Oceans and estuaries

Australia's coastal and marine regions support a large range of species, many of them found only in Australian waters. These regions are also important to Australian society and the economy.

Most Australians live near the coast. There are economic benefits from marine industries such as shipping, tourism, fisheries, and offshore oil and gas. Many of the ways we use our oceans, beaches and estuaries can affect the quality of the ocean's water and coastal habitat and the diversity of life these environments support.

There are very few nationwide time series data suitable for assessing the progress of Australia's marine environments. At some time in the future, perhaps, better progress indicators might become available. For the time being, this commentary:

- recognises the importance of the oceans, coasts and estuaries;
- describes some of the important influences on the health of our seas; and
- presents some contextual data on aspects of the marine and coastal environment that are relevant to progress.

However, it does not attempt to assess overall progress among Australia's marine ecosystems.

Australia has one of the longest coastlines of any country — a length of 59,736 kilometres, including islands in its jurisdiction. Australia's Exclusive Economic Zone is among the largest of any country in the world. This area surrounding Australia's coast for which Australia has exclusive responsibilities and to which it has exclusive rights, covers 10 million square kilometres — an area considerably larger than that of the Australian continent (7.7 million square kilometres). It is not surprising then, that beaches, estuaries and wider marine ecosystems play an important role in Australian life.

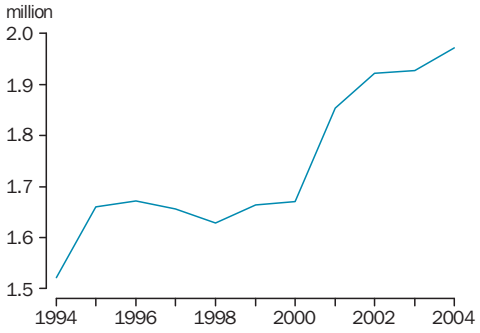
Australia's oceans are diverse, ranging from tropical seas, through temperate to polar waters; and from shallow coastal waters to ocean trenches that can be six kilometres deep. This diversity is reflected in a vast array of marine life. More than 4,000 species of fish live in Australian waters, and about one-quarter of them are found nowhere else in the world. Australian waters provide a home to at least 43 species of whales and dolphins and 110 species of seabirds. Australia has the world's largest seagrass bed (in Shark Bay, Western Australia), the largest area of coral reefs and highest diversity of mangrove species, (41 of the 68 mangrove species in the world).[1]

Factors influencing change

There are substantial pressures on Australia's marine environment. Over 80% of the population live within 50 kms of the coast,[2] and 97% of the volume of Australian trade is carried by ships.[3] In 2003–04 Australian fisheries produced about 267,000 tonnes of fish.[4]

Over fishing places strains on a number of species, and may also affect other species through disruptions to the food chain or accidental catching of other fish, birds, mammals, and turtles. The release of waste water, other nutrients and sediments can also disrupt marine ecosystems, while the introduction of foreign species into Australian waters also has the potential to cause great harm.

Visitors to the Great Barrier Reef(a)



(a) Figures based on Environment Management Charge (EMC) returns.

Source: Great Barrier Reef Marine Park Authority, GBRMP Reef Wide Visitor Days.

Our interest and enjoyment of marine areas can also place pressure on them and create challenges for their management. For example, visitor numbers to the Great Barrier Reef have been increasing over the past decade. In 1994 there were around 1.5 million visitors aboard tourism vessels in the Great Barrier Reef while in 2004, there were a total of 1.9 million visitors on such vessels.[5]

Coastal and marine management

Australia's coastline has significant environmental, social and economic value. Since European settlement, the coast and beaches have been central to our culture and lifestyle, and provide for many recreational opportunities. Many of us live on or near the coast. Economically, the coast is valued for activities such as tourism, mining (for example sand and gravel), and aquaculture. The environmental value of the coastal landscape includes scenic amenity, habitat for native plants and animals, and the physical functions of beach dunes and foreshore in providing a dissipative barrier to erosive forces.

Land on the coast is a valuable and limited resource with a continuing demand for residential, resort and marina development. Some coastal management plans aim to consolidate existing urban development rather than create new extensive urban developments.[6]

Developments on the coast can affect the coastal landscape. Our understanding of coastal processes has improved greatly over the past 20 years. For example we know that the natural movement of sand along the coast is altered by building on sand dunes, building structures such as seawalls along

Marine and coastal World Heritage areas

Half of Australia's 16 World Heritage areas have a marine or coastal feature. These are: Fraser Island, Kakadu National Park, Lord Howe Island, Heard Island and McDonald Island, Shark Bay, Great Barrier Reef World Heritage Area, Macquarie Island, and the Wet Tropics.

World Heritage status can result in strengthened management and improved interpretation and visitor facilities. It can also help cultivate local and national pride in a property and develop feelings of national responsibility to protect the area. For each Australian World Heritage area, management plans have been produced or are planned as a part of Australia's obligations under the World Heritage Convention.[7]

Increased tourist visitation due to World Heritage status can bring economic benefits and increased employment to local communities.[7] However, a higher level of tourism can also place pressure on the condition of these areas which needs to be managed. As available data on visitor numbers to World Heritage Areas shows, the numbers of visitors to Fraser Island, Lord Howe Island and Great Barrier Reef World Heritage Area have been increasing.[5, 8, 9]

Fraser Island

Stretching over 120 kilometres along the south east coast of Queensland, Fraser Island (184 000 hectares) is the largest sand island in the world. Fraser Island features complex dune systems that are still evolving, and an array of dune lakes that is exceptional in its number, diversity and age. Forty perched dune lakes, half the number of such lakes in the world, can be found on the island.[10] Visitors to Fraser Island have been steadily increasing from around 235,000 visitors in 1992 to over 300,000 by 2000.[8]

Shark Bay

Shark Bay is located on the most western point of the coast of Australia and covers an area of 2.3 million hectares. The Shark Bay region is an area of major evolutionary, geological and zoological importance. For example, of the 26 species of endangered Australian mammals, four (rufous hare wallaby, banded hare wallaby, the Shark Bay mouse and the western barred bandicoot) are found only on Bernier and Dorre Islands in this area.

The Shark Bay region is also renowned for:

- Bird species with over 230 species, or 35 per cent, of Australia's bird species represented
- Diversity of amphibians and reptiles, with nearly 100 species represented, and
- Marine ecosystems including a population of about 10 000 dugong, and large populations of dolphins and turtles, and the largest seagrass bed in the world.[11]

Monkey Mia (part of the Shark Bay) famous for its dolphins receives between 80,000–100,000 visitors per year.[8]

the foreshore, and by the loss of seagrass. This can increase natural erosion rates leading to the need for beach replenishment programs. Coastal planning and management now attempt to take into account more fully these physical coastal processes and avoid development on erosion prone areas.[6,12]

Bitou bush

The management of native vegetation is a significant coastal management issue. Bitou bush is a highly competitive environmental weed which reduces the abundance and diversity of native plant communities. Bitou bush invades native coastal heathlands, grasslands, woodlands and forests. It grows quickly and forms dense stands, replacing native plants and destroying the habitat of native animals. Numerous threatened species and plant communities have been affected. Bitou bush is a problem in coastal areas in a number of states, with NSW the most affected. Bitou bush is listed as a weed of national significance.[13] NSW now has containment lines for Bitou bush and has extensive management programs in place.

Other coastal management issues include:

- management of coastal vegetation
- management of Indigenous and non-Indigenous cultural resources, and
- protection of coastal wetlands, dune systems, and significant wildlife habitat.

Estuaries

The Estuarine Condition Index was developed by the National Land and Water Resources Audit (NLWRA) to provide a snap shot of estuary health. The index assesses the condition of about 1,000 estuaries around the Australian coast. Because estuaries occur at the borders of marine and freshwater ecosystems, they are influenced by the tides and also by fresh water from the land. Thus measuring the condition of estuaries not only reports on the state of our oceans; it sheds light on how land use around the water that flows into the estuary is affecting the sea. The more modified an estuary, the greater the pressures on it; in a 2002 assessment of a large proportion (979) of Australia's estuaries, the NLWRA found their condition was:

- near-pristine – 50%
- largely unmodified – 22%
- modified – 19%
- extensively modified – 9%.[14]

Fish and fishing

Australia's major fisheries target prized species such as lobsters, prawns, abalone and tuna, which, despite modest production tonnage in world terms, are subject to high fishing pressure.[15]

In 2004, for fish stocks managed by the Australian Commonwealth, 17 of the 74 principal species that are classified were overfished or subject to overfishing. This compares with 3 species a decade earlier. Overfished species are those for which the current stock is below a reference point set by scientists and managers.[16] Overfishing occurs when the fishing pressure is too heavy to allow the fish

population to replenish itself, or when too many small fish are taken, and therefore too few grow to a size that provides the largest yield from that fishery.

Of the 17 species that are classified as overfished or subject to overfishing, the Eastern gemfish and Southern bluefin tuna have been classified as overfished for the past two decades. The School shark has been classified as overfished for the past decade. The Pink ling and Pacific ocean bigeye tuna were newly classified as subject to overfishing in 2004.

In contrast, some progress has been made in reducing overfishing for some species. In the Northern Prawn Fishery, stocks of Grooved and Brown tiger prawns have recovered in recent years to the extent that these species are no longer classified as overfished.

Comparable information for overfished species at a state level is not available, but some state managed fisheries are also subject to heavy fishing pressure.

Curbing excessive fishing and rebuilding overfished stocks are fundamental to the long-term viability of fisheries. In 2005, the Commonwealth Government announced plans to buy back about up to 600 Commonwealth commercial fishing licences in an effort to ease overfishing pressures.[17] The status of most of the species caught incidentally to primary species (bycatch) is uncertain. The introduction of bycatch action plans for threatened or endangered species (mandatory for fisheries managed by the Australian government) has increased their protection from fishing. For example, Northern Prawn Fishery vessels must use turtle-excluder and bycatch-reduction devices. The use of these devices has resulted in the turtle bycatch decreasing from around 5,500 per year to a reported 120 per year since 2000.[17]

Introduced species

Introduced organisms can place native species at risk. More than 250 species are known to have been introduced into Australian waters. Most are not believed to pose a large threat, but a few have substantially altered habitats and ecosystems, for example the crown of thorns starfish.[18]

The accidental introduction of organisms can occur via ballast water. When a ship's hold is empty, ballast water is taken on board to balance the ship. When the ship next loads cargo at port, the ballast water may be discharged along with any organisms living in it. In 2001, Australia introduced new regulations making it mandatory for vessels entering Australian waters to undertake some form of treatment of ballast water before discharging it in any Australian port.

Coral reefs

Australia has two major coral reefs: the Great Barrier Reef in Queensland, which at 2,500 km long is the largest coral reef system in the world, and Ningaloo Reef in Western Australia which stretches for 230 km. There are several other coral reefs in Australian waters. These coral reef systems are biologically diverse marine environments, and provide commercial benefits to Australia, mainly through tourism and fishing.

Coral reefs are potentially at risk from a range of natural disturbances such as cyclones and floods, and from the impacts of human activity. Severe cyclones can strip reefs of coral and other organisms. Floods cause large quantities of sediment laden freshwater to be discharged, which can cause the death of coral. However, in the absence of further severe disturbance, coral reefs can recover from these events.

The amounts of nutrients, sediments, and other pollutants flowing to the Great Barrier Reef have increased greatly since European settlement. Low salinity, high nutrient levels and high turbidity can stress corals, and in severe cases cause death. More localised damage to coral reefs can occur from other human activities such as anchoring, diving and snorkelling, tourist facilities, pollution and shipping, and dredging at ports.[21]

Rising sea temperatures believed to be associated with climate change may place coral reefs at greater risk from coral bleaching. When coral bleaching occurs, corals become stressed and eject the brownish coloured algae that live within their tissues. The white coral skeleton is then visible and the corals appear bleached white. The corals can die if the stress is persistent or extreme.

In 1998, sea temperatures in some parts of the Great Barrier Reef were between 1 °C and 2 °C

Illegal fishing

Illegal, unreported and unregulated fishing (henceforth called illegal fishing) is considered to be one of the most serious threats to the health of the world's fisheries and oceans. Fishing on the high seas has increased over recent decades as a result of overfishing of coastal waters and in response to growing market demand for seafood products.

The increasing prevalence of illegal fishing is making it more difficult for the international community to effectively conserve and manage fisheries on the high seas. Not only does illegal fishing impact on management and overfishing but it also has broader ecosystems impacts such as the bycatch of seaturtles, seabirds and sharks in the longline fisheries for tunas and Patagonian toothfish.[19]

A recent report by the Marine Resources Assessment Group roughly estimated that the annual value of illegal fishing on the high seas could be in the vicinity of $US1.2 billion.[19]

One Australian fishery targeted by illegal fishing is the Patagonian toothfish in the Southern Ocean around Antarctica. Illegal, unregulated and unreported fishing is the biggest threat to the conservation of toothfish stocks.

Patagonian toothfish is a high value quality fish mainly sold to restaurants in Europe, the United States and Japan. High consumer demand and the consequent high prices for toothfish and other white fleshed fish not only places pressure on the fishery from legal fishinh, but also encourages illegal fishers to supply products to these markets.[20]

Whales and dolphins

In 2004 Australian waters were home to 45 species of whales and dolphins, a little over half of the world's 79 species. Five whale species are currently listed as nationally threatened: Blue Whale; Southern Right Whale; Sei Whale; Fin Whale; and the Humpback Whale.[22]

Current threats to species recovery or survival include:

- prey depletion from overfishing for both great whales and smaller whale and dolphin species;
- climate change for great whales;
- fishing interactions (bycatch and entanglement) for some coastal species of small whales and dolphins.[23]

Other activities which can impact on whales and dolphins include: noise pollution, coastal development, vessel collisions, ingestion of marine rubbish such as plastic bags, incidental catch in fishing operations or shark nets, and whale and dolphin tourism. Mesh net strandings are thought to be a significant cause of mortality for inshore dolphin species.[24]

We know little about the population size of most species of whale. In Australia there are ongoing efforts, through a number of joint university and community projects, to record whale sightings and the abundance of different species of whale. An annual Humpback Whale count has been conducted from Cape Byron since 1978, becoming a more substantial whale research project in 1995.[25] Dwarf minke whale management in the Great Barrier Reef is the focus of another project, which reported its most successful year in 2004, with between 216–238 dwarf minke sightings reported in the six week study period.[26]

The *Environment Protection and Biodiversity Conservation (EPBC) Act (1999)* provides strong protection for all marine and terrestrial species including whales, dolphins and porpoises in Australian waters. The Australian Whale Sanctuary includes all Commonwealth waters from the 3 nautical mile state waters limit out to the boundary of the Exclusive Economic Zone (i.e. out to 200 nautical miles and further in some places). Within the sanctuary it is an offence to kill, injure or interfere with whales and other marine mammals, with severe penalties applying to anyone convicted of such offences.[27]

Whale-watching is a developing industry, estimated to be worth up to $29 million a year in Australia.[28] Whale watching activities range from simply watching whales from the shore to organised boat tours and 'swim with whales' activities. Whale and dolphin tourism has the potential to impact on the use of habitat, as well as critical behaviours such as reproduction, feeding, resting and group cohesion.[25] National guidelines for whale-watching and for swimming with whales activities have been developed. These guidelines aim to minimise harmful impacts, while allowing people to enjoy and learn about the animals.[29]

above average temperatures for that period. Almost 90% of inshore coral reefs surveyed were bleached, with 25% experiencing extreme bleaching.

In 2002 mass coral bleaching, the largest on record for the Great Barrier Reef, occurred. The coral bleaching event in 2002 was more severe than that of 1998 with bleaching spread across a much larger area of the Great Barrier Reef. Between 50%–90% of corals were killed by bleaching on reefs around Bowen in 2002.[21]

Water quality

In 2001, experts on the State of the Environment Committee indicated that the maintenance or restoration of water quality, particularly in coastal waters, is a critical marine environmental issue in Australia. Although they assessed that many coastal areas have excellent water quality, they also assessed that many areas do not.[30]

Poor water quality can be attributed to many sources. Sometimes land use practices far inland add nutrients to inland waters (such as land clearance or overgrazing which can enhance erosion or the use of agricultural chemicals).

Nitrogen and phosphorus are found naturally in inland and coastal waters, but in large quantities they contribute to the increase in estuarine algal blooms. Toxic algal blooms kill fish, and plants can die because of decreased sunlight. They also affect human health by making seafood unsafe to eat and water unfit for recreational purposes.

Sewage and stormwater discharged into seas releases nutrients and, sometimes, disease-causing micro-organisms, which can make water dangerous to swim in or seafood dangerous to eat. High levels of disease-causing bacteria and viruses can cause problems such as gastroenteritis, respiratory infections and hepatitis.

The improvements in the disposal and treatment of sewage at Sydney's sewage outfalls saw a reduction in levels of certain bacteria (bacteria called coliforms) between 1989–90 and 1999–2000. None of the 23 beaches tested had a coliform density above health guidelines in the summer of 1999–2000. In 1989–90, 11 had exceeded the limit.[31]

Oil spills

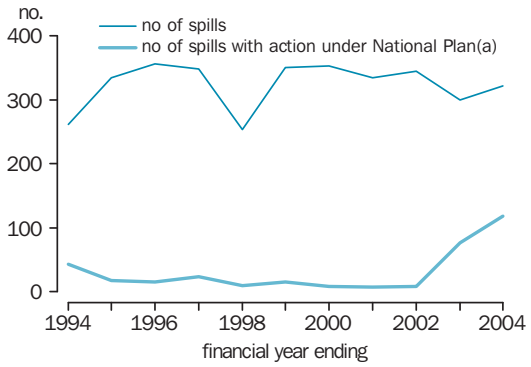
The environmental impact of oil spills depends largely on the size of the spill, the location of the accident and the prevailing weather conditions at the time: oil spills close to the coast or near areas of high conservation value are likely to cause the greatest damage.

In the decade to 2003–04 around 300 oil spills were reported each year. In 2003–04, 322 oil discharge sightings and oil spills were reported and 118 of these incidents required a response action under the National Plan arrangement.[32]

Oil spills affect marine wildlife, in particular birds and marine mammals, by coating their bodies with a thick layer of oil that sticks to fur or feathers, damaging the insulation and waterproofing properties of their feathers or fur, often resulting in hypothermia. Birds can sink or drown because of the weight of their oiled feathers.

Oil in the environment can cause problems by poisoning wildlife higher up the food chain, and can also cause a range of health problems

Number of reported oil spills



a) Criteria applied from 2003 is different to previous annual reports in that it now includes all incidents where a response was undertaken regardless of whether direct costs were claimed from the National Plan.

Source: Australian Maritime Safety Authority, National Plan Reports.[32]

including: irritation or ulceration of skin, mouth or nasal cavities; damage to and suppression of a marine mammal's immune system. It may also damage estuaries, coral reefs, seagrass and mangrove habitats which are the breeding areas of many fish and crustaceans.[33]

The effect on wildlife of one particular oil spill in Australian waters has been extensively studied. The bulk ore carrier Iron Baron ran aground on Hebe Reef pff northern Tasmania in 1995. One study of the effects on little penguins estimates that between 10,000 and 20,000 penguins were killed as a result of this oil spill.[34]

Some differences within Australia

Although the particular issues may vary from region to region, most Australian states, and the Northern Territory face similar pressures and issues with regards to ocean and coast management.

Pressure on fisheries is an issue for most Australian fisheries. That said, not all fisheries are experiencing overfishing and the numbers and specific species affected by overfishing vary with the location of the fishery. In the South-East Trawl, there are six overfished species. In the Southern Bluefin tuna fishery off South Australia, the Southern bluefin tuna is overfished. In 2004, the Heard Island and McDonald Island fisheries did not have any over-fished species.[16]

Many of the states have experienced problems such as seagrass depletion in coastal waters, and weed invasions by plant species such as Bitou bush in coastal areas. The use of beaches for recreation is popular all around Australia. However, the demand for land for development in coastal areas is more intense in the more populous states and in areas of high tourism activity.

Links to other dimensions of progress

A range of economic benefits come from our use of coastal and marine resources, through activities such as tourism, fishing, trade (shipping) and mining. In turn, these economic activities can place pressure on the condition of our marine and coastal environments. Fishing activity can impact on biodiversity by placing pressure on the stocks of fish, and contributing to the depletion of prey fish species for marine mammals and birds.

Human activities and land use patterns that increase nutrients and turbidity in inland waterways (which ultimately flow into the sea), can alter marine habitat by causing a deteoriation of water quality. This can lead to other changes in the

Seagrass and dugongs

Seagrasses are flowering plants that grow in marine or estuarine areas. Australia has the highest number of seagrass species in the world, with around 30 species. Australia has an estimated total area of around 51,000 square kilometres of seagrass.[35] The recent discovery of further deepwater seagrass beds in the Great Barrier Reef World Heritage Area indicates that our knowledge of seagrass is still incomplete.[36]

Seagrasses provide food for marine animals including green turtles and dugongs and provide habitats and nursery areas for many fish. Large scale destruction of seagrass areas could impact on the commercial viability of nearby fisheries. Seagrasses also helps trap sediment and stabilise the sea floor to avoid erosion.[35]

Although there are few accurate data, the best available estimate is that some 50% of our seagrass beds have been lost since European settlement, though patterns vary around the country. In New South Wales an estimated 50% of *Zostera* seagrass beds have been lost in recent decades; and at Cockburn Sound in Western Australia, 97% of seagrass beds have been lost.[35]

Water quality is important for the health and extent of seagrass communities. Increased turbidity, from soil erosion, is believed to be one factor behind the decline in seagrass beds. Turbidity affects light penetration, and may prevent sunlight from reaching the sea bed.[35]

Dugongs are marine mammals, that can grow to about three metres in length and weigh as much as 400 kilograms. They are the only marine mammals in Australia that feed mainly on plants. Most of the world's population of dugongs is now found in northern Australian waters between Shark Bay in Western Australia and Moreton Bay in Queensland.[37]

Dugong numbers have declined dramatically in the past 40 years in the part of the Great Barrier Reef World Heritage Area south of Cooktown. The decline in dugong numbers is thought to be caused by human-related causes such as: habitat loss or degradation; commercial mesh nets (fish nets), shark nets set for bather protection; Indigenous hunting; boat strikes; defence activities; and illegal take.[37] Government departments, community groups and industry organisations are working to minimise the number of dugong deaths from human-related causes. Actual or possible loss of seagrass feeding areas is a significant issue for the long-term survival of dugongs. Seagrass loss is thought to be a major cause of death of dugongs in Hervey Bay in 1992 following a cyclone and flood.[38]

Regional marine planning and Marine protected areas

Australia's oceans policy is designed to improve outcomes of marine management in estuaries, coastal and offshore waters. A number of initiatives are underway to provide greater protection and ensure better management of Australian oceans.

Regional marine planning is a key component of Australia's oceans policy. A regional plan has been completed for the South-East marine region, and two more plans are in progress for The Northern Planning Area and the Torres Strait.[39]

The National Representative System of Marine Protected Areas (NRSMPA) is setting up a system of marine protected areas established under law to protect biodiversity and natural and cultural resources. Developed cooperatively by the Commonwealth, the states and the Northern Territory, the NRSMPA aims to build a system of marine protected areas that is

- Comprehensive: sampling the full range of Australia's ecosystems.
- Adequate: to ensure the conservation of marine biodiversity and integrity of ecological processes.
- Representative: including marine protected areas that reflect the marine life and habitats of the area they are chosen to represent.

Scientists are working to gather better information about the condition of existing protected areas. In 2003–04, for instance, the Commonwealth trialled a new approach of monitoring its marine protected areas, by developing key indicators of ecosystem health in six coral reef reserves.

The protected areas of both the Great Barrier Reef Marine Park and the Ningaloo Reef have been enhanced. In 2004, the highly protected zones of the Great Barrier Reef were increased and now encompass around 33% of the Great Barrier Reef Marine Park. The high level protection of Ningaloo Reef in WA has also increased to encompass around 34% of the reserve.

marine habitat such as the loss of seagrass. Sea temperature increases are considered to be an associated with greenhouse gas emissions. Sea temperature increases can also alter marine habitat making it less suitable for some species.

Invasive species also put pressure on coastal and marine environments, for example invasive plant species can replace native coastal vegetation communities, altering the habitat and making it less suitable for native animal species.

The marine environment and our coast are a source of recreation or leisure for many Australians. Many of us prefer to live near the coast. Many of us enjoy going to the beach, and visiting coastal National Parks and other reserves as part of our leisure time activities.

Sea level and climate change

The Bureau of Meteorology is responsible for the Australian Baseline Sea Level Monitoring Project. The ultimate goal of the project is to identify sea level changes over long periods, with a particular emphasis on the enhanced greenhouse effect on sea level. The project produces monthly data reports for a range of parameters including sea level from 15 sites around the Australian coastline, and one on Cocos Island.[40]

See also the commentaries *The natural landscape, National income, The air and atmosphere, Culture and leisure.*

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