0.7 °C between 1910–1929 and 1989–2008, and current projections estimate ocean temperatures will be a further 1 °C warmer by 2030 (Lough 2009). Research from Europe suggests that the warming of deep waters may have negative consequences for ecosystem function and community distribution (Weaver et al. 2009). All species assessed are likely to experience shifts in distribution and abundance due to sea temperature rises, with impacts on their life cycle stages, prey availability and habitat. Adult black cod and syngnathids are particularly vulnerable given the species' tendency to have specific habitat preferences within a small home range, thus reducing their ability to find and adapt to new habitats (Malcolm 2011; McClatchie et al. 2006).
Changes In oceanography (climate change)	Eastern gemfish Orange roughy Black cod Seahorses, pipehorses and sea dragons	Changes in oceanography include consideration of circulation patterns; current intensities; wind strength and direction; the location and strength of eddy and upwelling events and climatic oscillations such as the El Niño–Southern Oscillation. Although species-specific responses to oceanographic changes are limited, consequences are expected for the structure, function and dynamics of deep sea habitats. For example, there is likely to be an impact on the transport of matter and energy to depths (Entoyer 2010; Weaver et al. 2009), thereby impacting on food supplies reaching these systems. Evidence from Europe suggests that this change alone will alter the population dynamics of commercial deep sea species such as orange roughy (Weaver et al. 2009). In New South Wales ocean current changes resulting from climate change are predicted to cause a reduction in the flow of freshwater to estuaries, and an increase in nutrient laden waters in near coastal areas. These changes will alter species distribution and abundance and potentially decrease sources of prey for juvenile black cod which use these habitats (DTIRIS 2012). Eastern gemfish are considered vulnerable to changes in productivity associated with changes in wind strength (Hobday et al. 2008), and the annual pre-spawning migration may also be impacted by changes in oceanography; however, it is unclear whether the impacts on migration will be positive or negative on the species (Prince & Griffin 2001; Rowling 2001). Black cod, seahorses, pipehorses and sea dragons have specific habitat preferences with small home ranges, and this may reduce their ability to find and adapt to new habitats (Malcolm 2011; McClatchie et al. 2006).

Species assessed = 10 (seahorses, pipehorses and sea dragons assessed as a group)		
Pressure	**Species**	**Rationale**
Chemical pollution/ contaminants **Nutrient pollution (agricultural activities, urban development)**	Black cod	Black cod's use of estuaries as juvenile development grounds makes them vulnerable to the effects of water pollution, in the form of pollutants contained within run-off from urban development and agricultural activities. These pollutants can degrade the quality of habitats, alter the water chemistry, encourage the growth of algae and smother benthic flora and fauna species. In particular, heavy metals and organochlorine pesticides pose high risks to estuarine biota, as they persist in the environment, magnify along food chains and reduce the relative abundance of top-order predators (ANZECC 2000; DECC 2009). Over time, changes in the water chemistry, food chain and turbidity caused by urban and agricultural run-off may significantly impact the long term viability of black cod within estuaries (DTIRIS 2012).
Physical habitat modification (dredging)	Seahorses, pipehorses and sea dragons	Physical habitat modification due to dredging activities is expected to increase adjacent to the Temperate East Marine Region due to the growth in recreational boating activity (Bay Journal 2008; MSQ 2011). Seahorses, pipehorses and sea dragons have a sedentary lifestyle and close affinity to sponge and reef habitats, which makes them vulnerable to impacts arising from this pressure. Impacts on habitat include a reduction in structural diversity and fewer opportunities for the settlement of new coral colonies, due to the removal of biogenic substratum (Althaus et al. 2009; Lack et al. 2003; Pogonoski et al. 2002).
Physical habitat modification (fishing gear)	Orange roughy Seahorses, pipehorses and sea dragons	Physical habitat modification from fishing gear (e.g. trawling) has the potential to impact on seahorses, pipehorses and sea dragons due to their specific habitat requirements and limited geographic range (Foster & Vincent 2004; Kuiter 2009). These species are distributed across the fishing grounds of the Queensland East Coast Otter Trawl Fishery. As is the case with dredging, mobile fishing gear crushes, buries and exposes marine animals and their habitat (e.g. sponge gardens and rocky reefs), and reduces the structural diversity of preferred habitat (Althaus et al. 2009; Lack et al. 2003; Pitcher et al. 2009; Pogonoski et al. 2002). Commercial bottom trawling on seamounts can cause physical damage to benthic environments affecting benthic fauna. Damage to seamounts could affect orange roughy recruitment due to the link between their spawning aggregations and this habitat feature.
Physical habitat modification (urban/coastal development)	Black cod	Estuaries provide a nursery, refuge and feeding opportunities for black cod in its juvenile development stages. Physical habitat modification of estuaries as a result of urban and coastal development can impact black cod prior to their migration to coastal rocky reefs. In particular, the ongoing building and repair of seawalls, designed to protect low-lying foreshore infrastructure from sea level rise associated with climate change (DTIRIS 2012) can have a detrimental effect on flows, vegetation and habitat, impacting juvenile black cod.

Species assessed = 10 (seahorses, pipehorses and sea dragons assessed as a group)		
Pressure	**Species**	**Rationale**
Extraction of living resources (illegal, unregulated and unreported fishing)	Black cod	Isolated incidences of the illegal take of black cod by recreational spear fishers along the New South Wales coast are occasionally reported (DTIRIS 2012), and illegal fishing is *of potential concern* for black cod. The New South Wales Fisheries' 2003 draft recovery plan for black cod reported anecdotal evidence of large catches of black cod in the early 1980s from Elizabeth and Middleton Reefs, and in 1993 a commercial fishing boat crew was found to have taken 24 black cod from the same area (TSSC 2012).
Bycatch (commercial fishing)	Black cod Seahorses, pipehorses and sea dragons	There is evidence that black cod, seahorses, pipehorses and sea dragons are caught in commercial fisheries in the region. Commercial take of black cod is prohibited, however, the species is still caught as bycatch in Commonwealth fisheries, with fish suffering mortality due to hooks from fishers and barotrauma (Baker 2009). Indiscriminate fishing methods such as bottom-set baited lines (e.g. setlining, trotlining, handlining) are the most widely used methods with the potential to have a significant negative impact on black cod numbers and distribution (DTRIS 2012). Commercial fisheries targeting estuarine species may also impact juvenile black cod numbers, in particular those fisheries trapping in the lower reaches of estuaries on the north coast of New South Wales (DTIRIS 2012). Seahorses, pipehorses and sea dragons are considered vulnerable to Danish-seine operations, as these activities occur in relatively shallow waters and use nets with a small mesh size. They are also caught as bycatch in the Queensland East Coast Otter Trawl Fishery, particularly Duncker's and Hardwick's pipehorses, although numbers are low and considered to be declining (Coles et al. 2008). In New South Wales, bycatch of these species, particularly *Solegnathus* spp. (pipehorses) is a concern (Bowles & Martin-Smith 2003).
Bycatch (recreational fishing)	Black cod	As for commercial fishing, recreational fishing of black cod is prohibited; however recreational fishers are still known to occasionally catch black cod. Limited recognition or knowledge of the species has meant that it is not always released, or even when released does not survive due to barotrauma. New fishing technologies have improved recreational fishing effectiveness, particularly in deeper waters where adult black cod are found, which may increase the risk of recreational bycatch of the species (TSSC 2012).

Table S1.7: Pressures *of concern* to selected cetaceans of the Temperate East Marine Region

Species assessed = 9		
Pressure	**Species**	**Rationale**
Physical habitat modification (urban/coastal development)	Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Increased physical habitat modification associated with urban and coastal development is expected adjacent to the region, along the south-east Queensland and New South Wales coastline. Studies on coastal and riverine cetaceans worldwide indicate that habitat degradation is a serious threat that fragments populations and, in some cases, eliminates habitat (Reeves & Smith 1999). In the Temperate East, the overlap between coastal development and habitats used by inshore dolphins makes them vulnerable to this pressure. Indo-Pacific humpback dolphin populations are particularly susceptible because they are highly localised, occur in small subpopulations and are extremely sensitive to disturbance in their preferred habitats (Corkeron et al. 1997; Parra et al. 2006).
Bycatch (commercial fishing)	Killer whale Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Bycatch of cetacean species predominantly results in drowning and may cause changes to species distribution and population health. Diet studies of inshore dolphins by Heinshohn (1979), Marsh et al. (1989) and Parra & Jendensjo (2009) indicate that coastal estuarine waters are important foraging habitats for these species and, as a result, they are at greater risk of directly or indirectly interacting with fisheries operating in coastal waters (Parra & Jendensjo 2009). For inshore dolphins, bycatch in gillnets has emerged as a key threat to their survival (D'Agrosa et al. 2000; Northridge 1991; Rojas-Bracho & Taylor 1999). Australian net fisheries' catch is taken close to the coast, at depths less than 50 m (Kearney et al. 1996) and there is evidence that coastal dolphin bycatch occurs in these fisheries (Corkeron et al. 1997). For example, the outcome of the ecological risk assessment process by AFMA for the Small Pelagic Fishery (purse seine) assessed both the coastal bottlenose and Indo-Pacific humpback dolphin as at high risk of capture. The Small Pelagic Fishery Bycatch Action Plan is intended to reduce bycatch in this fishery. The rating assigned for the killer whale has been led by the outcomes of the AFMA ecological risk assessment process, which assessed the species as at high risk of capture within the Eastern Skipjack Tuna Fishery. *Australia's tuna purse seine fisheries bycatch action plan* (AFMA 2005) is intended to reduce bycatch and associated impacts in the Commonwealth tuna purse-seine fisheries.

Species assessed = 9		
Pressure	**Species**	**Rationale**
Bycatch **(bather protection programs)**	Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Bather protection (shark meshing) programs have been in operation for over 70 years, deploying nets and drumlines to protect swimmers from the risk of shark attacks in coastal waters adjacent to the Temperate East Marine Region (Queensland and New South Wales). However, these programs lead to the bycatch of other marine species, including inshore dolphins. Between 1995 and 2009, 257 dolphins were caught in nets and drumlines associated with the bather protection programs (228 were caught in nets and 29 on drumlines); of these, 47 were bottlenose dolphins and 26 were Indo-Pacific humpback dolphins (Nias 2011).

Table S1.8: Pressures *of potential concern* to selected cetaceans of the Temperate East Marine Region

Species assessed = 9		
Pressure	**Species**	**Rationale**
Sea level rise (climate change)	Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Global sea levels rose by 20 cm between 1870 and 2004, and predictions estimate a further rise of 5–15 cm by 2030, relative to 1990 levels (Church et al. 2009). Longer term predictions estimate increases of 0.5–1 m by 2100, relative to 2000 levels (Climate Commission 2011). Inshore dolphins are vulnerable to rising sea levels because of the predicted impacts on their preferred foraging habitat (seagrass). In general, seagrass abundance and extent is predicted to decline as sea level rise decreases the light available for photosynthesis (Connolly 2009). A decrease in the extent of seagrass is expected to impact negatively on inshore dolphins.
Changes in sea temperature (climate change)	Blue whale Dwarf minke whale Humpback whale Killer whale Fin whale Sei whale Southern right whale Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Sea temperatures have warmed by 0.7 °C between 1910–1929 and 1989–2008, and current projections estimate ocean temperatures will be a further 1 °C warmer by 2030 (Lough 2009). Inshore dolphins are vulnerable to rising sea temperatures because of the expected impacts on their preferred foraging habitat (seagrass) (Connolly 2009; Parra & Corkeron, 2001; Parra et al. 2002; Parra, 2006). Temperature is a key factor determining the distribution of seagrasses (Poloczanska et al. 2007) and shallow subtidal species are considered at risk from warming ocean and air temperatures (Seddon et al. 2000). Climate variability may also affect other cetaceans; for example, research on climate variability and reproduction in southern right whales suggests a detrimental impact on reproductive success with warming events (Pirzl et al. 2008). Environmental fluctuations may impact on reproduction by affecting body condition and health through changes in foraging conditions, with krill availability in the summer feeding grounds influencing reproductive success the following winter (Trathan & Murphy 2002; Trathan et al. 2003).

Species assessed = 9		
Pressure	**Species**	**Rationale**
Changes in oceanography (climate change)	Blue whale Dwarf minke whale Humpback whale Killer whale Fin whale Sei whale Southern right whale Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Changes in oceanography include consideration of circulation patterns, current intensities, wind strength and direction, the location and strength of eddy and upwelling events and climatic oscillations such as the El Niño–Southern Oscillation. Oceanographic changes in the region will be primarily driven by the East Australian Current. Studies indicate this major boundary current has been strengthening, pushing warmer, saltier water further southward along the east coast (for up to 350 km). Predictive climate models have medium confidence that this trend will increase (Ridgway & Hill 2009). There will also be associated circulation effects arising from expected changes to the El Niño–Southern Oscillation. Potential consequences of changes in ocean circulation patterns and the bifurcation point of the East Australian Current include shifts in upwelling events, increased thermal stratification, increased eddy activity and a shift in the thermocline depth (Chin et al. 2010). For cetaceans, these changes may influence the availability of prey, migration patterns and selection of calving sites (Chin et al. 2010).
Ocean acidification (climate change)	Blue whale Dwarf minke whale Humpback whale Killer whale Fin whale Sei whale Southern right whale Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Driven by increasing levels of atmospheric CO_2 and subsequent chemical changes in the ocean, acidification is already under way and detectable. Since pre-industrial times, acidification has lowered ocean pH by 0.1 units (Howard et al. 2009). Furthermore, climate models predict this trend will continue, with a further 0.2–0.3 unit decline by 2100 (Howard et al. 2009). Recent research indicates significant impacts of ocean acidification on Antarctic krill (Kawaguchi et al. 2011), which are a key food source for many whale species that visit Australian waters. While there are no observed impacts of climate change on zooplankton in Australian waters, based on knowledge of impacts elsewhere, Australia is likely to start losing calcifying zooplankton from its southern waters (Richardson et al. 2009).

Species assessed = 9		
Pressure	**Species**	**Rationale**
Chemical pollution/ contaminants (urban development, agricultural activities)	Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Cetaceans that frequent nearshore areas, such as the Indo-Pacific bottlenose dolphin and the Indo-Pacific humpback dolphin, may be exposed to higher levels of chemical pollutants than wholly offshore species (Jacob 2009). Shipping is a key activity in the region, with shipping routes servicing a number of ports that are adjacent to the region and inshore dolphin habitat. Higher levels of polychlorinated biphenyls (PCBs) have been found in dolphins from the Gold Coast compared to anywhere else in Australia; high levels of PCBs have been linked to impaired reproductive capacity in dolphins (Gaus et al. 2001). There is limited data on the likelihood of chemical spills in the region; however, like oil spills, they are unpredictable events that may have severe consequences for marine species. Inshore dolphins are particularly vulnerable because of their highly localised populations along the east coast.
Nutrient pollution (urban development, agricultural activities)	Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Nutrient pollution, also known as eutrophication, refers to an increase in the rate of supply of organic matter into an ecosystem, particularly nitrogen, phosphorus and silica. Eutrophication is considered a threat to coastal marine environments, leading to an increased frequency of harmful algal blooms, loss of ecosystem integrity and changes to biodiversity. High rainfall and catchment run-off, particularly in south-east Queensland, increases the exposure of dolphins to bioaccumulated toxins (Lawler et al. 2007). For example, inshore dolphins can be directly exposed to toxins through algae outbreaks associated with increased nutrient loads, absorbing toxins from water or ingesting algal cells; or indirectly through eating prey that contain toxins (Carmago & Alonso 2006).

Species assessed = 9		
Pressure	**Species**	**Rationale**
Marine debris	Blue whale Dwarf minke whale Humpback whale Killer whale Fin whale Sei whale Southern right whale Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	*Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris* was listed in 2009 as a key threatening process under the EPBC Act (DEWHA 2009a). Marine debris is defined as any persistent, manufactured or processed solid material that has been disposed of or abandoned in the marine and coastal environment (UNEP 2005). Cetaceans are considered vulnerable to entanglement in marine debris, and the threat abatement plan lists a number of cetaceans that are known to be adversely affected by marine debris, including the southern right whale, blue whale and humpback whale (DEWHA 2009a). The potential for marine debris to affect inshore dolphin habitat is high because of the high number of people living adjacent to the coast (ABS 2001), the popularity of recreational fishing, and the number of commercial fisheries operating in and adjacent to the region (DEWHA 2009b). The Australian Government has developed a threat abatement plan that provides a coordinated national approach to prevent and mitigate the effects of harmful marine debris on marine life (DEWHA 2009a).
Noise pollution (shipping, urban development)	Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	There is growing concern that the impacts of human-made noise on marine life, particularly cetaceans, may result in physical or behavioural effects on these species (DEWHA 2008a). With pressures such as coastal development, a number of important ports and associated shipping activity, there is concern that noise may interfere with the ability of inshore dolphins to communicate, resulting in displacement from preferred habitat, or physical trauma and damage to sensory systems (Bejder & Samuels 2003; Mattson et al. 2005; Nowacek et al. 2007; Richardson et al. 1995). Evidence of changes in behaviour can be found in Moreton Bay, where the rate of whistling by humpback dolphins has increased in the presence of travelling boats, particularly in mother–calf pairs (van Parijs & Corkeron 2001).
Physical habitat modification (dredging/ dredge spoil)	Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Physical habitat modification from dredging activities is expected adjacent to the Temperate East Marine Region due to the growth in recreational boating activity (Bay Journal 2008; MSQ 2011). Dredging can also occur in association with development projects for extractive purposes and for the installation of pipelines and cables. Dredging modifies nearshore habitats by removing or smothering benthic flora and fauna, and changing water flows (GBRMPA 2009). Studies on coastal and riverine cetaceans worldwide indicate that habitat degradation is a serious threat that fragments populations and, in some cases, eliminates habitat (Reeves & Smith 1999). In the region, the overlap between coastal development and habitats used by inshore dolphins makes them vulnerable to this pressure. The Indo-Pacific humpback dolphin populations are particularly susceptible because they are highly localised, occur in small subpopulations and are extremely sensitive to disturbance in their preferred habitats (Corkeron et al. 1997; Parra et al. 2006).

Species assessed = 9		
Pressure	**Species**	**Rationale**
Bycatch (bather protection programs)	Humpback whale	Bather protection (shark meshing) programs have been in operation for over 70 years, deploying nets and drumlines to protect swimmers from the risk of shark attacks along the New South Wales and Queensland coasts. However, these programs lead to the bycatch of other marine species. The number of humpback whales caught in nets along the Queensland coast during migration has remained relatively constant over recent years (DERM 2009); however, as the population recovers, the interaction between humpback whales and shark meshing may increase.
Oil pollution (shipping, vessels)	Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Oil spills are unpredictable events and their likelihood is low, particularly in the context of the international and domestic regulatory mitigation measures that apply in Australia. However, their consequences can be severe, particularly in biologically significant areas or times. Shipping is a key activity in the region, with shipping routes servicing a number of ports that are adjacent to the region and inshore dolphin habitat. In the event of an oil spill, dolphins have been known to detect oil and avoid it; however, at other times they have been exposed to floating oil (AMSA 2010). Inshore dolphin species are particularly vulnerable to oil spills because of their highly localised populations along the east coast.
Collisions with vessels (shipping, tourism, fishing)	Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Collisions between dolphins and vessels have been recorded in Australian waters, with records of dolphin mortality attributed to boat strike in Victoria (DSE 2011) and South Australia (News Limited 2010). The growth in recreational boating activity in the region (Bay Journal 2008; MSQ 2011), combined with a preference for nearshore habitats, makes inshore dolphins vulnerable to collisions with vessels.
Changes in hydrological regimes (climate change)	Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Changes in hydrological regimes through, for example, an increase in the frequency and intensity of storm and flooding events could impact on nearshore environments used by inshore dolphins. The predicted increase in intensity of storm events, combined with rising sea levels, is expected to cause shoreline erosion, thereby increasing turbidity of shallow coastal waters (Cabaco et al. 2008; Hennessy et al. 2007; Waycott et al. 2007) and reducing the amount of light available for photosynthesis in seagrasses (Connolly 2009), the preferred habitat of inshore dolphins. Increases in turbidity within mangrove environments may also reduce the efficiency of predators (Abrahams & Kattenfeld, 1997), including both species of inshore dolphin.

Table S1.9: Pressures *of concern* to selected marine reptiles of the Temperate East Marine Region

Species assessed = 24 (sea snakes assessed as a group)		
Pressure	**Species**	**Rationale**
Sea level rise (climate change)	Loggerhead turtle	Global sea levels rose by 20 cm between 1870 and 2004, and predictions estimate a further rise of 5–15 cm by 2030, relative to 1990 levels (Church et al. 2009). Longer term predictions estimate increases of 0.5–1 m by 2100, relative to 2000 levels (Climate Commission 2011). The implications of sea level rise for marine turtles include an increased risk of tidal inundation or destruction of nests, the selection of suboptimal nesting areas, and risk of nest destruction by other turtles associated with higher nesting densities (Hamann et al. 2007; Poloczanska et al. 2010). Collectively, these impacts may reduce breeding success. It is expected that the effects of sea level rise will be particularly marked in regions of extensive coastal development, such as eastern Australia, where development acts as a barrier to the landward movement of beaches or hinders natural accretion of beach material and the evolution of beach morphology (Poloczanska et al. 2010).
Changes in sea temperatures (climate change)	Loggerhead turtle	Sea temperatures have warmed by 0.7 °C between 1910–1929 and 1989–2008, and current projections estimate ocean temperatures will be a further 1 °C warmer by 2030 (Lough 2009). Increasing sea temperatures have the potential to impact on marine turtles in a number of ways, including a shift in distribution, which may either increase or decrease the species range (Hawkes et al. 2009; Milton & Lutz 2003); alterations to life history characteristics such as growth rates and age at maturity (Balazs & Chaloupka 2004; Chaloupka & Limpus 2001; Hamann et al. 2007); and reduced prey availability (Chaloupka et al. 2008; Fuentes et al. 2009). For example, higher mean annual sea surface temperatures in core loggerhead foraging areas correlate with trends towards smaller annual nesting populations during the following summer in eastern Australia (Chaloupka et al. 2008).
Changes in terrestrial sand temperatures (climate change)	Loggerhead turtle	Changes in terrestrial sand temperature have implications for nesting marine turtles: higher sand temperatures increase the female bias in the sex ratio of turtle hatchlings, which may lead to a female bias in marine turtle populations (Fuentes et al. 2009). A rise in sand temperature may also compromise egg incubation, leading to lower hatchling success and reduced hatchling survival (Fuentes et al. 2009). Emerging research suggests that turtles are responding to these pressures in a highly adaptive manner; for example, by shifting nesting periods to correspond to lower temperatures (Poloczanska et al. 2010).

Species assessed = 24 (sea snakes assessed as a group)		
Pressure	**Species**	**Rationale**
Bycatch (commercial fishing)	Green turtle Leatherback turtle Loggerhead turtle	Bycatch associated with commercial fisheries operating in the region is *of concern* to marine turtles that are listed as threatened, including the green, leatherback and loggerhead turtle. Turtles are vulnerable to trawl, gillnet and longline fisheries gear, and bycatch interactions typically result in the death of individuals by drowning. All three gear types are used across the region and records indicate that all three species of turtle are caught (Limpus 2008a, 2008b, 2009). The population effects of bycatch mortality are unknown for some species; however, for others such as the loggerhead and green turtle, it has led to population declines. For example, mortality associated with otter trawl operations across eastern and northern Australia were identified as the cause of the 86% decline in loggerhead annual nesting numbers in eastern Australia from the mid-1970s to 2000. In the past decade, the introduction of turtle excluder devices (TEDs) in several key trawl fisheries such as the Queensland East Coast Otter Trawl Fishery has resulted in a significant reduction of bycatch. Despite their success, TEDs are not universally used. For example, New South Wales trawl fisheries (e.g. New South Wales Otter Trawl Fishery) do not use these devices and it is expected this will slow the recovery of threatened species across the Temperate East Marine Region and in the south-west Pacific. For other fisheries, such as longline operations, where TEDs cannot be used, bycatch levels continue to be considered a high risk. For example, in the Eastern Tuna and Billfish Fishery, green and leatherback turtles are the most frequently caught turtle species.
Collision with vessels	Green turtle Hawksbill turtle Loggerhead turtle	Boat strikes are a common cause of death and injury in marine turtles, with turtles' poor hearing and vision hampering their ability to avoid boats. Turtles are most vulnerable to boat strike when they are in shallow waters, or basking or breathing at the surface. Growing coastal development and the associated rise in recreational boating activities in the region are expected to exacerbate this issue (Limpus 2008a, b, 2009a). Adult turtles are particularly vulnerable, and this compounds the impact of this pressure on turtle populations by disproportionately reducing the numbers of breeding-age individuals (Limpus 2008a). Some very effective mitigation measures are in place, such as the 'Go slow' zones in the Moreton Bay Conservation Park; however, experts remain concerned about the impact of boat strikes on turtle populations within the region.

Table S1.10: Pressures *of potential concern* to selected marine reptiles of the Temperate East Marine Region

Species assessed = 24 (sea snakes assessed as a group)		
Pressure	**Species**	**Rationale**
Sea level rise (climate change)	Green turtle	Global sea levels have risen by 20 cm between 1870 and 2004, and predictions estimate a further rise of 5–15 cm by 2030, relative to 1990 levels (Church et al. 2009). Longer term predictions estimate increases of 0.5–1 m by 2100, relative to 2000 levels (Climate Commission 2011). The implications of sea level rise for marine turtles include an increased risk of tidal inundation or destruction of nests, the selection of suboptimal nesting areas, and risk of nest destruction by other turtles associated with higher nesting densities (Hamann et al. 2007; Poloczanska et al. 2010). Collectively, these impacts may reduce breeding success. It is expected that the effects of sea level rise will be particularly marked in regions of extensive coastal development, such as eastern Australia, where development acts as a barrier to the landward movement of beaches or hinders natural accretion of beach material and the evolution of beach morphology (Poloczanska et al. 2010).
Changes in sea temperature (climate change)	Green turtle Hawksbill turtle Leatherback turtle Sea snakes	Sea temperatures have warmed by 0.7 °C between 1910–1929 and 1989–2008, and current projections estimate ocean temperatures will be a further 1 °C warmer by 2030 (Lough 2009). Increasing sea temperatures have the potential to impact on marine turtles in a number of ways, including a shift in distribution that may either increase or decrease the species range (Hawkes et al. 2009; Milton & Lutz 2003), alterations to life history characteristics (e.g. growth rates, age at maturity and reproductive periodicity) (Balazs & Chaloupka 2004; Chaloupka & Limpus 2001; Fuentes et al. 2009; Hamann et al. 2007) and reduced prey availability (Chaloupka et al. 2008). Sea snakes depend on water temperatures for their body heat while foraging (Guinea 1995; Heatwole 1981). Little is known about the thermal requirements and tolerances of sea snakes and how they will respond to increasing water temperatures (Hamann et al. 2007). Potential impacts from changes in sea temperatures include changes to the availability of prey species and seasonal movements for breeding or feeding (Fuentes et al. 2009; Hamann et al. 2007).

Species assessed = 24 (sea snakes assessed as a group)		
Pressure	**Species**	**Rationale**
Changes in oceanography (climate change)	Green turtle Hawksbill turtle Leatherback turtle Loggerhead turtle	Changes in oceanography broadly refer to changes in ocean circulation patterns, current intensities, wind strength and direction, the location and strength of eddy and upwelling events and climatic oscillations such as the El Niño–Southern Oscillation. For turtles, changes to these ocean characteristics may have implications for hatchling dispersal, migration and feeding. For example, dispersal of loggerhead and green turtle hatchlings from the Great Barrier Reef occurs via offshore currents (Boyle 2006; Hamann et al. 2007), and any changes in offshore current will influence this dispersal.
Changes in terrestrial sand temperature (climate change)	Green turtle	Changes in terrestrial sand temperature have implications for nesting marine turtles: higher sand temperatures increase the female bias in the sex ratio of turtle hatchlings, which may lead to a female bias in marine turtle populations (Fuentes et al. 2009). A rise in sand temperature may also compromise egg incubation, leading to lower hatchling success and reduced hatchling survival (Fuentes et al. 2009). Emerging research suggests that turtles are responding to these pressures in a highly adaptive manner; for example, by shifting nesting periods to correspond to lower temperatures (Poloczanska et al. 2010).
Chemical pollution/ contaminants (shipping, vessels, urban development, agricultural activities)	Green turtle Hawksbill turtle Leatherback turtle Loggerhead turtle	The Temperate East Marine Region is highly exposed to possible vectors for chemical pollutants, including significant shipping, fishing and agricultural activities in and adjacent to the region. It is expected that the effects of a major chemical spill would be similar to, or possibly exceed, those of a major oil spill (GBRMPA 2009). The implications of small and gradual influxes of chemicals (e.g. agricultural run-off) are harder to ascertain, and the effects on turtle populations are unknown (Muusee et al. 2006). Studies indicate that turtles, as high-order predators, bioaccumulate and biomagnify chemicals, meaning that chemicals can reach high concentrations in individuals, with potentially negative consequences (Muusee et al. 2006). A number of management measures are in place to respond to this risk, including the National plan to combat pollution of the sea by oil and other noxious and hazardous substances and the International Convention for the Prevention of Pollution from Ships (MARPOL), both of which are implemented through the Australian Maritime Safety Authority. Although these measures mitigate the risk of a significant pollution event, the potential for such an event remains.

Species assessed = 24 (sea snakes assessed as a group)		
Pressure	**Species**	**Rationale**
Nutrient pollution (urban development, agricultural activities)	Green turtle Hawksbill turtle Loggerhead turtle	Nutrient pollution, also known as eutrophication, refers to an increase in the rate of supply of organic matter into an ecosystem, particularly nitrogen, phosphorus and silica. Eutrophication is considered a threat to coastal marine environments, leading to an increased frequency of harmful algal blooms, loss of ecosystem integrity and changes to biodiversity. Algal blooms have been associated with substandard diets in turtles, which may hamper growth and development and reduce reproduction (Arthur et al. 2006). It is also suggested that these blooms are associated with tumour-promoting toxins in turtles. Given the expected increase in nutrient pollution associated with the growth in coastal development, experts consider this pressure to be of increasing concern to turtle populations that are already compromised.
Marine debris	Green turtle Loggerhead turtle	*Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris* was listed in 2003 as a key threatening process under the EPBC Act (DEWHA 2009a). Marine debris is defined as any persistent, manufactured or processed solid material that has been disposed of, or abandoned, in the marine and coastal environment (UNEP 2005). The green and loggerhead turtles are known to be adversely affected by marine debris. Ingestion of debris is common, particularly plastic bags, which can be mistaken for prey (i.e. jellyfish) (Derraik 2002). This can cause turtles to float, thereby affecting foraging and animal health. Young turtles are especially vulnerable, as they drift within convergence zones (e.g. rips, fronts and drift lines formed by ocean currents) where high densities of marine debris accumulate. In a recent study by Boyle & Limpus (2008), synthetic materials accounted for up to 46% of total stomach content in green turtle post-hatchlings. Hatchlings are not able to compensate for the intake of non-nutritional items, and this results in reduced energy uptake. Research also indicates that toxins within materials are absorbed by turtles (Bjorndal et al. 1994).

Species assessed = 24 (sea snakes assessed as a group)		
Pressure	**Species**	**Rationale**
Light pollution (onshore activities and offshore activities)	Green turtle Loggerhead turtle	The Temperate East Marine Region is adjacent to a highly populated coastline where lighting from coastal development, ports and associated shipping activity is considered *of potential concern* to marine turtles, particularly during the breeding season. Light pollution along, or adjacent to, nesting beaches may alter nocturnal turtle behaviours, particularly the selection of nesting sites and the passage of adult females and emerging hatchlings from the beach to the sea (Limpus 2008b). The impacts of these changes in behaviour include a decrease in nesting success, beach avoidance by nesting females and disorientation, leading to increased mortality through predation, road kill and dehydration (Limpus 2008b; Lorne & Salmon 2007; Witherington & Martin 2000). Managers have addressed the issue by applying management zones to the majority of nesting sites (Limpus 2008b); for example, at Mon Repos Conservation Park, a 1.5 km radius darkness zone has been applied to protect nesting turtles. However, lighting from nearby towns is extensive and thought to remain visible out to sea for distances greater than 3 km, thereby influencing hatchling behaviour at Mon Repos (Limpus 2008b).
Physical habitat modification (dredging)	Green turtle Loggerhead turtle Sea snakes	Physical habitat modification due to dredging activities is expected to increase in areas adjacent to the Temperate East Marine Region due to the growth in recreational boating activity (Bay Journal 2008; MSQ 2011). Dredging can also occur in association with development projects for extractive purposes and for the installation of pipelines and cables. Dredging modifies nearshore habitats by removing or smothering benthic flora and fauna, and changing water flows (GBRMPA 2009). Marine turtles and sea snakes are likely to use habitats that are affected by dredging and are therefore vulnerable to this pressure.
Extraction of living resources (commercial fishing, non-domestic)	Green turtle Hawksbill turtle	Marine turtles are protected in Australian waters but, because they roam internationally, declines may be due to unsustainable fishing in other parts of the species' range. Evidence indicates that fishing occurs in neighbouring South Pacific countries (Meylan & Donnelly 1999), with green and hawksbill turtles preferentially taken for their meat and shells, respectively, and sold in markets (e.g. Daru and Koki markets in Papua New Guinea). Long life spans and late sexual maturity make these species vulnerable to continued harvesting and impacts on populations both within and beyond the region (Dethmers et al. 2010).

Species assessed = 24 (sea snakes assessed as a group)		
Pressure	**Species**	**Rationale**
Bycatch (commercial fishing)	Hawksbill turtle Sea snakes	Turtles are vulnerable to trawl, gillnet and longline fisheries gear and bycatch interactions typically result in the death of individuals by drowning. All three gear types are used across the region, and records indicate that hawksbill turtles are caught as bycatch (Limpus 2008a; 2008b; 2009). In the past decade, the introduction of turtle excluder devices (TEDs) in several key trawl fisheries has significantly reduced bycatch levels. Despite their success, TEDs are not universally used; for example, New South Wales trawl fisheries (e.g. New South Wales Ocean Trawl Fishery) do not use these devices. Bycatch from the Queensland trawl fishery is the main pressure impacting on sea snakes (Cogger 2000). In particular, the redspot king prawn fishery records significant sea snake bycatch (Courtney et al. 2010. This fishery has the potential to impact on all species, especially the spectacled and small-headed seasnakes. Very little is known about either of these species, other than that they are slow to mature, have few young and do not survive well in trawl nets.
Bycatch (illegal, unregulated and unreported fishing)	Green turtle Hawksbill turtle Leatherback turtle Loggerhead turtle	Illegal, unregulated and unreported (IUU) fishing is considered *of potential concern* for all turtle species. IUU fishing encompasses a complex range of fisheries activities, but generally refers to fisheries operations that violate the governing laws and conventions of that fish stock. Although not explicitly targeting turtle species, IUU fisheries operations create significant collateral damage to ecosystems. By their nature, such operations do not respect national and international actions designed to reduce bycatch and mitigate the incidental mortality of marine animals such as marine turtles (Agnew et al. 2009). Although IUU fishing is not a significant issue within the region, it is widespread in adjacent waters and is thought to be contributing to declines in turtle populations within the Temperate East Marine Region.

Species assessed = 24 (sea snakes assessed as a group)		
Pressure	**Species**	**Rationale**
Oil pollution (shipping, vessels)	Green turtle Hawksbill turtle Leatherback turtle Loggerhead turtle Sea snakes	Oil spills are unpredictable events and their likelihood is low, particularly in the context of the international and domestic regulatory mitigation measures that apply in Australia. However, their consequences can be severe, particularly in biologically significant areas and times. Shipping is a key activity in the region, with shipping routes servicing a number of ports adjacent to the region, and adjacent to habitat for turtles and sea snakes. Marine reptiles are affected by oil pollution through exposure when surfacing to breath, contaminated food supplies, fouling of nesting beaches and absorption through the skin (Anon 2010; Gagnon 2009; Watson 2009). Physical contact may result in a range of impacts including burns, damage to internal organs, and toxicity resulting in reduced hatchling success and deformities in developing embryos (AMSA 2010).
Invasive species	Green turtle Loggerhead turtle	Egg predation by invasive or introduced species is a significant issue for marine turtle populations. An invasive species is defined as one that occurs and thrives outside its normal geographical distribution as a result of human activities, and can include animals, weeds, diseases and parasites (Olsen et al. 2006). Of particular concern to turtle populations within the region are the European red fox and feral pig, both of which have had impacts on turtle populations, particularly the eastern loggerhead stocks (Limpus & Limpus 2003; Limpus & Parmeter 1985; Tisdell et al. 2004). Extensive monitoring of (index) nesting sites both within the region (e.g. Mon Repos) and beyond (e.g. Gulf of Carpentaria) indicate that a high proportion of nests are destroyed by foxes and pigs. In the case of Mon Repos, a key nesting site for the loggerhead, predation has seriously impacted on the recruitment of females to the population, reducing overall stocks (Limpus & Limpus 2003). A Queensland Government fox eradication program has reduced fox impacts to negligible levels at key sites (i.e. Mon Repos); however, uncontrolled predation remains an issue. Threat abatement plans have been prepared under the EPBC Act for foxes and pigs (DEWHA 2008c; DEH 2005a).

Table S1.11: Pressures *of concern* to selected seabirds of the Temperate East Marine Region

Species assessed = 34		
Pressure	**Species**	**Rationale**
Changes in oceanography (climate change)	Sooty tern	Changes in oceanography broadly refer to changes in ocean circulation patterns; current intensities; wind strength and direction; the location and strength of eddy and upwelling events; and climatic oscillations such as the El Niño–Southern Oscillation. The sooty tern is considered especially vulnerable to changes in oceanography through impacts on the distribution and availability of prey species, and on its breeding success. In the region, changes in oceanography will be primarily driven by the East Australian Current, which has been strengthening, pushing warmer, saltier water further southward along the east coast (for up to 350 km). Models suggest with medium confidence that this trend will increase (Ridgway & Hill 2009). For the sooty tern, El Niño events have also been linked to breeding failure. In 2002, following an El Niño–Southern Oscillation event, sooty terns at Lord Howe Island experienced almost complete breeding failure, with the majority of chicks dying of starvation (Congdon et al. 2007).

Species assessed = 34		
Pressure	**Species**	**Rationale**
Invasive species	Black noddy Common noddy Crested tern Sooty tern White tern Grey ternlet Flesh-footed shearwater Little shearwater Short-tailed shearwater Sooty shearwater Wedge-tailed shearwater Black petrel Black-winged petrel Gould's petrel Kermadec petrel Providence petrel White-bellied storm-petrel White-faced storm-petrel White-necked petrel Little penguin Masked booby Red-tailed tropicbird	Invasive species impact on seabird populations by preying on adults and nest contents (eggs and chicks), destroying nests and modifying habitat (DEH 2005). Invasive species are considered to be the greatest threat to seabirds after habitat loss, contributing to the threatened status of many species breeding within the region (Olsen et al. 2006). An invasive species is defined as one that occurs and thrives outside its normal geographical distribution as a result of human activities, and can include animals, weeds, diseases and parasites (Olsen et al. 2006). European settlers are implicated in the introduction of Australia's most established invasive species—the rat, rabbit and fox—all of which are known to threaten seabirds. More recent invaders also known to threaten seabirds include the Argentine ant and kikuyu grass. Rat predation on Lord Howe Island have resulted in the localised extinction of the Kermadec petrel, little shearwater and white-bellied storm-petrel (Garnett et al. 2011); severe degradation by rabbits of nesting habitat for Gould's petrel on Cabbage Tree Island (NSW NPWS 2000); and kikuyu grass mats on Montague Island that entangle little penguin adults and chicks (DECC 2009). Threat abatement plans have been prepared under the EPBC Act for pigs, rabbits, foxes, and exotic rodents on small islands (DEH 2005b; DEWHA 2008b; DEWHA 2008c; DEWHA 2009c).

Table S1.12: Pressures *of potential concern* to selected seabirds of the Temperate East Marine Region

Species assessed = 34		
Pressure	**Species**	**Rationale**
Sea level rise (climate change)	Black noddy Common noddy Crested tern Masked booby Red-tailed tropicbird	Global sea levels have risen by 20 cm between 1870 and 2004, and predictions estimate a further rise of 5–15 cm by 2030, relative to 1990 levels (Church et al. 2009). Longer term predictions estimate increases of 0.5 to 1 m by 2100, relative to 2000 levels (Climate Commission 2011). Seabird species nesting on the lowland parts of the Lord Howe Island group are at risk from sea level rise (Congdon et al. 2007). The impacts of rising sea levels on seabirds include loss of habitat through inundation of breeding sites, greater effect from storms (compounded by the predicted increase in frequency and intensity of storms), and impacts from altered erosion and deposition patterns (Chambers et al. 2009a). Impacts are expected to vary with breeding habitat and location, and high rocky islands are at lower risk than low-lying, less stable islands. However, there are no known quantitative links between observed sea level rise and changes in the distribution and abundance of nesting Australian seabirds (Chambers et al. 2009b).

Species assessed = 34		
Pressure	**Species**	**Rationale**
Changes in sea temperature (climate change)	Black noddy Common noddy Crested tern Roseate tern Sooty tern White tern Grey ternlet Flesh-footed shearwater Little shearwater Short-tailed shearwater Sooty shearwater Wedge-tailed shearwater Black petrel Black-winged petrel Gould's petrel Great-winged petrel Kermadec petrel Providence petrel White-bellied storm-petrel White-faced storm-petrel White-necked petrel Wilson's storm-petrel Northern giant petrel Southern giant petrel Antipodean albatross Black-browed albatross Campbell albatross Indian yellow-nosed albatross Salvin's albatross Wandering albatross White-capped albatross Little penguin Masked booby Red-tailed tropicbird	Sea temperatures have warmed by 0.7 °C between 1910–1929 and 1989–2008, and current projections estimate ocean temperatures will be a further 1 °C warmer by 2030 (Lough 2009). Seabirds are expected to be impacted by rising sea temperatures through changes in the availability and distribution of prey species (Feng et al. 2009), thereby shifting the distribution of seabirds in the region. Distributions are most likely to move southward, which may alter reproductive timing and success (Chambers et al. 2009a). Beyond the region, impacts have been observed in the Great Barrier Reef on populations of sooty tern, black noddy and wedge-tailed shearwater. These species have experienced decreased breeding success linked to reduced prey rates driven by increasing water temperatures (Congdon et al. 2007; Peck et al. 2004; Smithers et al. 2003). Data from across the central and eastern Pacific, Indian and Southern oceans also indicate similar impacts in a number of seabird species (Chambers et al. 2009a). For species such as those breeding on the Lord Howe Island group that are already at the extremity of their breeding range and travel long distances to obtain food, any southward shifts in prey distribution are likely to greatly impact breeding success.

Species assessed = 34		
Pressure	**Species**	**Rationale**
Changes in oceanography (climate change)	Black noddy Common noddy Crested tern Roseate tern White tern Grey ternlet Flesh-footed shearwater Little shearwater Short-tailed shearwater Sooty shearwater Wedge-tailed shearwater Black petrel Black-winged petrel Gould's petrel Great-winged petrel Kermadec petrel Providence petrel White-bellied storm-petrel White-faced storm-petrel White-necked petrel Wilson's storm-petrel Northern giant petrel Southern giant petrel Antipodean albatross Black-browed albatross Campbell albatross Indian yellow-nosed albatross Salvin's albatross Wandering albatross White-capped albatross Little penguin Masked booby Red-tailed tropicbird	Changes in oceanography broadly refer to changes in ocean circulation patterns; current intensities; wind strength and direction; the location and strength of eddy and upwelling events; and climatic oscillations such as the El Niño–Southern Oscillation. In the region, changes in oceanography will be primarily driven by the East Australian Current, which has been strengthening, pushing warmer, saltier water further southward along the east coast (for up to 350 km). Models suggest with medium confidence that this trend will increase (Ridgway & Hill 2009). At sea, seabirds commonly seek out regions of enhanced productivity (e.g. eddies or fronts) for foraging opportunities (BirdLife International 2010; Hyrenbach et al. 2000), and the breeding success of seabirds in the region is linked to the stability of a small number of highly productive nutrient hotspots along the edge of the continental shelf (Chambers et al. 2009a; Congdon et al. 2007). Temporal or spatial shifts in areas of upwelling are expected to influence the distribution, migration, foraging and breeding habits of seabirds (Chambers et al. 2009a). For example, El Niño events have been linked to breeding failure in seabirds (particularly temperate species) due to changes in ocean stratification and associated impacts on prey species. The southward movement of the East Australian Current is also expected to bring subtropical species into temperate waters, thereby increasing competition in foraging and nesting habitats (Chambers et al. 2009a).

Species assessed = 34		
Pressure	**Species**	**Rationale**
Ocean acidification (climate change)	Black noddy Common noddy Crested tern Roseate tern Sooty tern White tern Grey ternlet Flesh-footed shearwater Little shearwater Short-tailed shearwater Sooty shearwater Wedge-tailed shearwater Black petrel Black-winged petrel Gould's petrel Great-winged petrel Kermadec petrel Providence petrel White-bellied storm-petrel White-faced storm-petrel White-necked petrel Wilson's storm-petrel Northern giant petrel Southern giant petrel Antipodean albatross Black-browed albatross Campbell albatross Indian yellow-nosed albatross Salvin's albatross Wandering albatross White-capped albatross Little penguin Masked booby Red-tailed tropicbird	Driven by increasing levels of atmospheric CO_2 and subsequent chemical changes in the ocean, ocean acidification is already under way and detectable. Since pre-industrial times, acidification has lowered ocean pH by 0.1 units (Howard et al. 2009). Climate models predict this trend will continue, with a further 0.2–0.3 unit decline by 2100 (Howard et al. 2009). The impacts of ocean acidification on seabirds are expected to be indirect, through changes in the abundance, availability and distribution of prey species. For example, research indicates potentially significant impacts on Antarctic krill (Kawaguchi et al. 2011) and squid (Frisch 2006), which are important food sources for seabirds that visit the Temperate East Marine Region.

Species assessed = 34		
Pressure	**Species**	**Rationale**
Chemical pollution/ contaminants (shipping, vessel)	Black noddy Common noddy Crested tern Roseate tern Sooty tern White tern Grey ternlet Flesh-footed shearwater Little shearwater Short-tailed shearwater Sooty shearwater Wedge-tailed shearwater Black petrel Black-winged petrel Gould's petrel Great-winged petrel Kermadec petrel Providence petrel White-bellied storm-petrel White-faced storm-petrel White-necked petrel Wilson's storm-petrel Northern giant petrel Southern giant petrel Antipodean albatross Black-browed albatross Campbell albatross Indian yellow-nosed albatross Salvin's albatross Wandering albatross White-capped albatross Little penguin Masked booby Red-tailed tropicbird	The Temperate East Marine Region is highly exposed to possible vectors for chemical pollutants, including significant shipping and fishing activities in and adjacent to the region. It is expected that the effects of a major chemical spill would be similar to, or possibly exceed, those of a major oil spill (GBRMPA 2009). As top-order predators, seabirds are vulnerable to persistent chemical pollutants such as organochlorines, which accumulate through the food chain. Data in other regions show that chemical bioaccumulation results in seabird mortality and breeding failure (Becker 1989). A number of management measures are in place to respond to the risk of chemical spills, including the National plan to combat pollution of the sea by oil and other noxious and hazardous substances and the International Convention for the Prevention of Pollution from Ships (MARPOL), both of which are implemented through the Australian Maritime Safety Authority.

Species assessed = 34		
Pressure	**Species**	**Rationale**
Marine debris	Black noddy Common noddy Crested tern Roseate tern Sooty tern White tern Grey ternlet Flesh-footed shearwater Little shearwater Short-tailed shearwater Sooty shearwater Wedge-tailed shearwater Black petrel Black-winged petrel Gould's petrel Great-winged petrel Kermadec petrel Providence petrel White-bellied storm-petrel White-faced storm-petrel White-necked petrel Wilson's storm-petrel Northern giant petrel Southern giant petrel Antipodean albatross Black-browed albatross Campbell albatross Indian yellow-nosed albatross Salvin's albatross Wandering albatross White-capped albatross Little penguin Masked booby Red-tailed tropicbird	*Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris* was listed in 2003 as a key threatening process under the EPBC Act (DEWHA 2009a). Marine debris is defined as any persistent, manufactured or processed solid material that has been disposed of or abandoned in the marine and coastal environment (UNEP 2005). Impacts of marine debris on seabirds include death through drowning, injury through entanglement, or starvation following ingestion (Baker et al. 2002). Seabirds are particularly prone to ingesting polystyrene balls and plastic buoys (which they confuse with fish eggs) and entanglement (which can kill individuals or slow them down, reducing their ability to catch prey and avoid predators) (Ceccarelli 2009). A regional study analysing 205 known interactions between seabirds and plastic debris across 29 species found approximately 70 per cent of birds perished (C&R Consulting 2009).

Species assessed = 34		
Pressure	**Species**	**Rationale**
Light pollution (land-based activities)	Flesh-footed shearwater Little shearwater Short-tailed shearwater Sooty shearwater Wedge-tailed shearwater Black petrel Black-winged petrel Gould's petrel Great-winged petrel Kermadec petrel Providence petrel White-bellied storm-petrel White-faced storm-petrel White-necked petrel Wilson's storm-petrel Northern giant petrel Southern giant petrel Little penguin	Light pollution from onshore sources is *of potential concern* for shearwaters, petrels and the little penguin because it can attract and disorientate seabirds. Petrels, shearwaters and penguins are vulnerable to this pressure as they commonly return to their breeding colonies at night (Aubrecht et al. 2010). Juvenile seabirds are thought to be particularly vulnerable to disorientation from artificial lighting because they are less familiar with visual cues (e.g. moon and stars) (Aubrecht et al. 2010). Although research on the impact of light pollution on seabird populations is limited, preliminary studies in Hawaii, the Reunion Islands and the Canary Islands indicate that light-induced mortality rates are an issue for petrels and small shearwaters (Aubrecht et al. 2010).

Species assessed = 34		
Pressure	**Species**	**Rationale**
Human presence at sensitive sites (tourism, recreational and charter fishing, research)	Black noddy Common noddy Crested tern Roseate tern Sooty tern White tern Grey ternlet Flesh-footed shearwater Little shearwater Short-tailed shearwater Sooty shearwater Wedge-tailed shearwater Black petrel Black-winged petrel Gould's petrel Great-winged petrel Kermadec petrel Providence petrel White-bellied storm-petrel White-faced storm-petrel White-necked petrel Wilson's storm-petrel Northern giant petrel Southern giant petrel Antipodean albatross Black-browed albatross Campbell albatross Indian yellow-nosed albatross Salvin's albatross Wandering albatross White-capped albatross Little penguin Masked booby Red-tailed tropicbird	Disturbance to seabirds during the breeding season may result in decreased the breeding success and fitness of adult birds, particularly when adult birds are distracted from foraging, roosting or resting (WMB Oceanics & Claridge 1997). For example, if adult birds are disturbed from a nest, the unattended eggs and chicks become vulnerable to predation. The extent of the impact at a breeding site is influenced by visitor frequency, approach distances and the sensitivity of particular species to disturbance. In general, ground nesting species (e.g. tern and booby species) are more vulnerable to disturbance; highly sensitive species include the roseate tern, little tern and crested tern (Langham & Hulsman 1986; Surman & Nicholson 2006; WMB Oceanics & Claridge 1997).

Species assessed = 34		
Pressure	**Species**	**Rationale**
Bycatch (commercial fishing)	Flesh-footed shearwater Short-tailed shearwater Sooty shearwater Wedge-tailed shearwater Black petrel Great-winged petrel White-necked petrel Northern giant petrel Southern giant petrel Antipodean albatross Black-browed albatross Campbell albatross Indian yellow-nosed albatross Salvin's albatross Wandering albatross White-capped albatross	Bycatch associated with commercial fisheries operating in the region is *of concern* for 16 species of seabird. Direct interactions with commercial fishing operations can lead to seabird death by drowning (e.g. on longline hooks), death by collision (e.g. warp strike) and more broadly, decreased fecundity. Bycatch generally affects larger species of seabird because they can swallow baited hooks and habitually follow ships (Baker et al. 2002). Seabirds are known to be particularly vulnerable to longline operations, and these fisheries (e.g. the Eastern Tuna and Billfish Fishery) implement bycatch mitigation measures guided by the threat abatement plan for the incidental catch of seabirds in longline fishing operations (DEWR 2006). However, further efforts are required to reduce the impacts of bycatch on seabirds and this pressure remains *of concern* (Bensley et al. 2010; DEWR 2006; Phillips et al. 2010; Wilcox & Donlan 2007).
Bycatch (recreational and charter fishing)	Flesh-footed shearwater	Bycatch associated with the domestic recreational and charter fishing sector is considered *of potential concern* for the flesh-footed shearwater. Recreational and charter fishing activities are widespread along Australia's east coast, and recreational boating activity is growing (Bay Journal 2008; MSQ 2011). The likelihood of seabird–fisher interactions is high, and these interactions can result in seabird injury and death from the ingestion of baited hooks and fishing line, and entanglement (McPhee et al. 2002). Trolling in particular is known to affect flesh-footed shearwaters (Australian Bird and Bat Banding Scheme, unpublished data).

Species assessed = 34		
Pressure	**Species**	**Rationale**
Oil pollution (shipping, vessels)	Black noddy Common noddy Crested tern Roseate tern Sooty tern White tern Grey ternlet Flesh-footed shearwater Little shearwater Short-tailed shearwater Sooty shearwater Wedge-tailed shearwater Black petrel Black-winged petrel Gould's petrel Great-winged petrel Kermadec petrel Providence petrel White-bellied storm-petrel White-faced storm-petrel White-necked petrel Wilson's storm-petrel Northern giant petrel Southern giant petrel Antipodean albatross Black-browed albatross Campbell albatross Indian yellow-nosed albatross Salvin's albatross Wandering albatross White-capped albatross Little penguin Masked booby Red-tailed tropicbird	Oil spills are unpredictable events and their likelihood is low, particularly in the context of the international and domestic regulatory mitigation measures that apply in Australia. However, their consequences can be severe, particularly in biologically significant areas and times. Shipping is a key activity in the region, with shipping routes servicing a number of ports adjacent to the region, and adjacent to seabird habitat. Seabirds are vulnerable to oil pollution because oil sticks to feathers, affecting their insulation and waterproofing properties, rendering some birds flightless or vulnerable to predation. Oil may also indirectly impact seabirds through effects on prey species such as damage to fish eggs, larvae and young fish (AMSA 2010). Chemicals used to disperse oil can themselves be toxic to marine life (AMSA 2010). Adjacent to the region, a study on the effects of oil spills on birds at Moreton and Bribie islands found that sites affected by the spill contained 50% fewer species than unaffected sites. Seabirds such as terns and gulls were considered among those most at risk (Birds Australia 2010).

Species assessed = 34		
Pressure	**Species**	**Rationale**
Invasive species	Roseate tern Great-winged petrel Wilson's storm petrel Northern giant petrel Southern giant petrel Antipodean albatross Black-browed albatross Campbell albatross Indian yellow-nosed albatross Salvin's albatross Wandering albatross White-capped albatross	Invasive species impact on seabird populations by preying on adults and nest contents (eggs and chicks), destroying nests and modifying habitat (DEH 2005b). Invasive species are considered to be the greatest threat to seabirds after habitat loss, contributing to the threatened status of many species within the region (Olsen et al. 2006). An invasive species is defined as one that occurs and thrives outside its normal geographical distribution as a result of human activities, and can include animals, weeds, diseases and parasites (Olsen et al. 2006). European settlers are implicated in the introduction of Australia's most established invasive species—the rat, rabbit and fox—all of which are known to threaten seabirds. More recent invaders also known to threaten seabirds include the Argentine ant and kikuyu grass. Threat abatement plans have been prepared under the EPBC Act for exotic rodents on islands and rabbits (DEWHA 2009c, 2008a).

Table S1.13: Pressures *of concern* to selected sharks of the Temperate East Marine Region

Species assessed = 9		
Pressure	**Species**	**Rationale**
Bycatch (commercial fishing)	Grey nurse shark	The grey nurse shark is listed as threatened under the EPBC Act and is protected in Australian waters. The species interacts with a range of commercial fisheries, and there are reports of sharks with fishing gear trailing from their mouths (Bansemer & Bennett 2010). The effectiveness of management measures is not fully understood and bycatch mortality will continue to be *of concern* for this species until evidence of management effectiveness is conclusive.
Bycatch (recreational and charter fishing)	Grey nurse shark White shark	The grey nurse shark is listed as threatened under the EPBC Act and is protected in Australian waters. The species interacts with the recreational and charter fishing sector, and there are reports of individuals with recreational fishing gear (e.g. trolling lures) trailing from their mouths (Bansemer & Bennett 2010). Due to the small population size and conservation status, any fishing-related mortality is *of concern* to the species. The white shark is listed as threatened under the EPBC Act and is protected in Australian waters. Evidence suggests there is a partial failure to report captures of individuals and interactions within the recreational fishing sector (DEWHA 2009b). Data from the Great Barrier Reef Marine Park suggests post-release mortality could account for the majority of recreational fishing mortality. Mortality can occur as a result of capture and subsequent handling or, as seen in grey nurse shark populations, attached fishing gear (Lynch et al. 2009).

Table S1.14: Pressures *of potential concern* to selected sharks of the Temperate East Marine Region

Species assessed = 9		
Pressure	**Species**	**Rationale**
Changes in sea temperature (climate change)	Grey nurse shark Porbeagle shark Longfin mako shark Shortfin mako shark Whale shark White shark	Sea temperatures have warmed by 0.7 °C between 1910–1929 and 1989–2008, and current projections estimate ocean temperatures will be a further 1 °C warmer by 2030 (Lough 2009). Increasing sea temperatures may result in changes in the metabolism, behaviour and movement patterns of sharks (Chin & Kyne 2007). Climate change vulnerability assessments for the grey nurse shark and white shark in the Great Barrier Reef assessed both species as moderately vulnerable to rising sea temperatures (Chin et al. 2010). Indirect effects on sharks in general relate to potential changes in abundance and distribution of prey species. For example, studies predict that ocean warming will cause a large southward shift in the distribution of many tropical and subtropical zooplankton (Hobday et al. 2006), which may influence the distribution of whale sharks both within the region and beyond.
Change in oceanography (climate change)	Grey nurse shark Porbeagle shark Longfin mako shark Shortfin mako shark Whale shark White shark	Changes in oceanography broadly refer to changes in ocean circulation patterns; current intensities; wind strength and direction; the location and strength of eddy and upwelling events; and climatic oscillations such as the El Niño–Southern Oscillation. In the region, changes in oceanography will be primarily driven by the East Australian Current, which has been strengthening, pushing warmer, saltier water further southward along the east coast (for up to 350 km). Models suggest with medium confidence that this trend will increase (Ridgway & Hill 2009). These changes are likely to impact on productivity, resulting in subsequent shifts in trophic webs and migration patterns, and changes to reef and shelf habitats, all of which have implications for shark species (Chin et al. 2010). For example, a climate change vulnerability assessment of sharks in the Great Barrier Reef region suggested that white sharks would have high exposure and vulnerability to oceanographic change (Chin et al. 2010). As a specialist plankton feeder, whale sharks are also considered to have high exposure and vulnerability to oceanographic change due to expected impacts on the abundance and distribution of plankton populations (Chin et al. 2010). Other migratory species (e.g. mako and porbeagle sharks) are expected to be similarly impacted.

Species assessed = 9		
Pressure	**Species**	**Rationale**
Human presence at sensitive sites (tourism, recreational and charter fishing, research)	Grey nurse shark	Aggregation sites for grey nurse sharks off New South Wales and Queensland are popular recreational diving locations, and this threatened species is considered a major drawcard for recreational divers (Pollard et al. 1996). Interactions between divers and grey nurse sharks are common, and studies have found that sharks milled less in the presence of six or more divers, and the frequency of behaviours such as jaw gaping, rapid withdrawal and stiff or jerky movements correlated with the distance between divers and sharks (Pollard et al. 1996). Diving regulations are in place to limit the adverse effects of divers on sharks, particularly diver harassment of sharks (Smith et al. 2010). As recreational diving continues to grow in popularity, however, so does the potential for negative impacts at sensitive grey nurse shark sites.
Extraction of living resources (commercial fishing)	Shortfin mako shark	The shortfin mako is listed as migratory under the EPBC Act and the targeted commercial take of shortfin mako is prohibited in Commonwealth waters; however, individuals can be retained (as byproduct) if they are dead upon capture. Since their migratory listing in 2010, there has been a 30% reduction in the level of byproduct take and a number of management arrangements are in place; however, they remain vulnerable to capture in commercial fishing operations and this pressure remains *of potential concern*.
Extraction of living resources (commercial fishing—non-domestic)	Porbeagle shark Longfin mako shark Shortfin mako shark White shark	The white shark is listed as both threatened and migratory under the EPBC Act and is protected in Australian waters; the shortfin and longfin mako sharks and porbeagle shark are listed as migratory under the EPBC Act. All are highly migratory, and it is expected that these species will cross over the region's exclusive economic zone boundary and thus be exposed to international commercial fisheries targeting sharks for their meat and fins. This pressure is devastating northern Australian shark populations and although temperate east populations are not expected to interact with this pressure to the same extent, it nonetheless has the potentially to significantly impact them (Lack & Sant 2008).

Species assessed = 9		
Pressure	**Species**	**Rationale**
Extraction of living resources (illegal, unregulated and unreported fishing—non-domestic)	Longfin mako shark Shortfin mako shark	The shortfin and longfin mako sharks are listed as migratory under the EPBC Act and the targeted commercial take of both species is prohibited in Commonwealth waters; however, individuals can be retained (as byproduct) if they are dead upon capture. Mako sharks are an important component of the international shark fin trade (Clarke et al. 2006) and are vulnerable to capture in longline operations. It is likely that all non-domestic illegal, unregulated and unreported take, both within and beyond Australian waters, will impact on populations of mako sharks within the region.
Extraction of living resources (illegal, unregulated and unreported fishing—domestic)	White shark	The white shark is listed as threatened under the EPBC Act and is protected in Australian waters. Although fishing of white shark is prohibited, the illegal capture of white sharks by the commercial and recreational fishing sector and the illegal trade in white shark products threaten populations in Australian waters (DEWHA 2010). Demand for white shark products as trophies (e.g. jaws and teeth), as well as fins for the fin trade, has increased their value and there is evidence that these items support both international and national illegal trade (EA 2002). Despite strict regulations in both sectors, the high prices obtained for white shark products continue to provide incentive for this illegal trade (DEWHA 2010).
Bycatch (commercial fishing)	White shark	The white shark is listed as threatened under the EPBC Act and is protected in Australian waters. Individuals have been recorded hooked on longlines and caught in the nets of commercial fishing operations and aquaculture cages (e.g. tuna farms) (DEWHA 2010). Given the lack of data on white shark populations, it is unknown whether the species is recovering. Consequently, the effectiveness of management measures is not fully understood and bycatch mortality continues to be *of potential concern* for this species until conclusive evidence of management effectiveness is provided.

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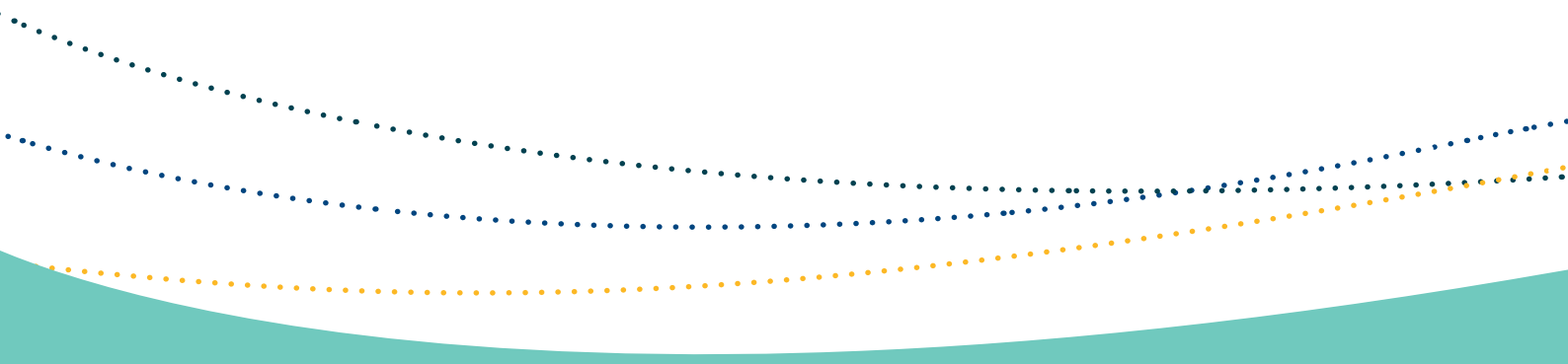

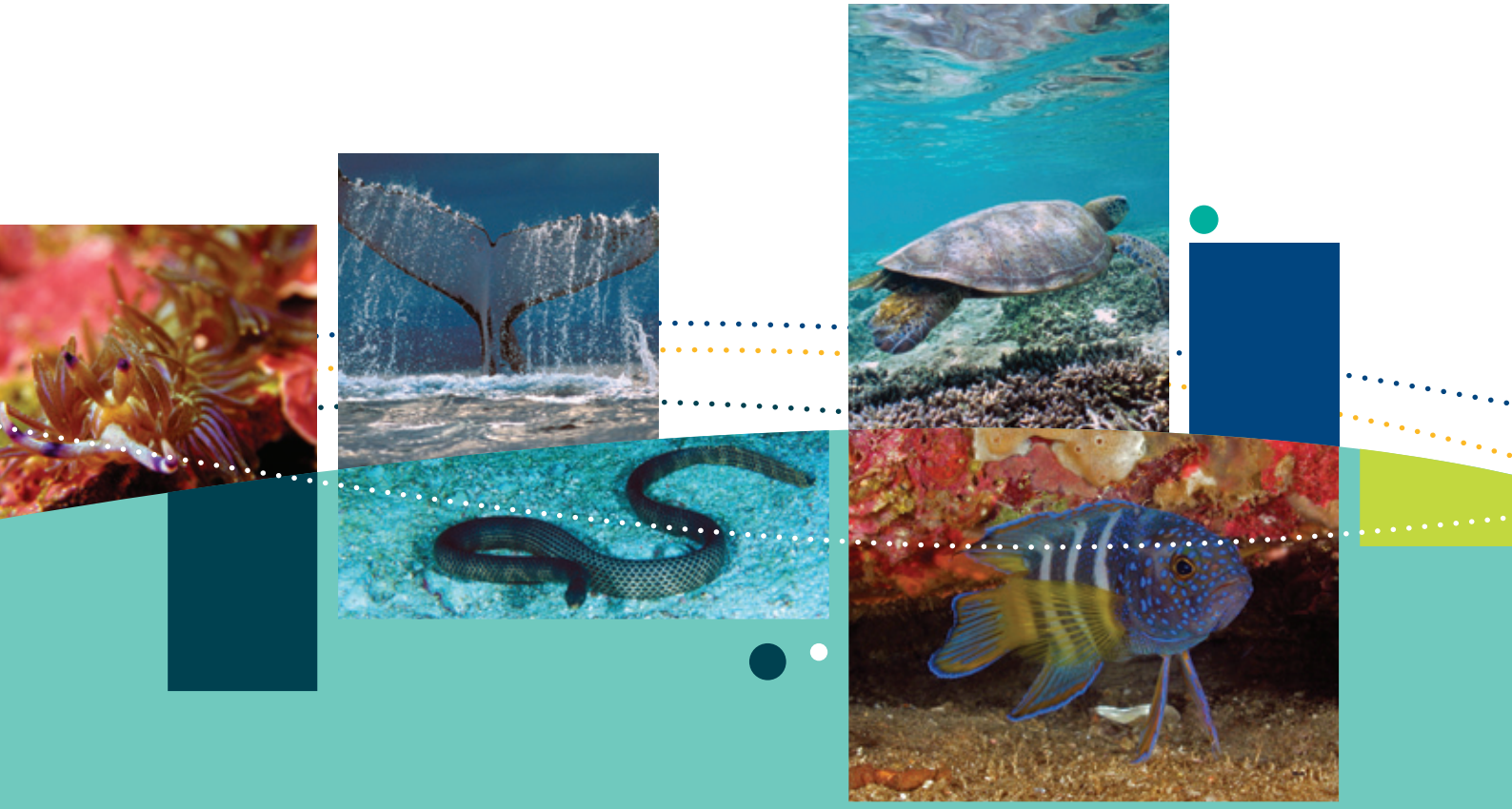

SCHEDULE 2

Regional advice on matters of national environmental significance

SCHEDULE 2 REGIONAL ADVICE ON MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Introduction

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), an action requires approval from the environment minister if it has, will have or is likely to have a significant impact (refer to glossary **www.environment.gov.au/marineplans**) on a matter of national environmental significance. A person proposing to take an action that they think is, or may be, such an action must refer it to the minister for a decision as to whether further assessment and approval are required under the EPBC Act. Substantial penalties apply for taking such an action without approval.

There are currently eight matters of national environmental significance protected under the EPBC Act:

- world heritage properties
- national heritage places
- wetlands of international importance (listed under the Ramsar Convention)
- listed threatened species (except those listed as extinct or conservation dependent) and ecological communities (except those listed as vulnerable)
- migratory species protected under international agreements
- the Commonwealth marine environment
- the Great Barrier Reef Marine Park
- nuclear actions, including uranium mines.

This schedule to the Temperate East Marine Bioregional Plan has been prepared under the EPBC Act. It contains information about matters of national environmental significance within the Temperate East Marine Region and should be considered when deciding whether a proposed action needs to be referred to the environment minister for a decision.

Under section 176 of the EPBC Act, once a bioregional plan has been made, the environment minister must have regard to it when making any decision under the Act to which the plan is relevant. The minister will have regard to the information provided in Schedule 2 when making decisions about referrals, assessments and approvals, as well as other relevant decisions under the EPBC Act. However, this does not limit the information the minister may consider when making decisions.

The advice contained in this schedule is not comprehensive (i.e. it does not cover all matters of national environmental significance occurring in the Temperate East Marine Region) and should not be regarded as definitive in relation to those matters for which advice is provided.

The regional advice should be read as supplementary to, and not as replacing, EPBC Act policy statements. In particular, the following policy statement is the key guidance document for determining whether a referral is required:

- *EPBC Act Policy Statement 1.1: Significant impact guidelines—matters of national environmental significance.*

Depending on the type of action proposed, industry policy statements also provide important information:

- *EPBC Act Policy Statement 2.1: Interaction between offshore seismic exploration and whales*
- *EPBC Act Policy Statement 2.2: Industry—offshore aquaculture*
- *EPBC Act Policy Statement 2.3: Wind farm industry.*

Other policy statements and guidelines may also be developed and provide important information. Further information and assistance can be obtained by contacting the referral business entry point through the department's community information unit on 1800 803 772 or by sending an email to **epbc.referrals@environment.gov.au**.

Schedule 2 does not provide advice for the assessment of the environmental performance of fisheries managed under Commonwealth legislation and state export fisheries. Guidelines for the strategic assessment of fisheries under Part 10 of the EPBC Act; assessments relating to impacts on protected marine species under Part 13; and assessments for the purpose of export approval under Part 13A are contained within the document Guidelines for the Ecologically Sustainable Management of Fisheries (**www.environment.gov.au/coasts/fisheries/publications/guidelines.html**).

Using the regional advice

This schedule is a guide and is not definitive. The regional advice provided in this schedule is augmented by information provided in the conservation value report cards, which are available on the website of the Department of Sustainability, Environment, Water, Population and Communities at **www.environment.gov.au/marineplans/temperate-east**.

The rating of risks in this schedule was developed to provide practical information on the kinds of actions which should be referred to determine if approval under the EPBC Act is needed. The ratings here are not designed to prioritise environmental risks. They relate to the risk of a proposed action needing to be referred under the EPBC Act. The highlighted advice provide further assistance in identifying types of activities that are at low risk of needing to be referred and those that are at higher risk of needing to be referred.

Considerations underpinning the rating of a risk include:

- pressure rating (of key ecological features and species, see Tables S1.2 and S1.3)
- conservation status (of species)
- presence of a biologically important area (for species; see Conservation Values Atlas **www.environment.gov.au/cva**)
- trends in pressures.

Commonwealth marine environment: Section 24 of the EPBC Act defines a Commonwealth marine area (see glossary for further details). It is the area that extends beyond the outer edge of State and Territory waters, generally 3 nautical miles (or 5.5 kilometres) from the coast, to the boundary of Australia's exclusive economic zone generally 200 nautical miles (370 kilometres) from shore. Under the EPBC Act, the environment within the Commonwealth marine area is a matter of national significance.

Where sufficient information exists to aid decision-making, this schedule presents regional advice on the Commonwealth marine environment in relation to:

- key ecological features of the Temperate East Marine Region and protected places
- protected species that occur in the Temperate East Marine Region that are not otherwise matters of national environmental significance.

Some advice provided in this schedule refers to **biologically important areas**. These are areas that are particularly important for the conservation of protected species and where aggregations of individual species display biologically important behaviour, such as breeding, foraging, resting or migration. The presence of the observed behaviour is assumed to indicate that habitat required for the behaviour is also present. Regional advice has been developed for biologically important areas due to their relevance to a protected species. The advice focused on these areas should not be construed to mean that legislative obligations do not apply

outside these areas. Biologically important areas are not protected matters and should not be confused with 'critical habitat' as defined in the EPBC Act.

A register of **critical habitat** is maintained under the EPBC Act. The register lists habitats considered critical to the survival of a listed threatened species or listed threatened ecological community. If a habitat occurs in or on a Commonwealth area and is listed in the register, it is an offence under the EPBC Act to take an action when it is known that the action significantly damages the critical habitat.

Species protected under the EPBC Act may be listed as threatened, migratory or marine species. Those protected species that are matters of national environmental significance are:

- threatened species (other than those categorised as extinct or conservation dependent)
- migratory species.

Species that are listed under the EPBC Act but are *not* matters of national environmental significance include those species that are listed as:

- marine (s. 248 of the EPBC Act)
- cetaceans (whales, dolphins and porpoises)
- threatened species listed as extinct or conservation dependent.

However, it is possible for listed marine species and cetaceans to also be matters of national environmental significance; that is, where they have been listed as a threatened species (other than in the conservation dependent category) or as migratory. For example, the humpback whale is listed as a cetacean but it is also a matter of national environmental significance because it is listed as vulnerable and migratory under the EPBC Act.

A number of terms related to protected species that are matters of national environmental significance have specific meaning under the EPBC Act, namely:

- **Population:** A population of a species is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to species that are categorised as critically endangered, endangered or vulnerable occurrences include but are not limited to:
  - a geographically distinct regional population or collection of local populations
  - a population or collection of local populations that occurs within a particular bioregion.
- **Important population:** This term relates to populations of threatened species that are categorised as vulnerable under the EPBC Act. An important population is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or populations that are:
  - key source populations either for breeding or dispersal
  - necessary for maintaining genetic diversity
  - near the limit of the species' range.

This definition is consistent with that provided in EPBC Act *Policy Statement 1.1: Significant impact guidelines—matters of national environmental significance*. In accordance with these guidelines, in determining the significance of an impact on a vulnerable species, consideration should be given to whether an important population is found in the area.

- **Ecologically significant proportion of a population:** This term applies to species listed as migratory. In accordance with Policy Statement 1.1: Significant impact guidelines—matters of national environmental significance, for migratory listed species, consideration should be given to whether an ecologically significant proportion of a population is found in an area. Whether the species in an area represents an ecologically significant proportion of a population needs to be determined on a case-by-case basis, as different species have different life histories and populations. Some key factors that should be considered include the species' population status, genetic distinctiveness and species-specific behavioural patterns (for example, site fidelity and dispersal rates).

Schedule 2.1 The Commonwealth marine environment of the Temperate East Marine Region

The Commonwealth marine environment, including the Temperate East Marine Region, is a matter of national environmental significance under the EPBC Act. An action requires approval if it is taken:

- in a Commonwealth marine area (refer to glossary **www.environment.gov.au/marineplans**), and the action has, will have, or is likely to have a significant impact on the environment, or
- outside a Commonwealth marine area but within Australian jurisdiction and the action has, will have, or is likely to have a significant impact on the environment in a Commonwealth marine area.[7]

7 Actions taken outside the Commonwealth marine area may impact on its environment through downstream effects—for example, by resulting in water quality changes that can spread offshore beyond 3 nautical miles or by adversely affecting species that are an important component of the Commonwealth marine environment, either throughout, or at specific stages of, their lifecycle. For example, seagrass beds are an important nursery habitat for a number of species, some of which move offshore in their adult stages. Reductions in seagrass beds—for example, as a result of dredging—depending on their extent, have the potential to impact on the population dynamics of a number of species that inhabit the Commonwealth marine area

The Temperate East Marine Region covers Commonwealth waters extending from the southern boundary of the Great Barrier Reef Marine Park to Bermagui in southern New South Wales, as well as the waters surrounding Lord Howe and Norfolk islands. The marine environment is made up of numerous habitats, biological communities and ecosystems. Determining whether a proposed action has the potential to cause a significant impact on the marine environment requires consideration of its individual and combined components at a scale relevant to the action.

The EPBC Act Policy Statement 1.1 outlines criteria to assist in determining the significance of impacts on the Commonwealth marine environment. Specifically, an action is likely to have a significant impact on the Commonwealth marine environment if there is a real chance or possibility that the action will:

- result in a known or potential pest species becoming established in the Commonwealth marine area
- modify, destroy, fragment, isolate or disturb an important or substantial area of habitat such that there will be an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area
- have a substantial adverse effect on a population of a marine species or cetacean, including its lifecycle (e.g. breeding, feeding, migration behaviour or life expectancy) and spatial distribution
- result in a substantial change in air quality or water quality (including temperature) that may adversely impact on biodiversity, ecological integrity, social amenity or human health
- result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected
- have a substantial adverse impact on heritage values of the Commonwealth marine area, including damage or destruction of an historic shipwreck.

The regional advice in this schedule has been developed to assist the interpretation of some of these criteria within the context of the Temperate East Marine Region. The regional advice addresses:

- S2.1.1: establishment of marine pest species
- S2.1.2: adverse impacts on marine ecosystem functioning and integrity
- S2.1.3: adverse effects on populations of a marine species or cetacean (excluding those listed as threatened or migratory)
- S2.1.4: adverse impacts on heritage values
- S2.1.5: actions in Commonwealth marine reserves.

S2.1.1 Establishment of marine pest species

Although the Commonwealth waters of the Temperate East Marine Region contain introduced marine species, no pest species[8] has been recorded yet in this region. Adjacent to the region, Queensland has no recorded established invasive marine pests; however, 26 invasive marine pests are listed as posing a potential threat to the state (Hayes et al. 2004). In New South Wales waters, six listed marine pest species occur (Table S2.1) (NSW Industry & Investment 2011).

The invasive strain of the green alga Caulerpa which occurs in State waters adjacent to the region, is capable of invading benthic communities in depths up to 100 metres. Other species in State waters capable of spreading into deeper water environments include the European/green shore crab, European fan worm, Japanese goby, and the New Zealand screw shell. The National System for the Prevention and Management of Marine Pest Incursions maintains a 'trigger list' of species that may become invasive if introduced as part of its Emergency Marine Pest Plan.[9]

8 Introduced marine pests are marine plants or animals that are not native to Australia but have been introduced by human activities such as shipping and have become aggressive pests.

9 **www.marinepests.gov.au**

Table S2.1: Marine pests known to be established in State waters, adjacent to the Temperate East Marine Region

Pest name	Location	Impact	Habitat
Caulerpa *(Caulerpa taxifolia)*	Batemans Bay Botany Bay Brisbane Waters Burril Lake Durras Lake Lake Conjola Narrawallee Inlet Hawkesbury River Pittwater Port Hacking Port Jackson St Georges Basin Wallagoot Lake	Overgrows native habitat and can establish vast beds on soft sediment, degrading fish habitat Tangles in nets and anchors	Depths up to 100 m Exposed and sheltered estuaries, coastal lagoons and bays Rock, sand, mud and seagrass beds

Pest name	Location	Impact	Habitat
European or green shore crab *(Carcinus maenas)*	Clyde River Batemans Bay Tomaga River/ Barlings Beach Candlagan Creek Coila Lake Wagonga Inlet Nangudga Lake Corunna Lake Tilba Tilba Lake Bermagui River Cuttagee Lake Wapengo Lake Nelson Lagoon Merimbula Lake Pambula Lake Twofold Bay Towamba River Kiah Creek Wonboyn River Nadgee Lake	Aggressive predator, outcompetes native species for food and habitat	Prefers bays and estuaries but found on all types of shores at depths up to 60 m Tolerates temperatures up to 30 °C

Pest name	Location	Impact	Habitat
European fan worm (*Sabella spallanzanii)*	Twofold Bay (near Eden)	Forms dense colonies that consume vast amounts of food No known predators in Australia	Tubes attached to hard surfaces, artificial structures, rocks, shells and seagrass on soft sediments Sheltered waters, depths up to 30 m
Japanese goby *(Tridentiger trigonocephalus)*	Sydney Harbour Port Kembla	Competes with native species	Prefers estuaries and rocky reef areas
New Zealand screw shell *(Maoricolpus roseus)*	Continental shelf off Merimbula and Bermagui	Forms a dense covering on the sea floor and competes with native shellfish for food	Depths up to 130 m Prefers sand, mud or gravel in intertidal to subtidal areas
Pacific oyster *(Crassostrea gigas)*	Most New South Wales estuaries south of the Macleay River and some offshore areas	Establish dense populations in some areas, displacing native intertidal species, with the potential to modify habitat for non-oyster species	Depths up to 3 m On hard substrate in intertidal and shallow subtidal areas Favours brackish waters in sheltered estuaries but tolerates a range of salinity and water quality Can also occur offshore

Marine pests can be introduced through ballast water exchange or via biofouling. High-risk vessels for the introduction of species include those that are slow moving, have space where marine species can settle, come in close contact with the sea bottom or remain in a single area for extended periods. These characteristics increase the likelihood that a species can establish on a vessel, from where it can be introduced to new regions. Vessels in this category include dredges, supply boats, drilling rigs and some fishing boats. Other high-risk ships include some of the flag-of-convenience carriers that are low-cost operators with poorly maintained vessels, as well as small private recreational vessels from other parts of the world.

Shallow and inshore areas, particularly port areas and sites where infrastructure development and maintenance take place, have the highest risk of marine pests becoming established. Some introduced species have the potential to settle or expand into deeper waters, including in the offshore Commonwealth marine environment.

The introduction of marine pests is a particularly important issue for the Temperate East Marine Region given the high levels of sea transport to and through the region, and fishing activity in the region.

The following types of actions have a real chance or possibility of resulting in marine pests becoming established in the Commonwealth marine environment, thereby affecting the biodiversity values and/or ecological integrity of the Commonwealth marine environment:

- development of new ports or upgrades of existing port facilities that substantially increase shipping traffic
- construction of infrastructure or any other action involving the translocation into the region of marine equipment (e.g. dredges or platforms), from within or outside Australia.

There is a low risk of marine pests becoming established in the Commonwealth marine environment or affecting its biodiversity values and/or ecological integrity as a result of these actions when appropriate mitigation measures are adopted. Mitigation measures consistent with the National System for the Prevention and Management of Marine Pest Incursions, the Australian Ballast Water Management Requirements and the *National biofouling management guidelines for commercial vessels*[10] and the *National biofouling management guidelines for recreational vessels*[11] aim to reduce the risk that actions will result in the introduction of marine pests, which may significantly impact on the Commonwealth marine environment, in port and inshore environments. Further information on responsibilities regarding the management of marine pest incursions is provided at **www.marinepests.gov.au**.

S2.1.2 Adverse impacts on marine ecosystem functioning and integrity

The Temperate East Commonwealth marine environment report card provides an overview of key ecological features defined for the region and their relevance to ecosystem processes and structure. While the report card provides useful context, determining potential impacts of specific activities on the Commonwealth marine environment requires consideration of habitats and biodiversity at an appropriate subregional and local scale.

10 **www.marinepests.gov.au/_data/pdf_file/001/1109594/Bifouling_guidelines_commercial_vessels.pdf**.
11 **www.marinepests.gov.au/_data/pdf_file/001/1109594/Bifouling_guidelines_rec.pdf**.

The regional advice below provides further guidance for considering impacts on areas and habitats that are defined as key ecological features in the Temperate East Marine Region by virtue of their regional importance for biodiversity and/or ecosystem functioning and integrity. The Temperate East Commonwealth marine environment report card provides further information, including references to relevant scientific literature, on the region's key ecological features.

The advice here provides information of relevance to people considering impacts on the Commonwealth marine environment. It is essential to note that provision of advice in relation to the key ecological features does not imply that they are the only habitats, areas, species or species groups that should be considered when determining the significance of potential impacts on the Commonwealth marine environment. It remains the responsibility of a person proposing to take an action to determine whether there is a real chance or possibility that the action is likely to result in a significant impact on the Commonwealth marine environment.

The Temperate East Marine Region has eight areas and/or types of habitats that are key ecological features (see Figure S1). Further information on these key ecological features is provided in the Temperate East Commonwealth marine environment report card (**www.environment.gov.au/marineplans/temperate-east**).

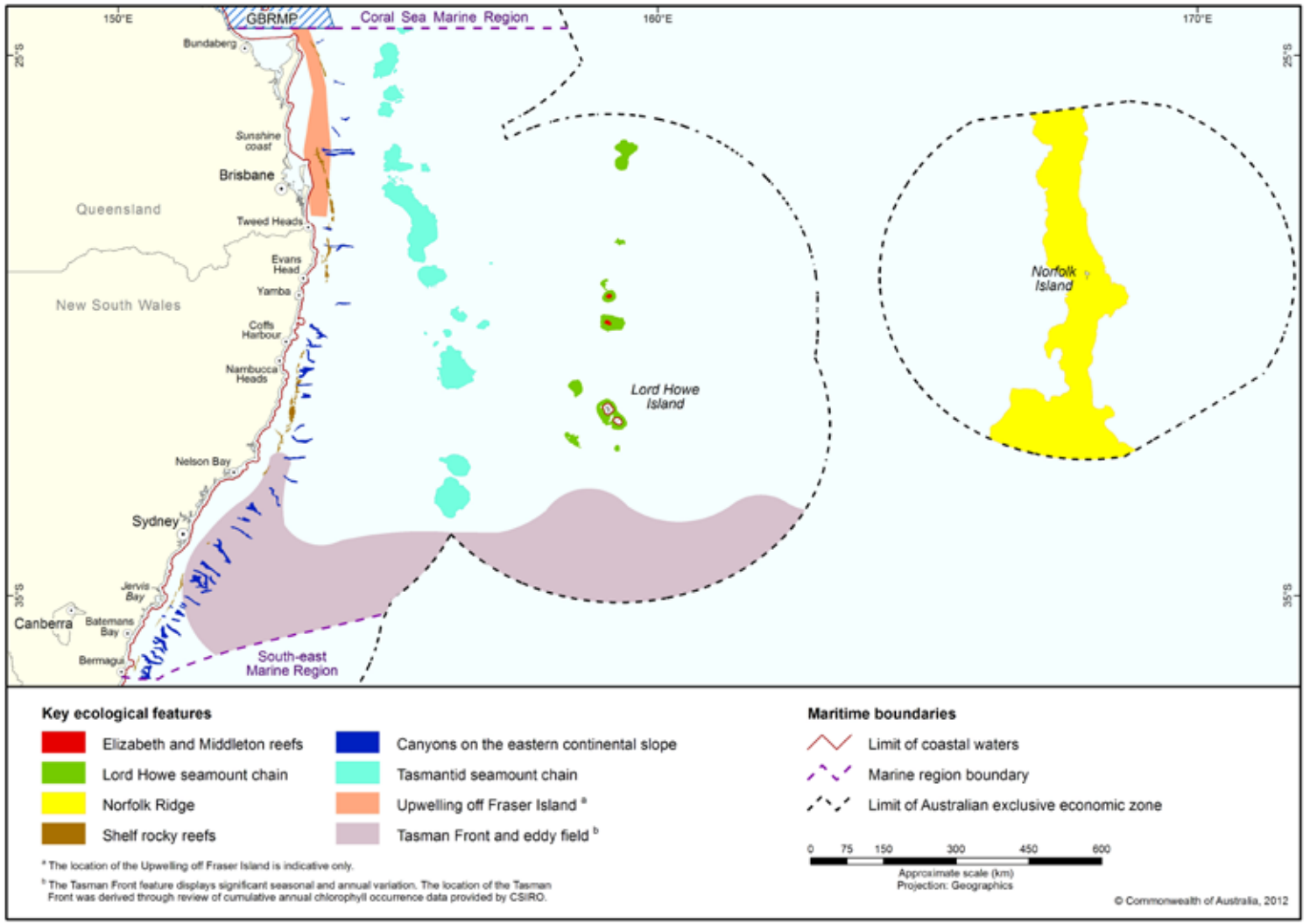

Figure S2.1: Key ecological features in the Temperate East Marine Region

In assessing the impacts of a proposed action on the Commonwealth marine environment and their significance, the relevance of the proposed action to the regional importance and vulnerabilities of the key ecological features described below should be considered.

Shelf rocky reefs: This key ecological feature is recognised for its enhanced ecological functioning and integrity, and biodiversity, which apply to its benthic habitats.

Along the continental shelf south of the Great Barrier Reef, benthic communities on rock outcrops and boulder substrates shift from algae-dominated communities to those dominated by attached invertebrates. This shift generally occurs at a depth of 45 metres, and these habitats are densely populated by large sponges, with a mixed assemblage of moss animals and soft corals. Below wave-influenced areas, massive and branched forms of sponges are more prevalent, and sponge species richness and density generally increases with depth along the New South Wales coast. Collectively, these invertebrates create a complex habitat–forming community that supports a multitude of microorganisms and invertebrates, such as crustaceans, molluscs, annelids and echinoderms. These habitats also provide refuge from predation for juvenile fishes, thereby increasing their survival. Rocky reef habitats on Australia's east coast support a diverse assemblage of demersal fish, which show distinct patterns of association with shelf reef habitats. For example, jackass morwong, barracouta, orange-spotted catshark, eastern orange perch, butterfly perch and warehou are species that distinguish rocky reef habitats at depths greater than 45 metres from those of soft sediments.

Pressures *of potential concern* on this key ecological feature include:

- climate change, which has the potential to alter ecological values through changes to sea temperatures and oceanographic processes, and causing ocean acidification. These changes alter localised productivity and/or community structures through shifts in marine species distribution
- marine debris from vessel based sources
- physical habitat modification from fishing gear
- extraction of living resources by commercial fishing impacting on the feature's ecosystem functioning and integrity
- bycatch.

Generally, most actions in or adjacent to the Temperate East Marine Region are unlikely to impact adversely on the ecosystem functioning and integrity of the Shelf rocky reefs.

Canyons on the eastern continental slope: This key ecological feature is recognised for its enhanced ecological functioning and integrity, and biodiversity, which apply to both its benthic and pelagic habitats.

Submarine canyons are widespread features around the Australian continent and island margins, and a large number of these features are present on the eastern continental slope. Canyon systems have a marked influence on the diversity and abundance of species, driven by the combined effects of steep and rugged topography, ocean currents, varied sea-floor types and nutrient availability. Large benthic species such as attached sponges and feather stars are abundant, with high diversity at upper-slope canyon depths of 150–700 metres. Canyons also provide critical feeding grounds for a wide range of species, including many which are commercially important (e.g. tuna) and threatened (e.g. marine turtles). Canyons contribute to habitat diversity by providing a hard surface that offers anchoring points and vertical relief for filter feeder benthic species (e.g. sponges and bryozoans). A range of higher trophic level species, including crustaceans, echinoderms, bivalves, cephalopods and fish are then attracted to these regions.

Pressures *of potential concern* on this key ecological feature include:

- climate change, which has the potential to alter ecological values through changes to sea temperatures and oceanographic processes. These changes alter localised productivity and/or community structures through shifts in marine species distribution
- oil pollution and chemical pollution/contaminants from shipping traffic which can impact on water quality and ecosystem functioning and integrity
- marine debris from vessel based sources
- extraction of living resources by commercial fishing impacting on the feature's ecosystem functioning and integrity
- bycatch.

Actions that, irrespective of where they occur, have a real chance or possibility of resulting in:

- a substantial change in water quality that may adversely impact on biodiversity or ecological integrity in the area of the canyons on the eastern continental slope
- persistent organic chemicals, heavy metals or other potentially harmful chemicals accumulating in the waters surrounding the canyons on the eastern continental slope

have a **high risk** of a significant impact on the Commonwealth marine environment.

Actions that introduce a new source from which a severe oil spill or other chemical pollution has a reasonable potential of arising (e.g. increased shipping and drilling) in the canyons on the eastern continental slope have a **risk** of significant impact on the Commonwealth marine environment of the Temperate East Marine Region.

Tasman Front and eddy field: This key ecological feature is recognised for its significant ecological functioning and integrity, and biodiversity, which apply to its pelagic habitats.

The Tasman Front is described as a region of intermediate productivity that separates the nutrient-poor waters of the Coral Sea from the nutrient-rich waters of the Tasman Sea. The front is formed by a meandering current located between 27° S and 33° S, which moves northward in winter months and southward in summer months. Across the southern portion of the Temperate East Marine Region, the Tasman Front creates a complex oceanographic environment where waters mix vertically. Patches of productivity are important for mid-level consumers including turtles and top fish predators, as well as catch in the Eastern Tuna and Billfish Fishery. Fishery oceanography studies describe a positive relationship between catch rates and proximity to frontal features, and a predominance of bigeye tuna and swordfish associated with the Tasman Front. The feature is also important for providing connectivity of tropical species to the Lord Howe seamount chain and Norfolk Ridge.

Pressures *of potential concern* on this key ecological feature include:

- climate change, which has the potential to alter ecological values through changes to sea temperatures and oceanographic processes. These changes alter localised productivity and/or community structures through shifts in marine species distribution
- oil pollution and chemical pollution/contaminants from shipping traffic which can impact on water quality and ecosystem functioning and integrity
- marine debris from vessel based sources
- extraction of living resources by commercial fishing impacting on the feature's ecosystem functioning and integrity
- bycatch.

Actions that, irrespective of where they occur, have a real chance or possibility of resulting in:

- a substantial change in water quality that may adversely impact on biodiversity or ecological integrity in the area of the Tasman Front and eddy field
- persistent organic chemicals, heavy metals or other potentially harmful chemicals accumulating in the waters in the area of the Tasman Front and eddy field

have a **high risk** of a significant impact on the Commonwealth marine environment.

Actions that introduce a new source from which a severe oil spill or other chemical pollution has a reasonable potential of arising (e.g. increased shipping and drilling) in the area around the Tasman Front and eddy field have a **risk** of significant impact on the Commonwealth marine environment of the Temperate East Marine Region.

Upwelling off Fraser Island: This key ecological feature is recognised for its enhanced ecological functioning and integrity, and biodiversity, which apply to its pelagic habitats.

In the vicinity of Fraser Island, two areas of upwelled waters mix with surface waters and are drawn onto the shelf through a number of processes, including tidal currents, wind and eddy influence. The upwelled waters support blooms of large diatoms that are important to food chains for commercially valuable species in the area. Examples of food chains include diatoms → macrozooplankton → laternfish → squid → tuna and billfish (long-chain), and diatoms→ crustaceans → tuna (short-chain). However, the entire food web for this system is complex and includes small pelagic fishes, mid-sized fish predators and top predators. The feature also appears to be an important node of connectivity in migrations of small pelagic fishes and top predators. The subtropical waters are an important spawning area for temperate small pelagic fishes (e.g. tailor, sardine, round herring and Australian anchovy), the adults of which appear to migrate from the south, and their larvae are subsequently transported back into temperate nursery areas by the East Australian Current.

Pressures *of potential concern* on this key ecological feature include:

- climate change, which has the potential to alter ecological values through changes to sea temperatures and oceanographic processes. These changes alter localised productivity and/or community structures through shifts in marine species distribution

- oil pollution and chemical pollution/contaminants from shipping traffic which can impact on water quality and ecosystem functioning and integrity
- marine debris from vessel based sources
- extraction of living resources by commercial fishing impacting on the feature's ecosystem functioning and integrity
- bycatch.

Actions that, irrespective of where they occur, have a real chance or possibility of resulting in:

- a substantial change in water quality that may adversely impact on biodiversity or ecological integrity in the area of the upwelling off Fraser Island
- persistent organic chemicals, heavy metals or other potentially harmful chemicals accumulating in the waters in the area of the Fraser upwelling

have a **high risk** of a significant impact on the Commonwealth marine environment.

Actions that introduce a new source from which a severe oil spill has a reasonable potential of arising (e.g. port developments that increase shipping and drilling) in the area of the upwelling off Fraser Island have a **risk** of significant impact on the Commonwealth marine environment of the Temperate East Marine Region.

Tasmantid seamount chain: This key ecological feature is recognised for its enhanced ecological functioning and integrity, and biodiversity, which apply to both its benthic and pelagic habitats.

The Tasmantid seamount chain is a prominent chain of submarine guyots, plateaux and terraces, running north–south at approximately 155° E, and extending down into the Tasman Basin. At its deepest, features rise from 1400–900 metres below sea level; at its northern extent, features rise to from 400–150 metres below sea level, with some breaking the surface to form islands. The Tasmantid seamount chain supports a diverse range of habitats, including deep sea sponge gardens and near-pristine tropical coral reef systems. Collectively, these are known to be biological hotspots, supporting significant demersal and pelagic diversity, and feeding grounds and reproduction sites for a number of open ocean species (e.g. billfish, marine turtles, marine mammals). There is limited information regarding pelagic species composition around these seamounts, but little information on benthic species. High species

diversity and endemicity has been reported from the neighbouring Lord Howe seamount chain, however, which may be used as an indicator for biodiversity levels for the Tasmantid chain.

Pressures *of potential concern* on this key ecological feature include:

- climate change, which has the potential to alter ecological values through changes to sea temperatures and oceanographic processes, and causing ocean acidification. These changes alter localised productivity and/or community structures through shifts in marine species distribution
- oil pollution and chemical pollution/contaminants from shipping traffic which can impact on water quality and ecosystem functioning and integrity
- marine debris from vessel based sources
- extraction of living resources by commercial fishing impacting on the feature's ecosystem functioning and integrity
- bycatch.

Actions that, irrespective of where they occur, have a real chance or possibility of resulting in:

- a substantial change in water quality that may adversely impact on biodiversity or ecological integrity in the area of the Tasmantid seamount chain
- persistent organic chemicals, heavy metals or other potentially harmful chemicals accumulating in the waters surrounding the Tasmantid seamount chain (i.e. waters adjacent to areas of the seamount chain that break the surface and those above areas that do not break the surface)

have a **high risk** of a significant impact on the Commonwealth marine environment.

Actions that introduce a new source from which a severe oil spill or other chemical pollution has a reasonable potential of arising (e.g. increased shipping and drilling) over the Tasmantid seamount chain have a **risk** of significant impact on the Commonwealth marine environment of the Temperate East Marine Region.

Lord Howe seamount chain: This key ecological feature is recognised for its enhanced ecological functioning and integrity, and biodiversity, which apply to both its benthic and pelagic habitats.

The Lord Howe seamount chain runs for approximately 1000 kilometres along the western margin of the Lord Howe Rise, extending from Lord Howe Island in the south to Nova Bank in the north. The chain includes Lord Howe Island, Balls Pyramid, Elizabeth Reef, Middleton Reef and Gifford Guyot within the Temperate East Marine Region, and to the north of the Region are Capel, Kelso, Argo and Nova banks. The seamount chain supports tropical shallow coral reefs and deep cold water corals (depths greater than 40 metres). The fringing coral reefs around Lord Howe Island, and Elizabeth and Middleton reefs to the north, are the southernmost tropical coral reefs in the Pacific Ocean. The seamount chain lies in the path of the Tasman Front, which brings a mix of warm tropical waters and colder, nutrient-rich waters from the south, depending on the season. In general, waters surrounding this feature are nutrient-deficient and relatively unproductive. However, significantly higher catch rates of a range of tuna species along the seamounts suggest periodic bursts of productivity, presumably from subantarctic waters to the south. Deep-water, large, benthic animals occur on the Lord Howe Rise and southern portion of the Norfolk Ridge, with distributions influenced by the Tasman Front. The distribution of benthic invertebrates does extend from the Lord Howe Rise across to the northern part of the Norfolk Ridge as these features lack a hydrographic connection.

Pressures *of potential concern* on this key ecological feature include:

- climate change, which has the potential to alter ecological values through changes to sea temperatures and oceanographic processes, and causing ocean acidification. These changes alter localised productivity and/or community structures through shifts in marine species distribution
- oil pollution and chemical pollution/contaminants from shipping traffic which can impact on water quality and ecosystem functioning and integrity
- marine debris from vessel based sources
- extraction of living resources by commercial fishing impacting on the feature's ecosystem functioning and integrity
- bycatch.

Actions that, irrespective of where they occur, have a real chance or possibility of resulting in:

- a substantial change in water quality that may adversely impact on biodiversity or ecological integrity in the area of the Lord Howe seamount chain
- persistent organic chemicals, heavy metals or other potentially harmful chemicals accumulating in the waters surrounding the Lord Howe seamount chain (i.e. waters adjacent to areas of the seamount chain that break the surface and those above areas that do not break the surface)

have a **high risk** of a significant impact on the Commonwealth marine environment.

Actions that introduce a new source from which a severe oil spill or other chemical pollution has a reasonable potential of arising (e.g. increased shipping and drilling) over the Lord Howe seamount chain have a **risk** of significant impact on the Commonwealth marine environment of the Temperate East Marine Region.

Elizabeth and Middleton temperate and tropical reefs: This key ecological feature is recognised for its enhanced ecological functioning and integrity, and biodiversity, which apply to both its benthic and pelagic habitats.

The Elizabeth and Middleton reefs are small, isolated, oceanic platform-reefs on volcanic seamounts of the Lord Howe seamount chain. The reefs are within the present filaments of the East Australian Current and represent an overlapping area of tropical, reef-building corals and cool-water, non-reef-building corals, which provide habitat for both tropical and temperate species of fish and invertebrates. The lagoons of both reefs are strongholds for populations of the black cod and Galapagos shark. A recent study of the genetic diversity of the reefs and their connectivity suggests that their gene pools are periodically supplemented by long-distance migrants and they are likely to have population sizes that are large enough to avoid inbreeding and maintain genetic diversity. For example, 48 per cent of the coral species of the southern Great Barrier Reef are also found on Elizabeth and Middleton reefs.

A pressure *of concern* on this key ecological feature is climate change, which has the potential to alter the ecological values of this feature through changes to sea temperature and ocean acidification. These changes alter localised productivity and/or community structures through shifts in marine species distribution.

Pressures *of potential concern* on the ecosystem functioning and integrity of this key ecological feature include:

- climate change, which has the potential to alter ecological values through changes to sea levels and oceanographic processes. These changes alter localised productivity and/or community structures through shifts in marine species distribution
- oil pollution and chemical pollution/contaminants from shipping traffic which can impact on water quality and ecosystem functioning and integrity
- marine debris from vessel based sources
- light pollution from offshore activities such as shipping traffic.

Actions that, irrespective of where they occur, have a real chance or possibility of resulting in:

- a substantial change in water quality that may adversely impact on biodiversity or ecological integrity in the area of Elizabeth and Middleton reefs
- persistent organic chemicals, heavy metals or other potentially harmful chemicals accumulating in the waters surrounding Elizabeth and Middleton reefs
- the introduction of a new source from which light pollution may modify, destruct, fragment, isolate or disturb an important or substantial area of habitat within the Elizabeth and Middleton reef ecosystems

have a **high risk** of a significant impact on the Commonwealth marine environment.

Actions that introduce a new source from which a severe oil spill or other chemical pollution has a reasonable potential of arising (e.g. increased shipping) at Elizabeth and Middleton reefs have a **risk** of significant impact on the Commonwealth marine environment of the Temperate East Marine Region.

Norfolk Ridge: This key ecological feature is recognised for its enhanced ecological functioning and integrity, and biodiversity, which apply to both its benthic and pelagic habitats.

The Norfolk Ridge is set within a region of remnant volcanic arcs, plateaux, troughs and basins. The ridge runs southward from New Caledonia to New Zealand, and lies between the New Caledonia Trough to the west and the Norfolk Basin to the east. The high level of diversity in seamount benthos in this area is likely to be caused by relatively productive benthic habitats that support far higher population densities than surrounding regions. The Tasman Front conveys tropical species to the southern portion of the ridge within the Temperate East Marine Region, supporting a diverse assemblage of tropical and temperate species, with evidence of connectivity to the benthic fauna of Lord Howe Rise. The semipermanent Norfolk Eddy may create a closed system that limits connectivity and increases endemism within the South Norfolk Basin.

Pressures *of potential concern* on this key ecological feature include:

- climate change, which has the potential to alter ecological values through changes to sea temperatures and oceanographic processes, and causing ocean acidification. These changes alter localised productivity and/or community structures through shifts in marine species distribution
- marine debris from vessel based sources
- extraction of living resources by commercial fishing impacting on the feature's ecosystem functioning and integrity
- bycatch.

Generally, most actions in or adjacent to the Temperate East Marine Region are unlikely to impact adversely on the ecosystem functioning and integrity of the Norfolk Ridge.

S2.1.3 Adverse impacts on populations of a marine species or cetacean (excluding those listed threatened or migratory)[12]

An impact on the Commonwealth marine environment might be significant if there is a real chance or possibility that it will result in a substantial adverse effect on a population of a marine species, including its lifecycle and spatial distribution. The regional advice below provides further guidance that might assist in considering impacts on the Commonwealth marine environment of the Temperate East Marine Region and their significance, with respect to:

- protected marine species, which are not considered matters of national environmental significance, including
  - cetaceans of known regional importance (that are not listed as threatened or migratory species under the EPBC Act)
  - listed marine species of known regional importance (that are not listed as threatened or migratory species under the EPBC Act)
  - threatened species listed as conservation dependent that are of known regional importance
- species and/or communities that have been defined as key ecological features, as they are believed to play an important role in the Temperate East Marine Region's ecosystem structure and functioning and/or to have particular relevance to its biodiversity and conservation.

It is essential to note that the provision of advice in relation to these species does not imply that they are the only species that should be considered in determining the significance of potential impacts on the Commonwealth marine environment. It remains the responsibility of a person proposing to take an action to determine whether the action will adversely and substantially affect any other marine species in a way that results in a significant impact on the Commonwealth marine environment.

12 Advice on the significance of actions for species listed as threatened and/or migratory that are matters of national environmental significance is provided in Schedules 2.2 to 2.5. (Listed threatened species that are conservation dependent and are not, of themselves, matters of national environmental significance are discussed here.)

Protected species of known regional importance (not listed as threatened or migratory)

Sixty-eight species protected under Part 13 of the EPBC Act (but not listed as threatened or migratory) are currently known to occur in the Temperate East Marine Region (see Table A appended to this schedule). The information currently available on many of these species is insufficient to provide separate regional advice. Six species are of known importance in the context of the region's biodiversity and/or ecological functioning. These species are described below to assist in the interpretation of the significant impacts criteria of EPBC Act Policy Statement 1.1.

The **Indo-Pacific (coastal) bottlenose dolphin** *(Tursiops aduncus)* is listed as cetacean and protected under the EPBC Act. Biologically important areas are defined for this species within the Temperate East Marine Conservation Values Atlas (**www.environment.gov.au/cva**). The Indo-Pacific bottlenose dolphin was only recently recognised and is considered taxonomically distinct from the common bottlenose dolphin. The common bottlenose dolphin is found throughout offshore waters of the region (including Norfolk and Lord Howe islands), but Indo-Pacific bottlenose dolphins occur in riverine and coastal waters, over shallow coastal waters on the continental shelf and around oceanic islands.

Pressures *of concern* to this species include:

- physical habitat modification associated with urban/coastal development
- bycatch associated with commercial fishing and bather protection programs.

Pressures *of potential concern* include:

- climate change (sea level rise, changes in sea temperature, oceanography and storm events and ocean acidification)
- chemical pollution/contaminants and nutrient pollution associated with urban development and agricultural activities
- marine debris
- noise pollution associated with shipping and urban development
- physical habitat modification associated with dredging activities
- oil pollution associated with shipping
- collision with vessels
- changes in hydrological regimes.

Actions that have a real chance or possibility of increasing the likelihood of chemical contamination, oil pollution and sediments in biologically important areas for the Indo-Pacific (coastal) bottlenose dolphin have a **risk** of resulting in substantial adverse effects on populations of these species.

Actions that have a real chance or possibility of increasing localised vessel traffic, including small crafts, in areas where Indo-Pacific (coastal) bottlenose dolphins reside, have a **risk** of substantial adverse impact on populations of these species.

Actions that have a real chance or possibility of increasing noise levels above ambient levels (e.g. dredging, pile-driving or blasting) have a **risk** of substantial adverse impact on populations of both bottlenose dolphin species.

Actions that have a real chance or possibility of modifying, destroying or isolating habitat (e.g. dredging or changes to hydrological regimes) have a **risk** of substantial adverse impact on populations of both bottlenose dolphin species.

Actions that have a real chance or possibility of introducing marine debris to the biologically important areas of the Indo-Pacific (coastal) bottlenose dolphins have a risk of resulting in substantial adverse effects on populations of these species.

The **little shearwater** *(Puffinus assimilis)* breeds on islands of the Lord Howe and Norfolk Island groups and, after breeding, disperses over the Tasman Sea and possibly the Coral Sea. Lord Howe Island has one of the larger breeding colonies of little shearwater in the Australian region. Biologically important areas are defined for this species within the Temperate East Marine Conservation Values Atlas. The little shearwater is vulnerable to a range of impacts from a number of invasive species. Other potential pressures include climate change (changes in sea temperature and oceanography, ocean acidification), oil pollution and chemical pollution/ contaminants associated with shipping, light pollution associated with land-based activities, marine debris and human presence at sensitive sites associated with tourism, recreational and charter fishing and research activities.

The **white-necked petrel's** *(Pterodroma cervicalis)* only known breeding location in Australia is Phillip Island, off Norfolk Island. However, no breeding pairs were recorded during a recent survey of Phillip Island. Globally, the species has a very small range, breeding on two to three small islands (BirdLife International 2011). Biologically important areas are defined for this species within the Temperate East Marine Conservation Values Atlas. This species is vulnerable to a range of impacts from a number of sources. Other potential pressures

include bycatch associated with commercial fishing activities, climate change (changes in sea temperatures and oceanography, ocean acidification), oil pollution and chemical pollution/ contaminants associated with shipping, light pollution associated with land-based activities shortfin and longfin, marine debris and human presence at sensitive sites associated with tourism, recreational and charter fishing and research activities.

The **eastern gemfish** *(Rexea solandri)* is listed as conservation dependent under the EPBC Act. The species is distributed from southern Queensland to the central western Australian coast, including Tasmania. Genetic studies have indicated two distinct populations in Australia, one in eastern Australian waters (referred to as the eastern gemfish) and another west of Bass Strait. Gemfish are meso-pelagic, inhabiting oceanic waters around the continental shelf and upper slope, and are known to feed near the ocean floor at 100–800 metres. The only confirmed spawning area for eastern gemfish in Australian waters is off the central New South Wales coast, and fish migrate there during the spawning season. Potential pressures on this species include climate change (changes in sea temperatures and oceanography). Biologically important areas have not been identified for this species.

Orange roughy *(Hoplostethus atlanticus)* is listed as conservation dependent under the EPBC Act. A high-value commercial species, it is highly vulnerable to depletion because of its long-lived and late maturing nature. It is a deep water species associated with pinnacles, seamounts (e.g. Lord Howe Rise) and other features where its prey aggregates. In Australia, the species is widely distributed in temperate waters between southern Western Australia and central New South Wales, including Tasmania, and is most commonly found on the continental slope at depths of 500–1400 metres. Potential pressures on this species include climate change (changes in sea temperature and oceanography) and physical habitat modification. Biologically important areas have not been identified for this species.

S2.1.4 Adverse impacts on heritage values

Historic shipwrecks

There are likely to be hundreds of historic shipwrecks in the Temperate East Marine Region, but the precise location in Commonwealth waters of many of these shipwrecks in unknown (Figure S2.2). The protected places report card provides further information (**www.environment.gov.au/marineplans/temperate-east**). It is an offence under the Historic Shipwreck Act 1976 to damage, destroy or interfere with a historic shipwreck without a permit.

Actions that have a real chance or possibility of resulting in substantial adverse impacts on the heritage values of the Commonwealth marine area, including damage to or destruction of a historic shipwreck, have a **high risk** of a significant impact on the Commonwealth marine environment.

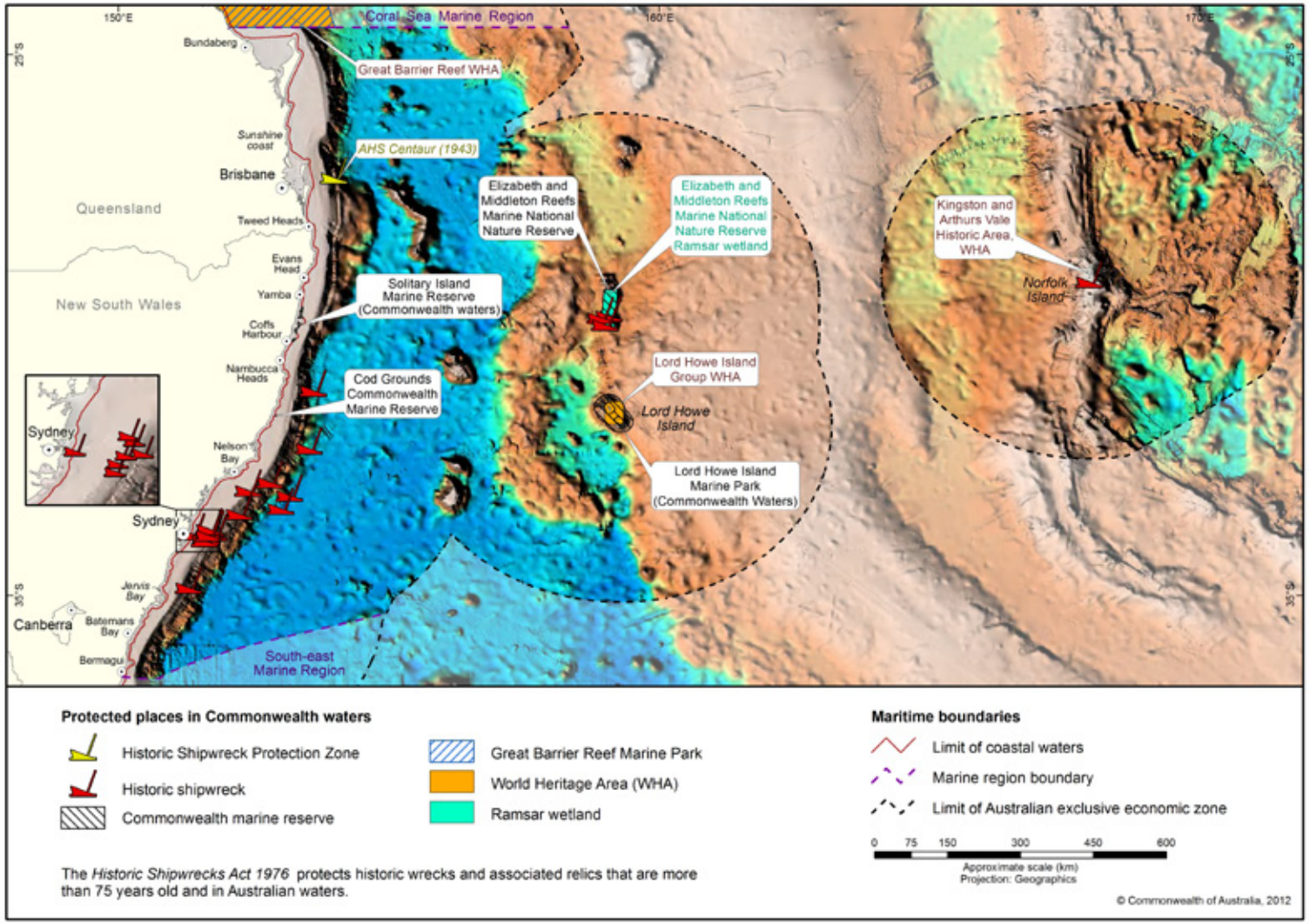

Figure S2.2: Heritage places in the Temperate East Marine Region

Other heritage places

The Lord Howe Island group is listed within several heritage categories under the EPBC Act (Table S2.2).

Table S2.2: Heritage places in the Temperate East Marine Region as of May 2012

Heritage place	Commonwealth marine reserve	World Heritage List	Commonwealth Heritage List	National Heritage List	Ramsar site	Relevant key ecological feature
Lord Howe Island group	✓	✓	✖	✓	✖	Lord Howe seamount chain

* The Lord Howe Island group World Heritage place and National Heritage place sits partly within the Lord Howe Island Marine Park (Commonwealth waters).

Heritage places adjacent to the region include the Great Barrier Reef and Kingston and Arthurs Vale Historic Area on Norfolk Island. These sites, along with the Lord Howe Island group, are listed on both the World Heritage and National Heritage lists therefore they are protected under the EPBC Act. The Act requires approval to be obtained before any action takes place that could have a significant impact on the world heritage or national heritage values of a listed place. For information on the specific world heritage and national heritage values of the three sites, visit the Australian Heritage Database at **www.environment.gov.au/heritage**.

Actions that have a real chance or possibility of causing one or more of the world heritage and/or national heritage values to be lost, degraded, damaged, or notably altered, modified, obscured or diminished, have a **high risk** of significant impact on the Lord Howe Island Group.

S2.1.5 Actions in Commonwealth marine reserves

Commonwealth marine reserves (also called marine protected areas) in the Temperate East Marine Region are areas recognised as having high conservation value. Marine protected areas in the region (Figure S2.2) for which information is provided in this plan include:

- Elizabeth and Middleton Reefs Marine National Nature Reserve
- Solitary Islands Marine Reserve (Commonwealth Waters)
- Cod Grounds Commonwealth Marine Reserve
- Lord Howe Island Marine Park (Commonwealth Waters).

The Director of National Parks is the statutory authority responsible for managing all Commonwealth reserves (including marine protected areas) as specified by the EPBC Act. The Act also requires all Commonwealth reserves (terrestrial and marine) to have a management plan. The Act prohibits some activities being carried out on or in a Commonwealth reserve unless they are expressly provided for by a management plan for the reserve or are approved in writing by the Director of National Parks when a management plan is not in operation. This includes actions that affect native species, commercial activities and mining operations.

People considering actions in or adjacent to the Temperate East Marine Region should check the Commonwealth environment department's web site (**www.environment.gov.au/marinereserves**) for the current list and location of Commonwealth marine reserves in the Temperate East Marine Region.

Elizabeth and Middleton Reefs Marine National Nature Reserve

Elizabeth and Middleton Reefs Marine National Nature Reserve is located in the Tasman Sea, approximately 600 kilometres east of Coffs Harbour and to the north of Lord Howe Island. The reserve includes two separate reefs, Elizabeth Reef and Middleton Reef. The reserve was proclaimed in 1987 and has two zones: Habitat Protection Zone (IUCN Category II) and Sanctuary Zone (IUCN Category Ia). Activities undertaken in the reserve are regulated under the management plan for the Elizabeth and Middleton Reefs Marine National Nature Reserve. This management plan is due to expire in 2013. People intending to undertake activities in Elizabeth and Middleton Reefs Marine National Nature Reserve must apply for approval from the Director of National Parks. For more information on Elizabeth and Middleton Reefs Marine National Nature Reserve, please visit **www.environment.gov.au/coasts/mpa/elizabeth/index.html**.

Solitary Islands Marine Reserve (Commonwealth Waters)

Solitary Islands Marine Reserve (Commonwealth Waters) (SIMR) is located off the coast of northern New South Wales, 600 kilometres north of Sydney, between Coffs Harbour and Plover Island. It is adjacent to the Solitary Islands Marine Park (New South Wales waters) and extends from the 3-nautical mile state limit seaward to the 50-metre depth contour. The Solitary Islands Marine Reserve encompasses the waters, seabed and subsoil beneath the seabed to a depth of 1000 metres. The Solitary Islands Marine Park covers 710 square kilometres; the Solitary Islands Marine Reserve covers a further 160 square kilometres. The reserve was proclaimed in 1993 and has three zones: General Use Zone (IUCN Category VI); Sanctuary Zone (IUCN Category Ia) and Habitat Protection Zone (IUCN Category IV). Activities undertaken in the reserve are regulated under management arrangements. People intending to undertake activities in the Solitary Islands Marine Reserve (Commonwealth waters) must apply for approval from the Director of National Parks. For more information on the Solitary Islands Marine Reserve, please visit **www.environment.gov.au/coasts/mpa/solitary/index.html**.

Cod Grounds Commonwealth Marine Reserve

The Cod Grounds Reserve comprises a 1000-metre radius from a point at 152°54'37"E 31°40'52"S, offshore of Laurieton, New South Wales. The reserve was proclaimed in 2007 as an IUCN Category 1a strict nature reserve (Sanctuary Zone) to protect important habitat of the critically endangered east coast population of grey nurse shark. Activities undertaken in the reserve are regulated under interim management arrangements. People intending to undertake activities in the Cod Grounds Commonwealth Marine Reserve must apply for approval from the Director of National Parks. For more information on the Cod Grounds Commonwealth Marine Reserve, please visit **www.environment.gov.au/coasts/mpa/cod-grounds/index.html**.

Lord Howe Island Marine Park

The Lord Howe Island Marine Park is approximately 700 kilometres north-east of Sydney. The park comprises State waters around Lord Howe Island and Ball's Pyramid and the Commonwealth waters between 3 nautical miles and 12 nautical miles around Lord Howe Island and Ball's Pyramid form the Lord Howe Island Marine Park (Commonwealth Waters). The perimeter of the Lord Howe Island Marine Park (Commonwealth Waters) roughly corresponds to the 1800-metre depth contour, which follows the base of the seamounts that underlie Lord Howe Island and Ball's Pyramid. The sea area of the Commonwealth Marine Park is estimated to be 3005 square kilometres and includes the seabed to a depth of 100 metres. The reserve was proclaimed in 2000 and has two zones: Sanctuary Zone (IUCN Category 1a) and Habitat Protection Zone (IUCN Category IV). Activities undertaken in the reserve are regulated under management arrangements. People intending to undertake activities in the Lord Howe Island Marine Park (Commonwealth Waters) must apply for

approval from the Director of National Parks. For more information on the Lord Howe Island Marine Park (Commonwealth Waters), please visit **www.environment.gov.au/coasts/mpa/lordhowe/index.html**.

Actions in or near Commonwealth marine reserves have a **greater risk** of significant impacts on the Commonwealth marine environment.

Advice for preparing a referral with respect to impacts on the Commonwealth marine environment of the Temperate East Marine Region

The 'referral of proposed action' form is available electronically at **www.environment.gov.au/epbc/index.html** and can also be obtained in hard copy by telephoning 1800 803 772. It includes detailed instructions about the type of information that is required in referring a proposed action for consideration.

In addition to the instructions included in the referral of proposed action form, if an action is referred because of the risk of significant impact on the Commonwealth marine environment of the Temperate East Marine Region, consideration of the following matters is recommended:

- For actions associated with physical habitat modification, for example dredging, independent dredge plume modelling undertaken to predict suspended sediment levels and the extent of sediment dispersal as a result of the proposed action would assist in assessing the action.
- For actions involving physical habitat modification, for example the dumping of dredge spoils or other materials into the Commonwealth marine environment, requirements under the Environment Protection (Sea Dumping) Act 1981 and the National assessment guidelines for dredging 2009 (DEWHA 2009) apply. An application for a sea dumping permit should be submitted. Further information on sea dumping is available at **www.environment.gov.au/coasts/pollution/dumping/index.html**.
- For actions likely to release nutrients or pollutants into the Commonwealth marine environment, modelling of nutrient or pollutant dispersal and accumulation undertaken to determine potential impacts on marine ecosystems would assist in assessing the action.
- To mitigate the effects of an accidental hydrocarbon spill from a vessel, an approved shipboard oil pollution emergency plan should be in place. For actions relating to petroleum facilities and pipelines, an approved environment plan containing an oil spill contingency plan should be in place. Further information on responsibilities regarding the protection of the marine environment from oil spills is available on the National Offshore Petroleum Safety and Environmental Management Authority's website: **www.nopsema.gov.au**.

References

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BirdLife International, 2011, Species factsheet: *Pterodroma cervicalis,* BirdLife International, Cambridge, UK, viewed July 2011, **<www.birdlife.org>**.

NSW Department of Primary Industries 2011, Marine Pests, viewed October 2011, **<www.dpi.nsw.gov.au/fisheries/pests-diseases/marine-pests>**.

Schedule 2.2
Cetaceans of the Temperate East Marine Region

All cetaceans are protected under the EPBC Act in the Australian Whale Sanctuary[13] (and, to some extent, beyond its outer limits). Of the 45 cetacean species (whales, dolphins and porpoises) recorded in Australian waters, 11 are known to occur in the Temperate East Marine Region, and one other species may occur infrequently in the region. Please refer to the conservation values report card—cetaceans, for a complete list of cetaceans and additional information (**www.environment.gov.au/marineplans/temperate-east**).

The Temperate East Marine Region supports diverse and abundant cetacean populations, whose use of the region's marine habitats and resources varies markedly. Toothed whales found in the region include killer whales, the Indo-Pacific humpback and Indo-Pacific (coastal) bottlenose dolphins, known to feed on a wide range of prey including fish and squid, are also found in the region, and the area is used as a migration pathway for humpback whales between their feeding and breeding areas.

The following advice relates only to those species listed above for which it has been possible to identify biologically important areas (Table S2.3). The Indo-Pacific bottlenose dolphin is listed as cetacean and is considered in Schedule 2.1.

Table S2.3: Cetaceans listed as threatened and/or migratory with known biologically important areas in or adjacent to the Temperate East Marine Region

Species	Listing status
Humpback whale (*Megaptera novaeangliae*)	Vulnerable, migratory
Indo-Pacific humpback dolphin (*Sousa chinensis*)	Migratory

13 The Australian Whale Sanctuary was established under the EPBC Act to protect all whales and dolphins in Australian waters. The Australian Whale Sanctuary comprises the Commonwealth marine area and covers all of Australia's Exclusive Economic Zone which generally extends out to 200 nautical miles from the coast and includes the waters surrounding Australia's external territories such as Christmas, Cocos (Keeling), Norfolk, Heard and Macdonald Islands. Within the Australian Whale Sanctuary it is an offence to kill, injure or interfere with a cetacean. Severe penalties apply to anyone convicted of such offences. More information about the Australian Whale Sanctuary can be found at **www.environment.gov.au/coasts/species/cetaceans/conservation/sanctuary.html**.

Key considerations in relation to significant impacts on cetacean species in the Temperate East Marine Region

Population status and ecological significance

The **humpback whale** is listed as vulnerable and migratory. The population is estimated to be growing consistently at about 10 per cent per year (Bannister & Hedley 2001; Bryden, Kirkwood & Slade 1990; Chaloupka & Osmond 1999; Paterson, Paterson & Cato 2001; Paterson, Paterson & Cato 2004). The Australian east coast population is estimated to be 10 000 individuals (Noad et al. 2008).

The **Indo-Pacific humpback dolphin** is listed as migratory. The total Australian population size of this species is unknown, but it is likely that the Indo-Pacific humpback dolphin occurs as one genetic population within Australia (DSEWPaC 2011). Regional population levels are likely to be in the low thousands on the east coast of Queensland, with populations in particular bays in the region varying between approximately 50 and 100 individuals. Populations of this inshore dolphin are highly localised, occur in small subgroups, and have low gene flow between groups (Cagnazzi 2010; Corkeron et al. 1997; Parra, Corkeron & Marsh 2006).

Top-order predators—such as dolphins—are a key functional species group, influencing abundance, recruitment, species composition, diversity and behaviour of prey species. Their removal can have a cascading effect on all the components of a food web (Heithaus 2001; Baum & Worm 2009; Ings et al. 2009, cited in Ceccarelli & Ayling 2010).

For the purposes of determining the significance of impacts of proposed actions on the two species listed above, note that:

- the humpback whale is listed as vulnerable under the EPBC Act. It should be assumed that populations of this species in and adjacent to the Temperate East Marine Region are important populations[14] of the species
- the Indo-Pacific humpback dolphin is listed as migratory under the EPBC Act. There is insufficient information to determine whether an ecologically significant proportion of the population occurs in the Temperate East Marine Region. However, it should be taken into consideration that this species generally exhibits small group sizes (less than 100 individuals), high site fidelity and geographic isolation with low gene flow between populations. As such, the loss (i.e. anthropogenic mortality) of even a very small percentage of mature animals may cause population decline or local extinction.

Species distribution and biologically important areas

Humpback whales migrate annually between their summer feeding grounds in Antarctica and their winter tropical and subtropical breeding grounds. In general, the species is sighted in southern Australian waters in May, and migrates slowly up the east and west coasts. By October, most whales have started their southward migration, and sightings are less frequent after November. During migration, individuals travel alone or in temporary aggregations of generally non-related individuals (cow–calf pairs being the exception) (Valsecchi et al. 2002).

14 Definitions of 'important population' and 'ecologically significant population' are provided in Section 1 of this schedule and are consistent with EPBC Act Policy Statement 1.1: Significant impact guidelines—matters of national environmental significance. In accordance with Policy Statement 1.1 for threatened species listed as vulnerable, such as the humpback whale, consideration should be given to whether an important population

Biologically important areas have been identified for the **humpback whale** in the Temperate East Marine Region and include (from north to south):

- the Hervey Bay area for migration/resting during migration, including resting during northbound migration (June–July) and as a resting area for females and calves on southbound migration (August–mid-October)
- Fraser Island to Moreton Bay, between the coast and 15 km offshore as a migration pathway (northbound migration peaking in June–July and southbound migration peaking in August–mid-October)
- the Moreton Bay area, for migration/resting during migration, including resting during northbound migration (peaking June–July), and as a resting area for females and calves on southbound migration (peaking August–mid-October)
- from the Queensland/New South Wales border to the Eden area for migration/resting during migration. Resting during migration between May and November, northbound (peaking June–July) and southbound (peaking August–mid-October). Feeding has been observed just to the south of the region, off Eden.

Actions undertaken offshore from the continental shelf and not affecting waters over the continental shelf have a **low risk** of significant impact on the humpback whale.

The **Indo-Pacific humpback dolphin** is found in coastal and estuarine areas of Queensland and New South Wales (Parra & Ross 2009). It occurs in a variety of inshore shallow water habitats at depths less than 20 metres, including inshore reefs, tidal and dredged channels, mangroves and river mouths (Karczmarski, Cockroft & McLachlan 2000; Parra 2006). The Indo-Pacific humpback dolphin is a generalist feeder, preying on bottom-dwelling and pelagic fish and cephalopods associated with coastal and estuarine waters (Parra & Jendensjo 2009).

Biologically important areas have been identified for the **Indo-Pacific humpback dolphin** in and adjacent to the Temperate East Marine Region and include (from north to south):

- from Hervey Bay north-east to Commonwealth waters, within the 20-metre depth contour (Queensland), for foraging
- from Hervey Bay south to Tin Can Bay, within the 20-metre depth contour (Queensland), for foraging/feeding and breeding year-round
- the southern tip of Fraser Island in coastal waters adjacent to Rainbow Beach, within the 20-metre depth contour (Queensland), for foraging
- from the north-eastern tip of Cooloola National Park south to the Queensland/New South Wales border (including Moreton Bay), within the 20-metre depth contour (Queensland), for foraging/feeding and breeding year-round
- coastal waters south of the Queensland—New South Wales border to Cabarita Beach, within the 20-metre depth contour (New South Wales), for foraging.

Further information on these areas is found in the Temperate East Conservation Values Atlas (**www.environment.gov.au/cva**).

Table S2.4 should be considered in assessing the risk of significant impact on each of the three species within and outside known biologically important areas.

Table S2.4: Advice on the risk of significant impact on humpback whale and Indo-Pacific humpback dolphin[15]

Species	Action in biologically important areas	Action outside biologically important areas	Temporal considerations[18]
Humpback whale	**High risk** of significant impact, depending on the type of action[16]	Actions undertaken outside of, and not affecting[17], biologically important areas for the humpback whale and, in the case of seismic activities, undertaken in accordance with EPBC Act Policy Statement 2.1, have a **low risk** of significant impact on this species	In the Temperate East Marine Region from early December to April[18], there is a low likelihood of encounter with humpback whales. Generally, actions undertaken anywhere in the region during this period have a **low risk** of significant impact on the species
Indo-Pacific humpback dolphin	**High risk** of significant impact, depending on the type of action[16]	Actions undertaken outside of, and not affecting[17], biologically important areas for the Indo-Pacific humpback dolphin have a **low risk** of significant impact on this species	Indo-Pacific humpback dolphins use biologically important areas all year

Further information on biologically important areas can be found in the Temperate East Conservation Values Atlas (**www.environment.gov.au/cva**).

15 This advice does not apply to actions that inherently result in prolonged or enduring changes to the biologically important areas or the marine environment in general. Actions should also be conducted in accordance with EPBC Act Policy Statement 2.1: Interaction between offshore seismic exploration and whales, where relevant.

16 see 'Nature of proposed action', following page

17 Actions that might affect a biologically important area, even when undertaken outside the area, include sound transmission that may result in behavioural reactions of whale species and/or prey, such that a physical impact is likely.

18 This time period reflects a precautionary approach and includes a buffer of one month on either end of the known periods during which humpback whales are found in these areas. The buffer has been used as there is a limited understanding of the migratory movements of humpback whales or the seasonality of their occurrence in the region before or after they are sighted in known biologically important areas.

Nature of the proposed action

The conservation values report card—cetaceans, provides an overview of the vulnerabilities and pressures on protected cetaceans in the Temperate East Marine Region. Inshore dolphins and humpback whale are particularly vulnerable to impacts from human activities because their nearshore coastal distribution overlaps with the areas of highest human use in the marine environment. Anthropogenic activities in coastal environments have the potential to significantly impact on inshore dolphins and humpback whales.

The Indo-Pacific humpback dolphin is vulnerable to physical habitat modification associated with urban/coastal development, and bycatch associated with commercial fishing activities and bather protection programs.

Pressures *of potential concern* on humpback whales include:

- climate change (changes in sea temperature, oceanography and ocean acidification)
- marine debris from a range of sources
- bycatch associated with bather protection programs.

Pressures *of potential concern* on the Indo-Pacific humpback dolphin include:

- climate change (sea level rise, changes in sea temperature and oceanography and ocean acidification)
- chemical pollution/contaminants and nutrient pollution associated with urban development and agricultural activities
- marine debris from a range of sources
- noise pollution associated with shipping and urban development
- physical habitat modification associated with dredging
- oil pollution associated with shipping
- collision with vessels
- changes in hydrological regimes.

People planning to undertake actions in biologically important areas for cetaceans should carefully consider the potential for their actions to have a significant impact on the species. For actions proposed outside biologically important areas for cetaceans, the risk of significant impact on the species is likely to be lower.

In addition to this general advice, the following actions have a **high risk** of a significant impact on humpback whales:

- actions that have a real chance or possibility of increasing rates of entanglement that potentially result in a long-term decrease in population size.

The following actions have a **risk** of a significant impact on Indo-Pacific humpback dolphins:

- actions that have a real chance or possibility of introducing a new source from which a severe chemical spill or nutrient pollution has a reasonable potential of arising (e.g. construction of ports or expansion in port facilities, development of residential, industrial or agricultural areas) within biologically important areas when the species is present
- actions that have a real chance or possibility of increasing relevant noise[19] above the ambient levels (e.g. actions resulting in a substantial increase in underwater acoustic noise from construction or ship noise) within any of the biologically important areas for this species when the species is present
- actions that have a real chance or possibility of substantially modifying, destroying or isolating habitat (e.g. dredging, changes to hydrological regimes, urban/coastal development) in a biologically important area
- actions that have a real chance or possibility increasing the rate of ship strike (e.g. increased shipping traffic associated with new or expanding port construction) within biologically important areas for this species when the species is present.

Actions that have a real chance or possibility of introducing marine debris to the biologically important areas of the Indo-Pacific humpback dolphin have a **risk** of significant impact on the Indo-Pacific humpback dolphin.

Actions that introduce a new source from which a severe oil spill or other chemical pollution has a reasonable potential of arising (e.g. increased shipping and drilling) in biologically important areas have a **risk** of significant impact on the Indo-Pacific humpback dolphin.

19 Relevant noise is defined here as low-frequency sounds (below 200Hz) that are within the same range of frequencies used by some whales.

For the Indo-Pacific humpback dolphin, given the currently incomplete knowledge of their population distribution, there is a risk of a significant impact from the actions described above outside known biologically important areas which are, however, still within the species' distribution and seasonal range in the region.

Ecotourism operations in biologically important areas for the Indo-Pacific humpback dolphin undertaken in accordance with the *Australian national guidelines for whale and dolphin watching 2005* (DEH 2005b) have a low risk of significant impact on the species. The national guidelines require strict management measures to be applied in areas where dolphin watching operations might be *of concern* (e.g. locations with a high number of operators). In an instance where these operations may be *of concern*, early advice should be sought from the Australian Government department responsible for the environment.

Advice for preparing a referral with respect to impacts on humpback whales and Indo-Pacific humpback dolphins in the Temperate East Marine Region

The 'referral of proposed action' form is available electronically at **www.environment.gov.au/epbc/indedex.html** and can also be obtained in hard copy by telephoning 1800 803 772. It includes detailed instructions about the type of information required in referring a proposed action for consideration.

In addition to the instructions included in the referral of proposed action form, if an action is referred because of the risk of significant impact on the humpback whale or Indo-Pacific humpback dolphin, consideration of the following matters is also recommended:

- If the action proposed is within a biologically important area, information should be considered about any alternative locations for the proposed action that would be outside the area, why the action is unlikely to have a significant impact or why any significant impact can be reduced to an acceptable level.
- If planning recreational or tourism operations, the *Australian national guidelines for whale and dolphin watching* (DEH 2005b) provides standards on approach distances and operating procedures.
- Referrals should be supported by scientifically credible information that places the proposal in the context of existing pressures on cetaceans and the life history characteristics of the species. The conservation values report card—cetaceans provides additional information on the range of pressures on cetaceans.
- For areas marked for long-term development involving noise-generating activities, passive acoustic monitoring programs (e.g. installation of sonobuoys) might assist in gaining the necessary understanding of the finer scale spatial and temporal patterns of some cetaceans and improve the ability to assess and mitigate impacts. It is recommended that early advice be sought from the Australian Government department responsible for the environment.

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Schedule 2.3
Marine turtles of the Temperate East Marine Region

Four species of marine turtle listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are known to occur in the Temperate East Marine Region, and all are listed as threatened and migratory under the EPBC Act.

Green and loggerhead turtles are the most common marine turtles found in the Temperate East Marine Region, with nesting sites dotted along the New South Wales and south-east Queensland coasts. Hawksbill and leatherback turtles are likely to be found foraging in the region.

The following advice relates to the marine turtles for which it has been possible to identify biologically important areas, listed in Table S2.5. Please refer to the conservation values report card—marine reptiles for a complete list of reptiles in the region and additional information (**www.environment.gov.au/marineplans/temperate-east**).

Table S2.5: Marine turtles listed as threatened and/or migratory in or adjacent to the Temperate East Marine Region for which biologically important areas have been identified

Species	Listing status
Green turtle *(Chelonia mydas)*	Vulnerable, migratory, marine
Loggerhead turtle *(Caretta caretta)*	Endangered, migratory, marine

Key considerations in relation to significant impacts on green and loggerhead turtles in the Temperate East Marine Region

Population status and ecological significance

The **green turtle** is listed as vulnerable and migratory under the EPBC Act. Three breeding aggregations (considered to be separate stock) exist in and adjacent to the region: the northern and southern Great Barrier Reef stock and the Coral Sea stock. The Temperate East Marine Region is most important for the southern Great Barrier Reef stock. This population is estimated to include 36 500 breeding females (Dethmers et al. 2010). This stock was thought to be in decline, but recent studies indicate it is now increasing (Chaloupka et al. 2007). The northern Great Barrier Reef and Coral Sea populations have an estimated 133 500 and 15 500 breeding females, respectively (Dethmers et al. 2010).

The **loggerhead turtle** is listed as endangered and migratory under the EPBC Act. The eastern Australian stock, the most important within the Temperate East Marine Region, has undergone a sharp decline since the 1970s, with estimates from the 1999–2000 breeding season of less than 500 breeding females (Limpus 2008).

For the purposes of determining the significance of impacts of proposed actions on the four species[20] listed above, note that:

- the loggerhead turtle is endangered under the EPBC Act. It is known that populations of this species occur in and adjacent to the Temperate East Marine Region
- the green turtle is listed as vulnerable under the EPBC Act. It is known that populations of this species occur in and adjacent to the Temperate East Marine Region.

Species distribution and biologically important areas

Green turtles are a global species that generally live in tropical environments within the 20 °C isotherm, but they are occasionally known to enter temperate waters. Adults forage mainly on seagrass and algae, and occasionally eat mangroves (Forbes 1994; Limpus & Limpus 2000; Pendoley & Fitzpatrick 1999), fish egg cases (Forbes 1994), jellyfish (Limpus, Couper & Read 1994) and sponges (Whiting, Guinea & Pike 2000). The species is common throughout north-eastern Australia and there are seven distinct genetic stocks within the Australian region (Dethmers et al. 2006; FitzSimmons et al. 1997). The northern Great Barrier Reef supports the largest population of nesting green turtles in Australia, with smaller breeding areas in the south (DEWHA 2009). Beyond the boundaries of the Great Barrier Reef, the islets that make up the Coringa-Herald National Nature Reserve in the Coral Sea, to the east of Cairns and Townsville, support the most significant nesting sites in the region.

20 Definitions of 'important population' and 'ecologically significant population' are provided in Section 1 of this schedule and are consistent with EPBC Act Policy Statement 1.1: Significant Impact Guidelines—Matters of National Environmental Significance. In accordance with Policy Statement 1.1, for threatened species listed as vulnerable, such as the green turtle, consideration should be given to whether an important population occurs in the area where the action is proposed; for listed migratory species, consideration should be given to whether an ecologically significant proportion of a population may be impacted.

In their post-hatchling and juvenile stages, green turtles drift on ocean currents (Carr & Meylan 1980). They travel south along the east coast of Australia on the East Australian Current, leaving the region as they move east to northern New Zealand, then continuing on the South Pacific Gyre to re-enter the region via the Coral Sea (DEWHA 2009). In their next phase, they move to shallow waters to forage on seagrass and algae, living in coral and rocky reefs, inshore seagrass beds and algal mats (Musick & Limpus 1997; Poiner & Harris 1996; Robins, Bache & Kalish 2002; Whiting, Guinea & Pike 2000). Green turtles are much smaller than other marine turtles when they leave their open ocean phase, and it is presumed that they do not travel as extensively as some other species within the south Pacific (Limpus et al. 2005, DEWHA 2009).

Biologically important areas have been identified for **green turtles** in the Temperate East Marine Region and include (from north to south):

- Mon Repos Conservation Park, for nesting, with an internesting buffer of 20 kilometres (November to February)
- Moreton Bay for foraging (year round).

The **loggerhead turtle** breeds in eastern Australia and forages throughout Queensland and New South Wales. Females predominantly nest on beaches near Bundaberg and the islands of the southern Great Barrier Reef. The largest nesting sites are Mon Repos on the mainland and Wreck Island in the Great Barrier Reef, where several hundred females lay their eggs every year. Some isolated nesting occurs south of Bundaberg and as far south as Ballina in northern New South Wales (Limpus 1985; DEWHA 2009). In their early life they are carried south by the East Australian Current to around 30° S (Limpus, Couper & Read 1994; Walker 1994), leaving the region as they move east to northern New Zealand, then travelling on the South Pacific Gyre and re-entering the region via the Coral Sea (DEWHA 2009). As large, immature turtles, their oceanic, pelagic, post-hatchling phase moves to a benthic feeding phase (Bjorndal 1997; Lanyon, Limpus & Marsh 1989; Limpus & Limpus 2000; Limpus et al. 2005). Adults and large juveniles inhabit environments with both hard and soft substrata, including rocky and coral reefs (Limpus, Fleay & Guinea 1984), muddy bays (Conway 1994), sand flats, estuaries and seagrass meadows (Limpus, Couper & Read 1994; Preen 1996; McCauley & Bjorndal 1999). Large concentrations of foraging loggerhead turtles have been found in the lagoons of the southern Great Barrier Reef islands (e.g. Heron and Wistari), as well as the Hervey Bay and Moreton Bay areas (DEWHA 2009).

Biologically important areas have been identified for **loggerhead turtles** in the Temperate East Marine Region and include (from north to south):

- the coastline between Bustard Head, Queensland, and Ballina, New South Wales for nesting, with an internesting buffer of 20 kilometres (November to February)
- Mon Repos Conservation Park–Woongara Coast for nesting, with an internesting buffer of 20 kilometres (November to February).

Further information on these areas is found in the Temperate East Conservation Values Atlas (**www.environment.gov.au/cva**).

Nature of the proposed action

The life history patterns of marine turtles, including long life spans and late sexual maturity, make them vulnerable to a range of pressures in the marine environment. Marine turtles spend their life at sea other than when adult females return to beaches in their natal region to nest (FitzSimmons et al. 1997; Chaloupka & Limpus 2001). They are highly migratory and occupy different habitats at different stages of their life.

The conservation values report card—reptiles provides a summary of the existing environment and pressures in the Temperate East Marine Region. Proposals for new actions should consider the existing environment, vulnerabilities and pressures acting on marine turtles in the region.

The green turtle is vulnerable to extraction of living resources associated with (non-domestic) commercial fishing activities; bycatch from commercial fishing activities; climate change (sea level rise); marine debris from a range of sources; and collision with vessels. Potential pressures include physical habitat modification from dredging activities; extraction of living resources from illegal, unregulated and unreported fishing activities; climate change (changes in sea and sand temperatures and oceanography); oil and chemical pollution/contaminants associated with shipping; chemical pollution/contaminants and nutrient pollution associated with urban development and agricultural activities; and light pollution from land-based and offshore activities.

The loggerhead turtle is vulnerable to bycatch from commercial fishing activities; climate change (sea level rise, changes in sea and sand temperatures); marine debris from a range of sources; and collision with vessels. Potential pressures include invasive species; physical habitat modification from dredging activities; extraction of living resources from illegal, unregulated and unreported fishing activities; climate change (changes in oceanography); oil and chemical pollution/contaminants associated with shipping; chemical pollution/contaminants and nutrient pollution associated with urban development and agricultural activities; and light pollution from land-based and offshore activities.

Growing urban and industrial development in the region is leading to an increase in recreational vessels and shipping in areas frequented by marine turtles, increasing the potential of vessel collisions for both species.

Pressures *of concern* and *of potential concern* on the loggerhead and green turtles in the Temperate East Marine Region are as follows:

- increases in sea temperature, changes in sea level and changes in terrestrial sand temperature are *of concern* for the loggerhead turtle and *of potential concern* for the green turtle
- bycatch as a result of commercial fishing activities is a pressure *of concern* while bycatch as a result of illegal, unregulated and unreported fishing is *of potential concern* for both turtle species
- vessel collision is a pressure *of concern* for both turtle species
- changes in oceanography is *of potential concern* for both species
- chemical and nutrient pollution as a result of industrial and coastal development and agricultural activities is a pressure *of potential concern* for both turtle species
- marine debris from a range of sources is a pressure *of potential concern* for both turtle species
- light pollution from onshore activities (e.g. petroleum facilities, ports and urban development) is a pressure *of potential concern* for both turtle species
- physical habitat modification through dredging is a pressure *of potential concern* for both turtle species
- oil pollution is *of potential concern* for both species
- invasive species (e.g. foxes and feral pigs) is a pressure *of potential concern* for both turtle species
- non-domestic commercial fishing is *of potential concern* for green turtles.

People planning to undertake actions in biologically important areas for marine turtles should carefully consider the potential for their action to have a significant impact on the species. For actions proposed outside biologically important areas for marine turtles, the risk of significant impact on the species is likely to be lower.

The following actions have a **very high risk** of a significant impact on the loggerhead turtle:

- actions that have a real chance or possibility of resulting in an increase in collision with vessels.

The following actions have a **high risk** of a significant impact on both the loggerhead and the green turtle:

- actions that have a real chance or possibility of resulting in an increase in lighting at important nesting sites during breeding seasons. Examples of such actions include onshore sources of lighting (e.g. petroleum processing facilities, ports)
- actions, such as dredging, that have a real chance or possibility of modifying, destroying or decreasing the availability of habitat for the species
- actions that have a real chance or possibility of changing the water quality of; increasing nutrient pollution of; or introducing contaminants into, biologically important areas
- actions that have a real chance or possibility of leading to the introduction of invasive species into biologically important areas.

Actions with a real chance or possibility of resulting in an increase in collision with vessels have a **high risk** of a significant impact on the green turtle.

Actions that have a real chance or possibility of introducing marine debris to the biologically important areas of the loggerhead and green turtle have a **risk** of significant impact on these species.

Actions that introduce a new source from which a severe oil spill or other chemical pollution has a reasonable potential of arising (e.g. increased shipping and drilling) have a **risk** of significant impact on the loggerhead and green turtles.

Advice for preparing a referral with respect to impacts on green and loggerhead turtles in the Temperate East Marine Region

The 'referral of proposed action' form is available electronically at **www.environment.gov.au/epbc/indedex.html** and can also be obtained in hard copy by telephoning 1800 803 772. It includes detailed instructions about the type of information required in referring a proposed action for consideration.

In addition to the instructions included in the referral of proposed action form, if an action is referred because of the risk of significant impact on either of the two species of marine turtle considered here, consideration of the following matters is recommended:

- If the action is proposed within a biologically important area classified in a nesting, internesting or foraging area, information should be considered about alternative locations for the proposed action that would be outside the area, why the action is unlikely to have a significant impact or why any significant impact can be reduced to an acceptable level.
- Referrals should include information on how the likelihood of any significant impacts will be mitigated, considering the advice provided above on likely significant impacts to any marine turtles. Independent scientific assessments of any intended mitigation measures should be sought before submitting a referral and these assessments should be included in the referral.
- Referrals should be supported by scientifically credible information that places the proposal in the context of existing pressures on marine turtles and the life history characteristics of the species. The conservation values report card—reptiles provides information on the range of pressures on marine turtles addressed in this regional advice.

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Schedule 2.4
Seabirds of the Temperate East Marine Region

Twenty species of seabird listed as threatened and/or migratory are known to have biologically important areas in the Temperate East Marine Region (Table S2.6), and a further 21 species may occur infrequently in the region.[21] Seabirds listed as threatened and/or migratory are matters of national environmental significance and protected under the EPBC Act. Regional advice for some seabird species in the region that are not listed as threatened or migratory is included in Schedule 2.1.

Table S2.6: Seabird species listed as threatened and/or migratory with biologically important areas in and adjacent to the Temperate East Marine Region

Species	Listing status	Breeding season and habits
Terns and noddies		
Common noddy *(Anous stolidus)*	Migratory, marine	Breeds in the region from October to January (Lord Howe and Norfolk Island groups)
Shearwaters		
Flesh-footed shearwater *(Ardenna carneipes)*	Migratory, marine	Breeds in the region from August to May Forages in the region from September to November and January to February
Short-tailed shearwater *(Ardenna tenuirostris)*	Migratory, marine	Breeds in the region from November to April
Sooty shearwater *(Ardenna grisea)*	Migratory, marine	Breeds in the region from September to April
Wedge-tailed shearwater *(Ardenna pacifica)*	Migratory, marine	Breeds in the region from November to April (Coral Sea, Great Barrier Reef, Montague Island, Muttonbird Island, Broughton Island) Breeds in the region from September to April (Lord Howe Island group) Breeds in the region from October to May (Norfolk Island group)

21 All birds that occur naturally in the region (including the airspace) are protected under the EPBC Act as listed marine species. Seabirds are those birds that rely on and have an ecological association with the marine environment. Not all the birds that occur in the Temperate East Marine Region are seabirds (a complete list of all the birds known to occur in the region is provided in the report card on seabirds).

Species	Listing status	Breeding season and habits
Petrels and storm-petrels		
Gould's petrel *(Pterodroma leucoptera)*	Endangered, migratory	Breeds in the region from August to May
Southern giant-petrel *(Macronectes giganteus)*	Endangered, migratory, marine	Forages in the region from June to October
Northern giant-petrel *(Macronectes halli)*	Vulnerable, migratory, marine	Forages in the region from June to October
Kermadec petrel *(Pterodroma neglecta)*	Vulnerable, marine	Breeds in the region from November to June
White-bellied storm-petrel *(Fregetta grallaria)*	Vulnerable, marine	Breeds in the region from February to May
Black petrel *(Procellaria parkinsoni)*	Migratory, marine	Forages in the region year-round
Providence petrel *(Pterodroma solandri)*	Migratory, marine	Breeds in the region from March to November
Wilson's storm-petrel *(Oceanites oceanicus)*	Migratory, marine	Migrates through the region North migration from April to June South migration from September to November
Albatrosses		
Antipodean albatross *(Diomedea antipodensis)*	Vulnerable, migratory, marine	Forages in the region year-round
Black-browed albatross *(Thalassarche melanophris)*	Vulnerable, migratory, marine	Forages in the region from May to November
Campbell albatross *(Thalassarche impavida)*	Vulnerable, migratory, marine	Forages in the region from June to August
Indian yellow-nosed albatross *(Thalassarche carteri)*	Vulnerable, migratory, marine	Forages in the region from May to November
Wandering albatross *(Diomedea exulans)*	Vulnerable, migratory, marine	Forages in the region from July to November

Species	Listing status	Breeding season and habits
White-capped albatross *(Thalassarche steadi)*	Vulnerable, migratory, marine	Forages in the region May to November
Boobies		
Masked booby *(Sula dactylatra)*	Migratory, marine	Breeds in the region year-round

The Temperate East Marine Region supports diverse seabird species, with areas such as the Lord Howe and Norfolk Island groups recognised both nationally and internationally as significant breeding sites (Dutson et al. 2009). The East Australian Current and the Tasman Front drive biological productivity, which offers key foraging opportunities for both resident and migratory species (DEWHA 2009).

The following advice relates only to those species listed in Table S2.6 which have known biologically important areas in the region. There is limited information on those species that may infrequently occur in the region. Please refer to the conservation values report card—seabirds for a complete list of seabirds and additional information (**www.environment.gov.au/marineplans/temperate-east**).

No specific advice is provided for birds that fly over but do not breed or feed within the Commonwealth marine area of the Temperate East Marine Region. A complete list of birds that are known to overfly the Temperate East Marine Region is provided in the conservation values report card—seabirds and migratory shorebirds.

Most actions would have low risk of significant impact on those birds listed as threatened and/or migratory which only fly over the region.

Key considerations in relation to significant impacts on 20 species of seabird in the Temperate East Marine Region

Population status and ecological significance

The **common noddy** is listed as migratory and marine. The species breeds on Lord Howe and Norfolk Islands, as well as beyond the region (e.g. Great Barrier Reef and Coral Sea) (Higgins & Davies 1996). There are estimated to be 2000 breeding pairs on islands adjacent to the Temperate East Marine Region (Higgins & Davies 1996).

The **flesh-footed shearwater** is listed as migratory and marine. The species breeds on Lord Howe Island and, in 2002–2003, there were an estimated 17 462 breeding pairs on the island (DSEWPaC 2011c). The species forages in the Tasman Sea, extending west from Lord Howe Island to waters in south-eastern Queensland (McKean & Hindwood 1965) and south-eastern Tasmania (Marchant & Higgins 1990).

The **short-tailed shearwater** is listed as migratory and marine. The species breeds on islands off the New South Wales coast, including Montague, Tollgate, Lion, Cabbage, Broughton, Little Broughton, Muttonbird, Boondelbah, Martin, Big, Bowen, Brush and Grasshopper islands. This species migrates to the northern hemisphere during the austral winter (Marchant & Higgins 1990). The global population of short-tailed shearwater is estimated to be 23 million individuals (Birdlife International 2011c).

The **sooty shearwater** is listed as migratory and marine. The species breeds on islands off the New South Wales Coast, including Montague, Tollgate, Lion, Cabbage, Broughton, Little Broughton, Muttonbird, Boondelbah, Martin, Big, Bowen, Brush and Grasshopper islands (Marchant & Higgins 1990). There were estimated to be 250 breeding pairs in New South Wales in 1979 (Lane & White 1983). This species migrates to the northern Pacific Ocean during the non-breeding (austral winter) season (BirdLife International 2011d; Brooke 2004).

The **wedge-tailed shearwater** is listed as migratory and marine. The species breeds on islands in the Lord Howe Island group, Norfolk Island group, off the New South Wales and Queensland coasts, and beyond the region (e.g. the Coral Sea) (Marchant & Higgins 1990). There is no information on breeding populations in the region.

The **black petrel** is listed as migratory and marine. The species breeds in New Zealand and there are estimated to be 1750 breeding pairs. The species forages in the Tasman Sea (ACAP 2009e).

Gould's petrel is listed as endangered and migratory. The species breeds at four locations in New South Wales: Cabbage Tree Island (1000 breeding pairs), Boodelbah Island (35 breeding pairs), Broughton Island and Little Broughton Island (Garnett, Szabo & Dutson 2011; DSEWPaC 2011a). The Australian birds are considered to be an endemic subspecies,

Pterodroma leucoptera leucoptera (Garnett, Szabo & Dutson 2011). The species disperses throughout the Tasman Sea and eastern Pacific Ocean (BirdLife International 2011a).

The **Kermadec petrel** is listed as vulnerable and marine. The species breeds on Balls Pyramid and Phillip Island and there are estimated to be 40 breeding birds on these islands (Garnett & Crowley 2000). The species forages in the Tasman Sea.

The **providence petrel** is listed as migratory and marine. The species breeds on Lord Howe Island (32 000 breeding pairs) and Phillip Island (20 individuals). The species forages in the western Tasman Sea (Birdlife International 2011b).

The **white-bellied storm-petrel** is listed as vulnerable and marine. The species breeds on Roach Island (around 1000 breeding pairs), Ball's Pyramid, Muttonbird Island and possibly Blackburn Island in the Lord Howe Island group (Garnett, Szabo & Dutson 2011; DSEWPaC 2011b). The Australian birds are considered to be a subspecies, *Fregetta grallaria grallaria* (Garnett, Szabo & Dutson 2011). The species is highly pelagic, foraging in the Tasman and Coral Seas, and rarely approaches land except near breeding colonies (Garnett, Szabo & Dutson 2011; Marchant & Higgins 1990).

Wilson's storm-petrel is listed as migratory and marine. The species breeds in Australian territory (Macquarie Island, Heard Island) and there are estimated to be 10 000 breeding birds on Australia's subantarctic islands (Garnett & Crowley 2000). The species migration path appears to follow the edge of the continental shelf until approximately the New South Wales–Queensland border and then turns eastwards (Marchant & Higgins 1990).

The **northern giant-petrel** is listed as vulnerable, migratory and marine. The species breeds in Australian territory (Macquarie Island) and there are estimated to be 1793 breeding pairs on Macquarie Island (ACAP 2010c). The species forages in the Tasman Sea.

The **southern giant-petrel** is listed as endangered, migratory and marine. The species breeds in Australian territory (Heard Island and McDonald Island, Macquarie Island) and there are estimated to be 5625 breeding pairs on Australia's subantarctic islands (ACAP 2010b). The species forages in the Tasman Sea.

The **antipodean albatross** is listed as vulnerable, migratory and marine. The species breeds in New Zealand and there are estimated to be 11 557 breeding pairs. The antipodean albatross forages in the Tasman Sea (ACAP 2009a).

The **black-browed albatross** is listed as vulnerable, migratory and marine. The species breeds in Australian territory (Heard Island and McDonald Island, Macquarie Island) and there are estimated to be 787 breeding pairs on Australia's subantarctic islands (ACAP 2010a). The black-browed albatross forages over the New South Wales shelf and generally not north of the New South Wales–Queensland border.

The **Campbell albatross** is listed as vulnerable, migratory and marine. The species breeds in New Zealand and there are estimated to be 21 000 breeding pairs. During winter, adults can be found widely dispersed in the Tasman Sea (ACAP 2009b).

The **Indian yellow-nosed albatross** is listed as vulnerable, migratory and marine. The species breeds in France, South Africa and New Zealand (a single pair has been recorded on Chatham Island), and there are estimated to be 36 500 breeding pairs globally. The species forages in the Tasman Sea (ACAP 2009c).

The **wandering albatross** is listed as vulnerable, migratory and marine. The species breeds in Australian territory (Macquarie Island) and there are estimated to be 5–10 breeding pairs on Macquarie Island (ACAP 2009d). The wandering albatross forages in the Tasman Sea.

The **white-capped albatross** is listed as vulnerable, migratory and marine. The species breeds in New Zealand and there are estimated to be 97 111 breeding pairs. The species forages in the Tasman Sea (ACAP 2011).

The **masked booby** is listed as migratory and marine. The species breeds on islands in the Lord Howe Island and Norfolk Island groups, as well as beyond the region (e.g. Great Barrier Reef and Coral Sea) (Marchant & Higgins 1990). There are estimated to be 400 breeding pairs on islands adjacent to the Temperate East Marine Region (Marchant & Higgins 1990).

As a group, seabirds consume large amounts of marine resources and therefore play an important functional role in marine ecosystems. Examples of their role include nutrient transfer from pelagic and offshore regions to islands, reefs and coasts, dispersal of seeds and movement of organic matter through the soil layers, particularly by burrow-nesting species (Congdon et al. 2007).

For the purpose of determining the significance of impacts of proposed actions on the 20 species[22] listed above, note that:

- Gould's petrel and the southern giant-petrel are listed as endangered under the EPBC Act. It is known that populations of these species occur in and adjacent to the region.

The following species are listed as vulnerable under the EPBC Act: Kermadec petrel, white-bellied storm-petrel, northern giant-petrel, Antipodean albatross, black-browed albatross, Campbell albatross, Indian yellow-nosed albatross, wandering albatross and white-capped albatross. It should be assumed that populations of these species in and adjacent to the Temperate East Marine Region are important populations of the species.

The following species are listed as migratory under the EPBC Act: common noddy, flesh-footed shearwater, short-tailed shearwater, sooty shearwater, wedge-tailed shearwater, black petrel, providence petrel, Wilson's storm-petrel and masked booby. It should be assumed that important habitat for these species occurs in the Temperate East Marine Region.

Species distribution and biologically important areas

The 20 species listed in Table S2.6 are known to either breed and/or forage in the region. In general, the albatross and petrel species only forage, feeding in offshore waters, mainly along the edge of the continental shelf. The shearwaters, boobies, terns, noddies and some smaller petrels breed on islands in and adjacent to the region, including islands in the Great Barrier Reef, Lord Howe and Norfolk Island groups and smaller islands off New South Wales.

22 Definitions of 'important population' and 'ecologically significant population' are provided in Section 1 of this schedule and are consistent with EPBC Act Policy Statement 1.1: Significant Impact Guidelines—Matters of National Environmental Significance. In accordance with Policy Statement 1.1, for threatened species listed as vulnerable, such as the antipodean albatross, consideration should be given to whether an important population occurs in the area where the action is proposed; for listed migratory species, consideration should be given to whether an ecologically significant proportion of a population may be impacted.

Biologically important areas have been identified for all 20 species and include:

- breeding areas (encompasses breeding sites and areas where the species is likely to forage to provision young)
- foraging areas
- migration pathways.

Further information on these areas is found in the Temperate East Conservation Values Atlas (**www.environment.gov.au/cva**).

Nature of the proposed action

The conservation values report card—seabirds provides an overview of the vulnerabilities and pressures on protected seabirds in the Temperate East Marine Region. Anthropogenic activities in coastal environments and offshore have the potential to significantly impact on seabirds.

Disturbance of colonies by invasive species, particularly during the breeding season, can reduce breeding success or cause direct mortality. **All seabird species** that breed in the region (see Table S2.6) are vulnerable to pest species, such as rats, rabbits and ants (e.g. Argentine ant, African big-headed ant).

Pressures *of potential concern* on **all seabird species** in the region include:

- climate change (changes in sea temperature and oceanography, ocean acidification)
- oil and chemical pollution/contaminants associated with shipping
- marine debris from a range of sources
- human presence at sensitive sites (e.g. breeding colonies).

Pressures *of potential concern* on specific species occurring in the region include:

- light pollution associated with land-based activities (shearwater and petrel species)
- bycatch from commercial fishing activities (foraging seabirds, particularly the larger species, such as the flesh-footed shearwater, short-tailed shearwater, sooty shearwater, wedge-tailed shearwater, black petrel, northern giant-petrel, southern giant-petrel, Antipodean albatross, black-browed albatross, Campbell albatross, Indian yellow-nosed albatross, wandering albatross and white-capped albatross)
- bycatch associated with recreational and charter fishing (flesh-footed shearwater)

People planning to undertake actions in biologically important areas for seabirds used for breeding, during breeding season, should carefully consider the potential for their actions to have a significant impact on the species. The risk of actions proposed outside 'breeding area' biologically important areas to have a significant impact on the species is likely to be significantly lower. For biologically important areas used for foraging, the potential for significant impact is not as high however actions undertaken within these areas during times when the species are present do carry a higher risk than actions undertaken outside these areas.

In addition to this general advice, actions with a real chance or possibility of resulting in the establishment of harmful invasive species into the biologically important areas of Gould's petrel (e.g. tourism development) have a **very high risk** of a significant impact on that species.

Actions with a real chance or possibility of resulting in the establishment of harmful invasive species in biologically important areas for all other seabird species in the region have a **high risk** of a significant impact on those species (e.g. tourism development).

The following actions have a **high risk** of a significant impact on all seabird species in the region:

- actions with a real chance or possibility of introducing a new source from which chemical contamination has a reasonable potential of arising in biologically important areas (e.g. construction of ports or expansion in port facilities leading to greater shipping traffic)
- actions with a real chance or possibility of increasing disturbances at breeding colonies (e.g. tourism, research), potentially disrupting the breeding cycle of an important population (of a threatened species) or ecologically significant proportion of the population (such as a non-breeding aggregation of a migratory species).

The following actions have a **high risk** of a significant impact on shearwaters (flesh-footed shearwater, short-tailed shearwater, sooty shearwater, wedge-tailed shearwater) and petrels (black petrel, Gould's petrel, Kermadec petrel, providence petrel, white-bellied storm-petrel, Wilson's storm-petrel, northern giant-petrel and southern giant-petrel):

- actions with a real chance or possibility of increasing lighting from land-based activities (e.g. construction of ports or expansion in port facilities; lighthouses and buildings at or around breeding colonies).

Actions that have a real chance or possibility of introducing marine debris within biologically important areas of the 20 species of seabirds have a **risk** of significant impact on these species.

Actions that introduce a new source from which a severe oil spill has a reasonable potential of arising in biologically important areas have a **risk** of significant impact on all seabird species (e.g. increased shipping).

Advice for preparing a referral with respect to impacts on 20 species of seabirds of national environmental significance in the Temperate East Marine Region

A referral of proposed action form is available electronically at **www.environment.gov.au/epbc/index.html** and can also be obtained in hard copy by telephoning 1800 803 772. It includes detailed instructions about the type of information that is required in referring a proposed action for consideration.

In addition to the instructions included in the referral of proposed action form, if an action is referred because of the risk of significant impact on any of the 20 species of seabird discussed in this schedule, consideration of the following matters is recommended:

- If the action is proposed within a biologically important area classified as a breeding area (including breeding colonies and/or foraging areas that are likely to incorporate chick provisioning), information about alternative locations for the proposed action that would be outside the area and/or why the action is unlikely to have a significant impact or why any significant impact can be reduced to a level that is acceptable should be considered.
- Referrals should include information on how it is proposed that the likelihood of any significant impacts will be mitigated, considering the advice provided above on likely significant impacts to any seabirds. It is recommended that independent scientific assessments of any intended mitigation measures be sought before submitting a referral and that any such assessment is included in the referral.
- Referrals should be supported by scientifically credible information that places the proposal in the context of the advice on existing pressures on seabirds and the particular life history characteristics of the species. The conservation values report card—seabirds provides information on the current understanding of the range of pressures on seabirds addressed in this regional advice.

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Schedule 2.5
Sharks of the Temperate East Marine Region

Six species of shark listed under the EPBC Act are known to occur in the Temperate East Marine Region. In addition to these listed species, two sharks occurring in the region have been nominated for listing under the EPBC Act, Harrison's dogfish and the southern dogfish.

Important breeding, feeding and aggregation areas for sharks are found throughout and adjacent to the Temperate East Marine Region. Grey nurse sharks are found on the continental shelf, occasionally venturing off the shelf to aggregate around inshore rocky reefs, islands or in rocky caves. Pelagic species such as the white, whale, mako (shortfin and longfin) and porbeagle sharks are wide ranging and diverse in their ecological niches. In general, sharks in the region predominantly feed on bony fishes and cephalopods, although some species feed on other sharks, rays, crustaceans, birds and marine mammals. Whale sharks are plankton feeders.

The following advice relates only to the grey nurse shark and the white shark for which biologically important area information is available (Table S2.7). Please refer to the conservation values report card—sharks for a complete list of sharks and additional information (**www.environment.gov.au/marineplans/temperate-east**).

Table S2.7: Sharks listed as threatened and/or migratory with biologically important areas identified within the Temperate East Marine Region

Species	Listing status
Grey nurse shark [east coast population] (*Carcharias taurus*)	Critically endangered
White shark (*Carcharodon carcharias*)	Vulnerable, migratory

Key considerations in relation to significant impacts on sharks species in the Temperate East Marine Region

Population status and ecological significance

The **grey nurse shark** is listed as two separate populations under the EPBC Act. The west coast population is listed as vulnerable, while the east coast population is listed as critically endangered. The east coast population is estimated at 1365 individuals, with 95 per cent confidence that the population is between 1146 and 1662 individuals (Cardno Ecology Lab 2010).

The **white shark** is listed as vulnerable and migratory under the EPBC Act. There are currently no estimates of the white shark population in Australian waters and no reliable measures with which to compare changes in population status over time. This is partly due to the scarcity of white sharks, but also the difficulty in distinguishing population changes from the high rates of variability in numbers observed in any one site or region between years (Bruce 2008).

Top-order predators—such as grey nurse and white sharks—are a key functional species group, influencing abundance, recruitment, species composition, diversity and behaviour of prey species. Their removal can have a cascading effect on all components of a food web (Baum & Worm 2009; Heithaus 2001; Ings et al. 2009, cited in Ceccarelli & Ayling 2010).

For the purposes of determining the significance of impacts of proposed actions on the two species[23] listed above, note that:

- the grey nurse shark (east coast population) is critically endangered under the EPBC Act. It is known that populations of this species occur in and adjacent to the Temperate East Marine Region
- the white shark is listed as vulnerable under the EPBC Act. It should be assumed that populations of this species in and adjacent to the Temperate East Marine Region are important populations of the species.

23 Definitions of 'important population' and 'ecologically significant population' are provided in Section 1 of this schedule and are consistent with EPBC Act Policy Statement 1.1: Significant Impact Guidelines—Matters of National Environmental Significance. In accordance with Policy Statement 1.1, for threatened species listed as vulnerable, such as the antipodean albatross, consideration should be given to whether an important population occurs in the area where the action is proposed; for listed migratory species, consideration should be given to whether an ecologically significant proportion of a population may be impacted.

Species distribution and biologically important areas

The **grey nurse shark** has a broad distribution within Australian waters, from subtropical to cool temperate waters. The east coast population, estimated at 1146–1662 individuals (Cardno Ecology Lab 2010) is found between the Capricornia coast of central Queensland and Narooma in southern New South Wales, although records from locations further north and south also exist. The species is found primarily in subtropical to cool temperate inshore waters around rocky reefs and islands, and is occasionally found in the surf zone and shallow bays. Grey nurse sharks have been recorded at varying depths to 230 metres, but are most commonly found at depths of 15–40 metres (Otway & Parker 2000). Critical habitats and key aggregation sites are adjacent to the region in New South Wales and southern Queensland state waters and there are also several sites in Commonwealth waters at the Cod Grounds and Solitary Islands. These regular aggregation sites may play an important role in pupping or mating activities.

Biologically important areas have been identified for the **grey nurse shark** in the Temperate East Marine Region and include:

- foraging areas
- aggregation areas
- seasonal breeding areas (mating or pupping).

Further information on these areas is found in the Temperate East Conservation Values Atlas (**www.environment.gov.au/cva**).

The **white shark** is widely distributed throughout temperate and subtropical regions and most frequently observed in inshore cool to warm temperate continental waters. Off eastern Australia, white sharks regularly range from central–southern Queensland southwards (Bruce et al. 2006; Last & Stevens 2009), from inshore rocky reefs, surf beaches and shallow coastal bays, to outer continental shelf and slope areas. They also make open ocean excursions and can cross ocean basins. Both adults and juveniles have been recorded diving to depths of 1000 metres, but most white shark movements and activities in Australian waters occur between the coast and the 100-metre depth contour (Bruce & Bradford 2008; Bruce et al. 2006). White sharks are often found in regions with high prey density and in sites where prey species aggregate. They do not live in one specific area or territory, but travel great distances between sites of temporary residency. There is also mounting evidence that they have common migratory routes between some areas of temporary residency in Australian waters (Bruce & Bradford 2008; Bruce et al. 2006). White shark movement data suggest a northerly movement along the east coast during autumn and winter, and a return to southern Australia by early summer (Bruce et al. 2006).

Biologically important areas have been identified for the **white shark** in the Temperate East Marine Region and include:

- a juvenile aggregation area off Port Stephens between September and mid-January (extending from the shoreline to the 120-metre depth contour and approximately 10–15 kilometres offshore) (Bruce & Bradford 2008)
- the distribution generally between the 120 and 1000-metre depth contours during autumn, winter and spring.

The location of pupping grounds is not known (Bruce 2008). Further information on these areas is found in the Temperate East Conservation Values Atlas (**www.environment.gov.au/cva**).

Actions undertaken offshore of the continental shelf and not affecting waters over the continental shelf in the Temperate East Marine Region have a **low risk** of significant impact on the grey nurse shark and white shark.

Nature of the proposed action

The conservation values report card—sharks provides an overview of the vulnerabilities and pressures on protected sharks in the Temperate East Marine Region.

Like most sharks, **grey nurse and white sharks** are characterised by a life history (late age at maturity, slow growth rate, low fecundity, longevity, low rate of natural mortality), which restricts productivity. They therefore have a limited capacity to withstand human-induced pressures and to recover from population depletion as a result of these pressures.

As coastal environments appear to be a preferred habitat for the grey nurse and white sharks, both species could be adversely affected by anthropogenic activities in these habitats, particularly by types of actions that have the potential to result in habitat degradation.

Pressures *of concern* for the grey nurse shark include bycatch from commercial, recreational and charter fishing activities. Pressures *of potential concern* include human presence at sensitive sites and changes in sea temperature and oceanography associated with climate change.

Pressures *of concern* for the white shark include bycatch from recreational and charter fishing activities. Pressures *of potential concern* include bycatch associated with commercial fishing activities and illegal, unregulated and unreported fishing, extraction of living resources associated with non-domestic commercial fisheries and climate change (changes in sea temperature and oceanography).

People planning to undertake actions in biologically important areas for grey nurse and white sharks should carefully consider the potential for their action to have a significant impact on these species. For actions proposed outside biologically important areas the risk of significant impact on these species is likely to be lower.

Actions which have a real chance or possibility of increasing human disturbance in biologically important areas of the grey nurse shark and have a **high risk** of significant impact on this species.

Advice for preparing a referral with respect to impacts on grey nurse and white sharks in the Temperate East Marine Region

A referral of proposed action form is available electronically at **www.environment.gov.au/epbc/index.html** and can also be obtained in hard copy by telephoning 1800 803 772. It includes detailed instructions about the type of information required in referring a proposed action for consideration.

In addition to the instructions included in the referral of proposed action form, if an action is referred because of the risk of significant impact on either of the two species of shark considered here, consideration of the following matters is recommended:

- If the action is proposed within a biologically important area classified as a breeding area (including mating, pupping and aggregation areas), information about alternative locations for the proposed action that would be outside the area and/or why the action is unlikely to have a significant impact or why any significant impact can be reduced to a level that is acceptable should be considered.
- Referrals should include information on how it is proposed that the likelihood of any significant impacts will be mitigated, considering the advice provided above on likely significant impacts to sharks. It is recommended that independent scientific assessments of any intended mitigation measures be sought before submitting a referral and that any such assessment is included in the referral.
- Referrals should be supported by scientifically credible information that places the proposal in the context of the advice on existing pressures on sharks and the particular life history characteristics of the species. The conservation values report card—sharks provides information on the current understanding of the range of pressures on sharks addressed in this regional advice.

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Table A: Listed marine and cetacean species known to occur in the Temperate East Marine Region

Species (common/scientific name)	Conservation status[24]
Bony fishes	
Big-bellied or pot-bellied seahorse *(Hippocampus abdominalis)*	Marine
Bullneck seahorse *(Hippocampus minotaur)*	Marine
Duncker's pipehorse *(Solegnathus dunckeri)*	Marine
Hardwick's pipehorse *(Solegnathus hardwickii)*	Marine
Kellogg's seahorse *(Hippocampus kelloggi)*	Marine
Sad seahorse *(Hippocampus tristis)*	Marine
Weedy seadragon *(Phyllopteryx taeniolatus)*	Marine
Cetaceans	
Dolphins	
Bottlenose dolphin *(Tursiops truncatus)*	Cetacean
Common dolphin *(Delphinus delphis)*	Cetacean
Fraser's dolphin *(Lagenodelphis hosei)*	Cetacean
Indian Ocean bottlenose dolphin *(Tursiops aduncus)*	Cetacean
Pantropical spotted dolphin *(Stenella attenuate)*	Cetacean

Species (common/scientific name)	Conservation status[24]
Risso's dolphin *(Grampus griseus)*	Cetacean
Rough-toothed dolphin *(Steno bredanensis)*	Cetacean
Southern right whale dolphin *(Lissodelphis peronii)*	Cetacean
Spinner dolphin *(Stenella longirostris)*	Cetacean
Striped dolphin *(Stenella coeruleoalba)*	Cetacean
Other cetaceans	
Andrew's beaked whale *(Mesoplodon bowdoini)*	Cetacean
Arnoux's beaked whale *(Berardius arnuxii)*	Cetacean
Blainville's beaked whale *(Mesoplodon densirostris)*	Cetacean
Cuvier's beaked whale *(Ziphius cavirostris)*	Cetacean
Dwarf minke whale *(Balaenoptera acutorostrata)*	Cetacean
Dwarf sperm whale *(Kogia simus)*	Cetacean
False killer whale *(Pseudorca crassidens)*	Cetacean
Ginkgo-toothed beaked whale *(Mesoplodon ginkgodens)*	Cetacean
Gray's beaked whale, scamperdown whale *(Mesoplodon grayi)*	Cetacean

Species (common/scientific name)	Conservation status[24]
Hector's beaked whale *(Mesoplodon hectori)*	Cetacean
Long-finned pilot whale *(Globicephala melas)*	Cetacean
Melon-headed whale *(Peponocephala electra)*	Cetacean
Pygmy killer whale *(Feresa attenuate)*	Cetacean
Pygmy sperm whale *(Kogia breviceps)*	Cetacean
Shepherd's beaked whale or Tasman beaked whale *(Tasmacetus shepherdi)*	Cetacean
Short-finned pilot whale *(Globicephala macrorhynchus)*	Cetacean
Southern bottlenose whale *(Hyperoodon planifrons)*	Cetacean
Strap-toothed beaked whale, strap-toothed whale, Layard's beaked whale *(Mesoplodon layardii)*	Cetacean
True's beaked whale *(Mesoplodon mirus)*	Cetacean
Marine Reptiles	
Sea snakes	
Beaked seasnake *(Enhydrina schistosa)*	Marine
Blue-lipped sea krait *(Laticauda laticaudata)*	Marine
Colubrine sea krait, banded sea krait or yellow-lipped sea krait *(Laticauda colubrine)*	Marine

Species (common/scientific name)	Conservation status[24]
Dubois' seasnake *(Aipysurus duboisii)*	Marine
Elegant seasnake *(Hydrophis elegans)*	Marine
Horned seasnake *(Acalyptophis peronii)*	Marine
Laboute's seasnake *(Hydrophis laboutei)*	Marine
Little file snake *(Acrochordus granulatus)*	Marine
Marbled or spine-tailed seasnake *(Aipysurus eydouxii)*	Marine
Olive-headed seasnake *(Hydrophis major)*	Marine
Olive seasnake *(Aipysurus laevis)*	Marine
Plain-banded seasnake *(Hydrophis vorisi)*	Marine
Small-headed seasnake *(Hydrophis macdowelli)*	Marine
Spectacled seasnake *(Hydrophis kingii)*	Marine
Spotted seasnake *(Hydrophis ornatus)*	Marine
Stokes' seasnake *(Astrotia stokesii)*	Marine
Turtle-headed seasnake *(Emydocephalus annulatus)*	Marine
White-bellied mangrove snake *(Fordonia leucobalia)*	Marine

Species (common/scientific name)	Conservation status[24]
Yellow seasnake *(Hydrophis spiralis)*	Marine
Yellow-bellied seasnake *(Pelamis platurus)*	Marine
Seabirds	
Terns and noddies	
White tern *(Gygis alba)*	Marine
Crested tern *(Thalasseus bergii)*	Marine
Sooty tern *(Onychoprion fuscata)*	Marine
Grey ternlet *(Procelsterna cerulea)*	Marine
Black noddy *(Anous minutus)*	Marine
Shearwaters	
Little shearwater *(Puffinus assimilis)*	Marine
Petrels and storm-petrels	
Black-winged petrel *(Pterodroma nigripennis)*	Marine
Great-winged petrel *(Pterodroma macroptera)*	Marine
White-faced storm-petrel *(Pelagodroma marina)*	Marine
White-necked petrel *(Pterodroma cervicalis)*	Marine

Species (common/scientific name)	Conservation status[24]
Penguins	
Little penguin *(Eudyptula minor)*	Marine
Tropicbirds	
Red-tailed tropicbird *(Phaethon rubricauda)*	Marine

24 Species listed as threatened and/or migratory under the EPBC Act are not listed in this table

MAP DATA SOURCES

DSEWPaC (2011): Australia, World Heritage Areas

DSEWPaC (2011): Key Ecological Features in the Temperate East Marine Planning Region

DSEWPaC (2011): Ramsar Wetlands of Australia

DSEWPaC (2010): Historic Shipwrecks Register

DSEWPaC (2010): Collaborative Australian Protected Areas Database (CAPAD)

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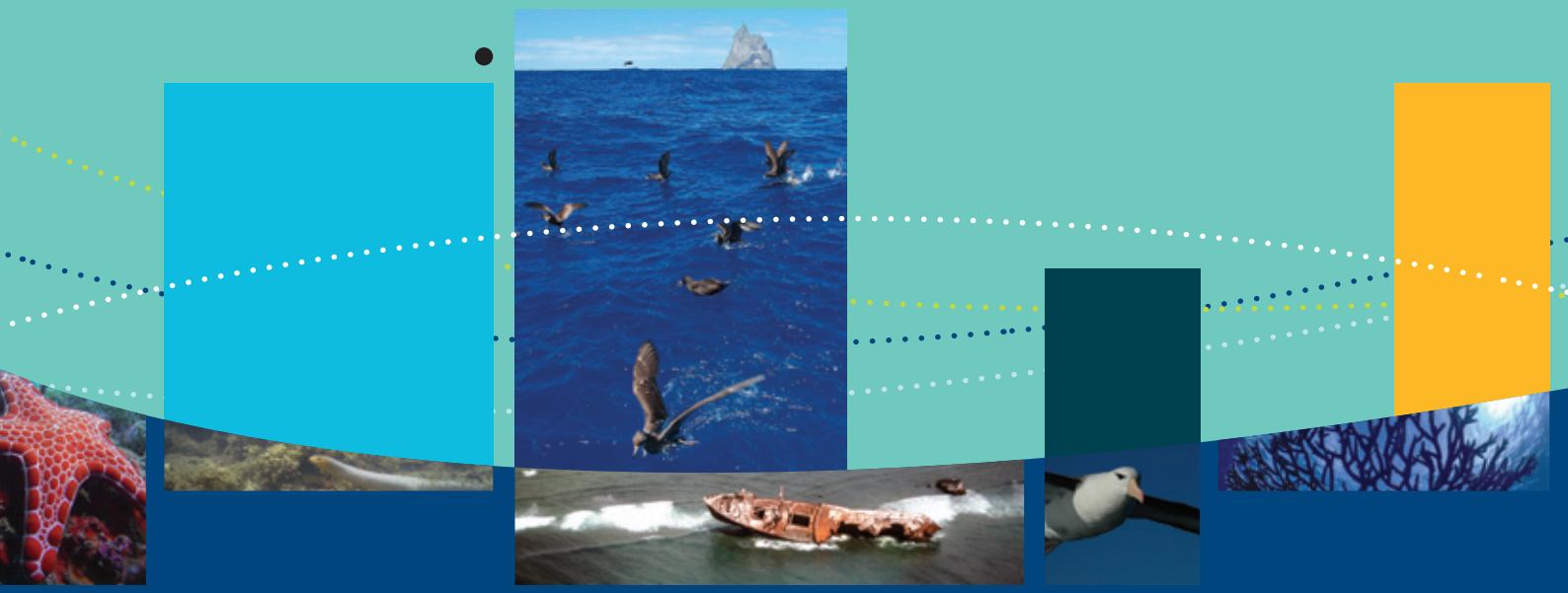

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