POLICY DOCUMENT

Whale and Dolphin Conservation in the Great Barrier Reef Marine Park

GREAT BARRIER REEF
MARINE PARK AUTHORITY

Species Conservation Team
Conservation, Biodiversity and World Heritage Group

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Consultation

Preparation of this *Whale and Dolphin Conservation in the Great Barrier Reef Marine Park* booklet involved extensive discussion with users of the Marine Park, interest groups, institutions and government agencies. The primary responsibility within the Authority for development of this document was assumed by Dr Cheri Recchia. Initially, meetings were held with government agencies and scientists to identify relevant issues to be considered in the policy. A preliminary version of the policy was then distributed to 20 experts, including scientists, Queensland and Commonwealth government officers and representatives of interest groups and stakeholders. As a result of the 15, largely supportive, submissions that were received, changes were made and a public draft of the policy was issued. The draft policy was mailed to over 150 individuals and organisations. It was also advertised in the "*Reef Research*" newsletter of the Great Barrier Reef Marine Park Authority that is mailed to 1700 individuals and institutions, and was made available on the Authority's website. Thirty-six submissions were received, again mostly supportive. Further changes to the policy were made as a result of the submissions before a final round of consultation with government agencies and tourist operators regarding the proposed definitions of commercial whalewatching and swimming-with-whales activities. Two additional submissions on the matter were received, and the definitions were modified accordingly.

FOREWORD

To many people, cetaceans (whales, dolphins and porpoises) are amongst the most attractive of marine animals. Their streamlined and swift bodies, refined communication system and seemingly high intelligence combine in a unique appeal which is behind the increasing importance of whalewatching on the Great Barrier Reef and elsewhere. For similar reasons, modern Australian society demands close scrutiny of activities that threaten to harm these magnificent creatures. Over 30 different species of whales and dolphins may occur in the Great Barrier Reef Marine Park, including species that are listed as threatened internationally and under Australian and Queensland legislation. A prudent and precautionary policy which minimises risks to the animals whilst they are in the Marine Park is therefore essential.

This *Whale and Dolphin Conservation in the Great Barrier Reef Marine Park* booklet includes the Great Barrier Reef Marine Park Authority's *Whale and Dolphin Conservation Policy* and the *Supporting Document for the Whale and Dolphin Conservation Policy*. Together, these documents provide a synthesis of information on the biology and ecology of cetaceans occurring in the Great Barrier Reef, on natural and human-related issues affecting their conservation status, and on management responses to those issues. As many species of whales and dolphins move long distances during their lives, many that occur regularly or infrequently on the Reef may be adversely affected by impacts outside the Authority's jurisdiction. Nevertheless, the Authority is committed to undertaking the actions described in this document for the conservation of cetaceans whilst they are in Reef waters.

The Policy was approved by the Great Barrier Reef Marine Park Authority in February 2000 after extensive discussion within and outside the Authority. It will be used to guide management actions in the Marine Park for the conservation of whales and dolphins and complements a number of other Commonwealth and Queensland plans and guidelines for whales and dolphins. As the Authority moves into the new century, the policy will be pivotal in providing for a precautionary approach to cetacean conservation in the Marine Park.

The Great Barrier Reef Marine Park Authority is pleased to publish this document and to make it available for general consideration.

Hon Virginia Chadwick
Chair
Great Barrier Reef Marine Park Authority

March 2000

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WHALE AND DOLPHIN CONSERVATION POLICY

GREAT BARRIER REEF
MARINE PARK AUTHORITY

Policy Objective

The objective of this policy is to provide a basis for managing human activities that will, or are likely to, affect the whale and dolphin populations in the Great Barrier Reef Marine Park so as to ensure their conservation and, where necessary, recovery.

Many of the whales and dolphins found within the Great Barrier Reef Marine Park (the Marine Park) spend at least part of each year outside its boundaries. Conservation of these highly mobile animals requires cooperation across not only Marine Park boundaries, but also across State and international boundaries. Indeed, many of the issues concerning whales and dolphins are global in scope. Thus this policy is intended to complement and reinforce other State, Commonwealth and international conservation and management initiatives.

This policy has been developed to address both short-term and long-term conservation issues. It seeks to be proactive rather than reactive or crisis-driven, and therefore addresses current issues while also anticipating potential future issues to the extent possible. This policy should be considered to be a 'living document', and will be subject to review and modification as necessary to ensure the overall objective is met.

This policy should be read in conjunction with the document entitled *Supporting Document for the Whale and Dolphin Conservation Policy*, which identifies the major impacts of human activities on whales and dolphins occurring in and around the Marine Park, as well as the possible effects of those impacts on individual animals and on whale and dolphin populations.

For the purposes of this policy, the term 'whale' is used to refer to all baleen and toothed whales (all members of the suborder Mysticeti and members of the suborder Odontoceti from the families Physeteridae, Ziphiidae, and Kogiidae and the delphinid genera *Globicephala, Pseudorca* and *Orcinus*). The term 'dolphin' is used to refer to all remaining members of the suborder Odontoceti found in the Marine Park.

Policy Implementation

This policy will be implemented in accordance with the existing Goal and Aims of the Great Barrier Reef Marine Park Authority (the Authority) and in collaboration with the appropriate Commonwealth and Queensland agencies.

Management of human activities to reduce potential adverse impacts on whales and dolphins in the Marine Park will be achieved primarily through education and, where appropriate, through regulations, permits, and development of mechanisms to encourage industries (such as the whalewatching industry) to become self-regulating. These elements, along with the implementation of essential regulations and gathering of additional information on major threats to whales and dolphins in the Marine Park, will be accorded high priority for implementing this policy.

The Authority will base management decisions affecting whales and dolphins on the available information about the species and human activities and other factors that may affect them, and on prudent application of the precautionary principle where there are threats of serious or irreversible harm to whale and dolphin populations. Where possible, performance indicators will be developed to assess the effectiveness of management measures. Management measures will be reviewed as necessary, and an adaptive approach employed to allow incorporation of new information as it becomes available.

Actions taken to implement this policy may also benefit other rare and threatened species, such as dugongs. Conversely, actions taken to protect other species (including dugongs) and implement other programs (such as the Representative Areas Program) may help to implement this policy and conserve whales and dolphins. To maximise efficiency and effectiveness, the Authority will seek,

and take advantage of, opportunities for such dual benefits in delivering new and existing programs and initiatives.

A. Improving information about whales and dolphins in the Marine Park

Reliable information is needed about the whale and dolphin species in the Marine Park, especially their distributions, abundances and key habitats, and also about the effects of human activities on the animals.

A.1. Information priorities

The Authority will encourage, and where appropriate coordinate, the gathering of reliable information about whales and dolphins in the Marine Park. Emphasis will be placed on:

- improving our understanding of priority species (see section H.2);
- identifying key whale and dolphin habitats (habitats that are essential for feeding, breeding and other activities); and
- assessing threats to whales and dolphins in the Marine Park, including levels of contaminants in animals, sources and levels of underwater noise, incidence of vessel strikes, risks of entanglement in shark control gear and fishing gear, and issues relating to prey abundance.

A.2. Scientific research

The Authority will encourage appropriate scientific research on topics that are considered high priorities for management purposes and will, where possible, assist in funding such studies.

A.3. Other sources of basic information

The Authority will work with stakeholders of the Marine Park, including the tourism industry, community groups and others, to collect information on whales and dolphins through voluntary and mandatory data collection and environmental reporting programs.

B. Development of educational programs and materials

Education is a critical element of effective management, essential both as a stand-alone measure and to support codes of practice, regulations and other management measures.

B.1. Educational programs and materials

The Authority will coordinate the development of appropriate educational programs and materials providing general information about whales and dolphins in the Marine Park, the possible effects of human activities on the animals and ways to reduce these effects through:

- review and subsequent periodic evaluation of existing educational programs and materials; and
- development of new educational programs and materials where necessary.

B.2. Dissemination of information

The Authority will employ various means of disseminating appropriate information about whales and dolphins, including:

- promotion of participation by the tourism industry, the fishing industry, associations and community groups in educational programs for clients and members; and
- provision of educational materials to key outlets.

C. Codes of practice

Codes of practice based on the best available information and reasonable application of the precautionary principle can substantially reduce the adverse effects of human activities on whales and dolphins.

C.1. Development of codes of practice

The Authority will work with stakeholders to:

- as soon as possible review, and periodically evaluate, existing codes of practice;
- develop new codes of practice as required.

C.2. Compliance with codes of practice

The Authority will work with relevant parties to assist the dissemination of information relating to Codes of Practice in the Marine Park. To encourage compliance with codes of practice, mechanisms to allow user groups to be self-regulating will be developed where appropriate and will be underpinned by regulations or other legislative tools as the Authority considers necessary.

D. Management of vessels and aircraft in the Marine Park

Many of the existing and potential threats to whales and dolphins in the Marine Park arise from the operation of vessels and aircraft.

D.1. Vessel and aircraft regulations

The Authority will develop regulations concerning the operation of vessels and aircraft around whales and dolphins. These regulations will consider relevant Queensland legislation and other appropriate statutory and non-statutory instruments (such as whalewatching guidelines and management plans and programs) and will specify minimum approach distances to whales for vessels and aircraft.

The Authority may, in future, consider development of additional regulations if necessary and if other management measures are judged inadequate for the conservation of whales and dolphins. Such regulations may, for example, specify:

- vessel speed limits when operating in proximity to whales and dolphins; and
- other limitations on the operation of vessels or aircraft when in proximity to whales and dolphins.

D.2. Permission for close approaches and other exemptions to regulations

The Authority will require that any persons, including researchers and photographers, seeking exemption from regulations, such as a minimum approach distance, must apply for permission. Depending on the nature of the research proposed, assessment of such an application may require consideration by the Authority's Great Barrier Reef Environmental Research Ethics Advisory Committee. Such exemptions should not be granted for the purposes of commercial tourism.

D.3. Traffic management in key habitats

As key whale and dolphin habitats are identified, the Authority will, as required, implement voluntary or mandatory traffic management measures, such as vessel speed limits, designation of traffic routes, and limited-access areas.

E. Management of whalewatching and swimming-with-whales activities

Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, 'whalewatching means any activity conducted for the purpose of observing a whale, including but not limited to being in the water for the purposes of observing or swimming with a whale, or

otherwise interacting with a whale'. In the Marine Park, this definition will be extended to include both whales and dolphins.

The potential adverse impacts of people, vessels and aircraft on whales and dolphins may be intensified in the context of whalewatching because more time is spent looking for, and operating in close proximity to, the animals in order to observe them. Swimming, snorkelling or scuba diving with whales and dolphins (all included in the term 'swimming-with-whales') pose additional risks to humans and the animals. Management of these activities will reflect the additional risks posed by swimming-with-whales compared to other forms of whalewatching and will distinguish between these activities as necessary. Swimming-with-whales will, however, be considered a specialised form of whalewatching.

Adverse impacts of whalewatching and swimming-with-whales activities on whales and dolphins can occur regardless of whether they are conducted in a recreational or commercial context.

E.1. Management of recreational whalewatching and swimming-with-whales activities

No specific permissions are required to engage in recreational whalewatching and swimming-with-whales activities in the Marine Park. These activities will be managed through implementation of regulations governing the conduct of vessels and aircraft around whales and dolphins (see section D.1), education (see sections B.1 and B.2) and other measures as the Authority deems necessary and appropriate.

E.2. Management of commercial whalewatching and swimming-with-whales activities

Commercial whalewatching and swimming-with-whales activities will be managed through implementation of regulations governing the conduct of vessels and aircraft around whales and dolphins (see section D.1), education (see sections B.1 and B.2), codes of practice (see sections C.1 and C.2) and other measures as the Authority deems necessary and appropriate.

The operation of a commercial tourist program in the Marine Park requires a permit under the Commonwealth *Great Barrier Reef Marine Park Act 1975*. Whalewatching and swimming-with-whales activities conducted incidentally to the core activities of a permitted commercial tour operation do not require specific permission. For example, an operation permitted to conduct snorkelling trips to the Great Barrier Reef does not require a specific whalewatching permission simply to stop and look at a whale passing by the vessel. However, whalewatching and swimming-with-whales activities that form a primary component of a permitted commercial tour operation require specific additional permission(s) as follows.

Commercial tour operations will continue to require a permit specifically allowing the activity of **whalewatching** if:

- watching whales and / or dolphins is advertised; and / or
- a spotter aircraft is used to locate whales and / or dolphins for the purpose of watching the animals; and / or
- vessels or aircraft are operated in a manner to actively search for and observe whales and / or dolphins.

Commercial tour operations will require a permit specifically allowing the activity of **swimming-with-whales** if:

- swimming, snorkelling or scuba diving with whales and / or dolphins is advertised; and / or
- a spotter aircraft is used to locate whales and / or dolphins for the purpose of swimming, snorkelling or scuba diving with the animals; and / or

- people are placed in the water for the express or primary purpose of observing whales and / or dolphins (e.g. from a vessel that is not moored or anchored at a reef location).

Note that a permission granted to conduct whalewatching will not confer permission to conduct swimming-with-whales activities (as defined above). A tour operator wishing to conduct both whalewatching and swimming-with-whales activities (as defined above) will require a permit specifically allowing both activities.

The above definitions of whalewatching and swimming-with-whales will be reviewed periodically and revised as the Authority deems necessary.

E.3. Assessments of applications for commercial whalewatching and swimming-with-whales permissions

The Authority will take into account the Queensland commercial whalewatching permit assessment guidelines and any other relevant information in assessing applications for new permissions and applications for permission renewals for commercial whalewatching and swimming-with-whales activities in the Marine Park. Application assessment criteria and conditions and / or regulations associated with permissions granted for the conduct of these activities will be reviewed to ensure they are consistent with the other elements of this policy and with relevant statutory and non-statutory instruments (e.g. whalewatching guidelines).

E.4. Managing impacts of commercial whalewatching and swimming-with-whales activities

The Authority, in collaboration with State agencies and other stakeholders, will develop a long-term strategy for management of commercial whalewatching and swimming-with-whales activities throughout the Marine Park, including:

- review or setting (as appropriate) of limits on numbers of whalewatching and swimming-with-whales permissions in all areas of the Marine Park;
- review of existing areas in which commercial whalewatching and / or swimming-with-whales are not permitted (including the areas described below); and
- consideration of additional areas which should be closed to commercial whalewatching and / or swimming-with-whales activities or areas within which these activities should occur only under special limits or conditions.

Until this long-term strategy is developed and implemented, as a precautionary measure and consistent with the *Management Program for the Conservation of Whales and Dolphins in Queensland 1997–2001*,[1] the Authority will not grant commercial whalewatching or swimming-with-whales permissions to operate in the part of the Marine Park extending from the southern boundary of the Marine Park north to the southern boundary of the area covered by the *Whitsundays Plan of Management*.

Strategies in the *Whitsundays Plan of Management* (e.g. Part 1, Division 2, Subparagraphs 1.7(3)(b) to (g) inclusive) relating to the conservation of whales will continue to apply unless or until specifically amended. Measures applying to commercial whalewatching activities apply also to commercial swimming-with-whales activities.

An amendment to the whale conservation strategy established in the *Cairns Area Plan of Management* will be sought to allow consideration of granting of specific permissions to conduct commercial swimming-with-whales activities focusing on dwarf minke whales in the vicinity of the Ribbon Reefs. Such permissions will be limited to actual levels of use as of 1 January 2000.

[1] Department of Environment 1997, *Conservation and Management of Whales and Dolphins in Queensland 1997–2001*, Department of Environment, Brisbane.

Applications for permission to conduct swimming-with-whales with dwarf minke whales outside the Cairns Planning Area (such as in the Offshore Cooktown Sector) may, if granted, have the effect of increasing the total number of vessels and / or operators engaging in this activity in the general vicinity of the Ribbon Reefs. If so, assessments of such applications will consider any new information about the animals and the effects of this activity that may be sufficient to indicate that the increased level of the activity will be ecologically sustainable and compatible with application of the precautionary principle.

Assessments of applications for permission to conduct swimming-with-whales with other species (e.g. humpback whales), and / or in areas other than in the general vicinity of the Ribbon Reefs, will consider whether there is any scientifically valid research indicating the likely effects of the activity on the species in the area, and will consider making the conduct of, or participation in, such research a condition of permit. The assessment will consider whether sufficient specific information is available to indicate that the activity will be ecologically sustainable and compatible with application of the precautionary principle.

F. Management of other human activities

A variety of other human activities can have adverse effects on whales and dolphins.

F.1. Prohibition on feeding

Deliberate feeding, or attempted feeding, of whales and dolphins will not be permitted in the Marine Park except by persons appropriately authorised by the Authority and under exceptional circumstances (such as caring for sick, injured, trapped or entangled individuals).

F.2. Consideration of whales and dolphins in all relevant programs

The Authority will ensure that direct and indirect effects on whales and dolphins are assessed during consideration of relevant programs, including programs concerning water quality, coastal development, fisheries, and tourism. This may include, for example, development of tourism industry accreditation criteria and best environmental practices, efforts to reduce adverse environmental effects of fisheries, and initiatives to reduce land-based sources of marine pollution.

F.3. Consideration of whales and dolphins in permit assessments

Possible effects on whales and dolphins will, where appropriate, be taken into account by the Authority during consideration of applications for new permits and permit renewals involving activities or projects proposed to occur in the Marine Park. Where pertinent, permit conditions will be modified to ensure they are consistent with this policy and any relevant statutory or non-statutory instruments (e.g. whalewatching guidelines). Where appropriate, environmental impact assessments will consider possible effects on whales and dolphins and, if necessary, propose mitigative measures.

F.4. Development of additional regulations

If necessary, the Authority will consider the need for other regulations to protect whales and dolphins from human activities. This may include enacting regulations based on provisions contained in relevant non-statutory instruments (e.g. whalewatching guidelines).

G. Protection of key whale and dolphin habitats

As with most species, effective conservation of whales and dolphins requires protection of key habitats.

G.1. Managing in key habitats

As information on key whale and dolphin habitats becomes available, the Authority will publicise this information to the extent possible and will, in consultation with appropriate parties, implement specific management measures as required.

G.2. Establishing additional whale and dolphin protection areas

The Authority will, in consultation with appropriate parties, implement a process to consider designation of Whale or Dolphin Protection Areas (in addition to the Whale Protection Area in the Whitsundays). Possible provisions in these areas may include permanent or seasonal restrictions on some human activities, and/or modification of other activities, such as operation of vessels, and tourism or Defence activities.

G.3. Consideration of key habitats in permit assessments

When assessing permit applications for any activities and when evaluating projects, the Authority will take into account whether proposed activities will occur within or affect key whale and dolphin habitats.

G.4. Consideration of key habitats in other programs

The Authority will take into account key whale and dolphin habitats in all relevant programs and initiatives, including the Representative Areas Program, pollution prevention and reduction programs, and programs to address land-based influences on the Marine Park.

H. Priority species, populations and individual animals

The Authority will pay particular management attention to certain species, populations and individual animals.

H.1. Dwarf minke whales

Consistent with the recommendations of the International Whaling Commission and *The Action Plan for Australian Cetaceans*,[1] the Authority will consider dwarf minke whales as a separate species for the purposes of management.

H.2. Priority species

The Authority will take additional care with, and focus data collection and management efforts on, species and populations of high priority, including species listed as critically endangered, endangered, vulnerable or conservation dependent under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, species listed as rare under the Queensland *Nature Conservation (Wildlife) Regulation 1994*, species that are a focus of commercial activities, and any other species and population(s) for which a particular conservation or management concern is identified.

H.3. Provisions for sick, injured, or at risk whales or dolphins

The Authority will, as necessary, take appropriate measures to identify and protect individual whales or dolphins, or groups of whales or dolphins, that are of special interest. These measures would be reserved for an animal or animals within the Marine Park that are judged to be at particular risk of harassment, injury or death from humans (for example, morphological or colour-variant individuals, and sick, injured, trapped or entangled animals). These measures would be implemented only in rare cases and to an extent commensurate with the benefit to the conservation of species or populations, and would not generally be used to interfere with natural processes.

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[1] Bannister, J.L., Kemper, C.M. & Warneke, R.M. 1996, *The Action Plan for Australian Cetaceans*, Australian Nature Conservation Agency, Canberra, Australia. 242 pp.

SUPPORTING DOCUMENT
FOR THE
WHALE AND DOLPHIN
CONSERVATION POLICY

Prepared by Dr Cheri Recchia

GREAT BARRIER REEF
MARINE PARK AUTHORITY

1. Preface

The objective of the Great Barrier Reef Marine Park Authority *Whale and Dolphin Conservation Policy* is to provide a basis for managing human activities that will, or are likely to, affect the whale and dolphin populations occurring in the Great Barrier Reef Marine Park so as to ensure their conservation and, where necessary, recovery.

Many of the whales and dolphins found within the Great Barrier Reef Marine Park (the Marine Park) spend at least part of each year outside its boundaries. Conservation of these highly mobile animals requires cooperation across not only Park boundaries, but also across State and international boundaries. Indeed, many of the issues concerning the conservation of cetaceans (whales, dolphins and porpoises) are global in scope. Thus the policy is intended to complement and reinforce other State, Commonwealth and international cetacean conservation and management initiatives.

This supporting document identifies the major impacts of human activities on cetaceans occurring in and around the Marine Park and the possible effects of those impacts on individual animals and on populations. It describes management measures that can reduce human-generated impacts in order to minimise or prevent the possible resulting effects. Recognition is given to global issues and threats, but the principal focus is on managing threats to cetaceans arising from human activities in and around the Marine Park. This document identifies known and anticipated problems, as well as vital information gaps, and solutions or processes for developing solutions.

This document and the policy build on a considerable amount of other work on Australian cetaceans and the management of human activities affecting them, including:

- *The Action Plan for Australian Cetaceans* (Bannister et al. 1996);
- the Australian National Guidelines for Cetacean Observation (Environment Australia 1999); and
- the *Conservation and Management of Whales and Dolphins in Queensland 1997–2001* (Department of Environment 1997).

The *Whale and Dolphin Conservation Policy* is based on the current scientific understanding of cetaceans, on analysis of present and, to some extent, predicted future patterns of human activity, and on prudent application of the precautionary principle. Like virtually all marine plants and animals occurring inside and outside the Marine Park, much remains unknown about Australian cetaceans. As fundamental information about the populations (e.g. abundance, distribution and key habitats) becomes available and as human activities within and around the Marine Park change, the policy will need to change as well. It should be considered to be a 'living document', and will be subject to review and modification as necessary.

Many agencies, organisations and individuals have assisted in the preparation of this document and the policy.

2. Introduction

Established under the *Great Barrier Reef Marine Park Act 1975* (the GBRMP Act), the Great Barrier Reef Marine Park covers an area of approximately 340,000 km^2, and includes one of the most complex and biologically diverse ecosystems on earth.

The Marine Park comprises nearly 98% of the Great Barrier Reef World Heritage Area (GBRWHA), which was inscribed on the World Heritage List in 1981 on the basis of its outstanding natural, cultural and historical features and its ecological integrity.

The GBRMP Act also established the Great Barrier Reef Marine Park Authority (the Authority). The Authority's Goal is:

> To provide for the protection, wise use, understanding and enjoyment of the Great Barrier Reef in perpetuity through the care and development of the Great Barrier Reef Marine Park.

The stated Aims of the Authority include protecting the natural qualities of the Great Barrier Reef while providing for reasonable use of the Reef Region, and minimising regulation of, and interference in, human activities, consistent with meeting the Goal and other Aims of the Authority. Consistent with these obligations, the Authority is responsible for conserving whales and dolphins in the Marine Park. This is achieved through managing human activities that impact on cetaceans occurring in the Marine Park, including both current activities and predicted future activities. To the extent that it is consistent with protecting the natural values of the Great Barrier Reef, including whales and dolphins, the Authority provides for ecologically sustainable use of the Marine Park.

The Authority must also ensure that the interests of Aboriginals and Torres Strait Islanders are reflected in the management of the Great Barrier Reef World Heritage Area. The particular relationship between Aboriginals and Torres Strait Islanders and whales and dolphins within the Area has not been well documented. However, there are reports from the late nineteenth and early twentieth centuries of dolphins assisting Aboriginals to catch fish around Moreton and Stradbroke Islands, and this type of relationship may have been widespread in south-east Queensland (Neil and Brieze 1998). Regardless of the specific significance of whales and dolphins to Aboriginals and Torres Strait Islanders in the GBRWHA, Indigenous rights and interests must be considered in developing and implementing any cetacean conservation or management measures in the Area.

To conserve whales, dolphins and the other natural values of the Marine Park over the long term, management should seek to be proactive rather than reactive or crisis-driven. Current problems must be addressed, but possible future problems should be anticipated to the extent possible. Further, management within the Marine Park cannot occur in isolation, but must operate effectively in the context of other Commonwealth, Queensland, and, to some extent, international initiatives.

3. Context and Complementarity with Other Policies

None of the cetacean species found in Australian waters are exclusively Australian (Bannister et al. 1996). Thus, conservation of cetaceans requires collaboration and efforts at the local, state, national, and international levels.

At the international level, Australia has played a leading role in the International Whaling Commission, which is the major international forum regulating human impacts on cetaceans. Australia is also signatory to several international conservation conventions that apply to cetaceans, including the *Convention on Biological Diversity*, the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES), the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention), and the *Convention on the Conservation of Antarctic Marine Living Resources* (CCAMLR).

Nationally, there currently are various pieces of legislation applicable to the conservation and management of cetaceans, including the Commonwealth waters of the Marine Park. The *Whale Protection Act 1980* prohibits killing, injuring, taking or interfering with cetaceans, and applies to all persons, vessels and aircraft in Commonwealth waters. The *Endangered Species Protection Act 1992* provides a framework for the protection of species listed as endangered and vulnerable, and ecological communities listed as endangered. This Act provides for the preparation of recovery

plans for all scheduled species and ecological communities. Each recovery plan must provide for the research and management actions necessary to stop the decline of, and support the recovery of, the species or community so that its chances of long-term survival in nature are maximised. As a Commonwealth agency, the Authority must not take any action that contravenes a recovery plan or threat abatement plan. Currently, five species of cetaceans, including four found in the Marine Park, are scheduled as endangered or vulnerable under the Act (see section 4). The *Whale Protection Act 1980* and the *Endangered Species Protection Act 1992* will be replaced in July 2000 by the *Environment Protection and Biodiversity Conservation Act 1999*, as is discussed below.

The Commonwealth Department of the Environment and Heritage has recently led the updating of the national Whalewatching Guidelines. The new Australian National Guidelines for Cetacean Observation (Environment Australia 1999) set a minimum national standard and ensure consistency across jurisdictions for policies and practices relating to the recreational observation of cetaceans. The National Guidelines are intended to provide a base level of guidance, with regional, temporal and species-specific issues to be addressed at the local or regional level. The Authority's whale and dolphin conservation policy is intended to meet or, where necessary, exceed the National Guidelines.

In Queensland, the *Nature Conservation Act 1992* protects all cetaceans indigenous to Australia. The *Nature Conservation (Whales and Dolphins) Conservation Plan 1997* applies to all cetacean species in Queensland waters. The Plan is to be administered in conjunction with the *Management Program for the Conservation of Whales and Dolphins in Queensland 1997–2001* (Department of Environment 1997). The Authority's *Whale and Dolphin Conservation Policy* is intended to operate in harmony with the Queensland Plan and Program.

The GBRMP Act also provides protection to cetaceans within the Marine Park, through zoning, issuing of permits and implementation of plans of management that collectively enable management of human activities. The Act establishes the requirement to obtain permits to undertake a range of uses or activities in both zoned and unzoned areas of the Marine Park. Under the Regulations, the Authority must not grant a permit to enter or use, or carry on an activity, in the Marine Park unless the Authority has made, or had made, an assessment of the impact that the entry, use or activity is likely to have on the Marine Park and the Great Barrier Reef, including on whales and dolphins.
Further, the actions of the Authority are subject to the provisions of the Commonwealth *Environment Protection (Impact of Proposals) Act 1974* (the EP(IP) Act). Thus, consideration of applications for permits must include evaluation of whether the proposed entry, use or activity may result in significant impacts, thereby triggering the EP(IP) Act, which can result in an Environmental Impact Assessment or other procedure. Major developments are one type of proposed activity that can trigger the EP(IP) Act (but see discussion below of the *Environment Protection and Biodiversity Conservation Act 1999*).

Additional protection can be afforded to whales and dolphins in the Great Barrier Reef World Heritage Area (GBRWHA) under the Commonwealth *World Heritage Properties Conservation Act 1983*. Cetaceans are recognised among the World Heritage values of the GBRWHA and are therefore protected under this legislation. Under the GBRMP Act, the Authority must have regard to the protection of World Heritage values of the Marine Park and the precautionary principle in preparing management plans. The 'precautionary principle' in the GBRMP Act is defined in the *Intergovernmental Agreement on the Environment (1992)*, which states that in the application of the precautionary principle, public and private decisions should be guided by:

(i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and,
(ii) an assessment of the risk-weighted consequences of various options.

In July 2000, the *Environment Protection and Biodiversity Conservation Act 1999* (EP&BC Act) will take effect. This Act will replace the *National Parks and Wildlife Conservation Act 1975*, the *Whale Protection Act 1980*, the *World Heritage (Properties Conservation) Act 1983*, the *Endangered Species Protection Act 1992*, and the *Environment Protection (Impact of Proposals) Act 1974*. One of the objects of the EP&BC Act is 'to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance'. The Commonwealth marine environment, world heritage areas, nationally threatened species, and migratory species protected under international agreements (such as the Bonn Convention) are considered to be matters of national environmental significance.

Another object of the EP&BC Act is to 'promote the conservation of biodiversity'. A division of the Act specifically applies to whales and other cetaceans. This part of the Act establishes the Australian Whale Sanctuary 'in order to give formal recognition of the high level of protection and management afforded to cetaceans in Commonwealth marine areas and prescribed waters'. This division of the Act, like the *Whale Protection Act 1980*, establishes a number of offences relating to, for example, killing, injuring, or taking cetaceans, and provides for issuing permits to conduct whalewatching.

Cetaceans that are nationally listed as threatened species or are listed under certain conventions protecting migratory species (including the Bonn Convention) receive additional protection under the corresponding provisions of the EP&BC Act. Further, within 10 years of the commencement of the Act, inventories must be prepared that identify and state the abundance of cetaceans in Commonwealth marine areas.

4. Cetaceans in the Great Barrier Reef Marine Park

The mammalian order Cetacea comprises approximately 80 living species of whales, dolphins and porpoises worldwide (Klinowska 1991). Cetaceans may be divided into two broad groups. The baleen whales, members of the suborder Mysticeti, have mouths containing hundreds of plates of baleen, a material resembling human fingernails. The number, size and shape of plates vary among species. The plates are used to filter seawater to extract prey, including crustaceans (shrimp-like animals) and small fishes. The suborder Odontoceti comprises the toothed whales, dolphins and porpoises. These animals lack baleen and instead have teeth, although teeth may erupt only in adult males. The number, size, shape and arrangement of teeth vary among species.

For the purposes of this document and the Whale and Dolphin Conservation Policy, the term 'whale' is used to refer to all baleen and toothed whales (i.e. all members of the suborder Mysticeti and members of the suborder Odontoceti from the families Physeteridae, Ziphiidae and Kogiidae and the delphinid genera *Globicephala*, *Pseudorca* and *Orcinus*). The term 'dolphin' is used to refer to all remaining members of the suborder Odontoceti found in the Marine Park. (The term 'porpoise' is reserved for members of the odontocete family Phocoenidae, but no porpoises are known to occur in the Marine Park.)

Forty-three species of cetaceans are found in Australia (Bannister et al. 1996), including most of the great whales (such as humpback and fin whales) and many less familiar species (such as several species of beaked whales). Based on available information of cetacean species distributions in Australia, over thirty species of whales and dolphins may occur in the Marine Park (table 1). Some species are frequently seen, such as humpback and dwarf minke whales and bottlenose dolphins (e.g. Marsh 1990). Other species, such as killer whales and common dolphins, are known to occur in the Marine Park but are seldom seen or perhaps seldom recognised. Still others have never been reported in the Marine Park, but have stranded on the adjacent Queensland coast and so are believed to inhabit Marine Park waters at least occasionally. One species, Longman's

beaked whale, is known only from two skulls found on beaches worldwide, including one from Mackay, Queensland.

A major obstacle to effective management of human activities affecting cetaceans is the lack of information about the animals. For most species of Australian cetaceans, including those found in the Marine Park, little is known about the sizes of populations, their distributions and movement patterns, or the locations of any key habitats. Without this kind of information, it is difficult to assess accurately the conservation status of individual species and populations. Nevertheless, efforts have been made at the global, national and state levels to identify cetacean species that are threatened or at risk of extinction.

The Cetacean Specialist Group of the World Conservation Union (IUCN) assesses the conservation status of cetacean species at a global level. After a particular species is evaluated, it is placed in one of the following categories: extinct, extinct in the wild, critically endangered, endangered, vulnerable, lower risk, or data deficient. Taxa included in the lower risk category are further classified as conservation dependent, near threatened or least concern. Of the species known or suspected to occur in the Marine Park, IUCN has categorised blue, fin and sei whales as endangered, and humpback and sperm whales as vulnerable (IUCN 1996). Many other species are listed as data deficient, while a few are listed as lower risk but conservation dependent, including short-finned pilot whales and three of the dolphin species (Table 1).

At the national level, the Australian *Endangered Species Protection Act 1992* currently provides for species to be listed as presumed extinct, endangered or vulnerable. Of the cetacean species known or suspected to occur in the Marine Park, only blue whales are listed as endangered. Humpback, fin and sei whales are listed as vulnerable (table 1). A draft recovery plan has recently been released for blue whales, and plans will be prepared for humpback, fin and sei whales.

As of July 2000, the *Endangered Species Protection Act 1992* will be replaced by the *Environment Protection and Biodiversity Conservation Act 1999*, which provides for species to be listed as extinct, extinct in the wild, critically endangered, endangered, vulnerable and conservation dependent. When the new Act takes effect, species listed under the old Act will be transferred to the same categories in the new Act.

Bannister et al. (1996, p. 1) developed *The Action Plan for Australian Cetaceans* to provide 'a national overview of the conservation status of Australian cetaceans and recommend[ed] conservation priorities, and research and management action, with particular emphasis on endangered and vulnerable taxa'. Based on work done around the world by IUCN and others in assessing the conservation status of species, Bannister et al. defined the following categories: extinct; endangered; vulnerable; insufficiently known but suspected of being endangered or vulnerable; no category assigned because of insufficient information; no category assigned but possibly secure; no category assigned but probably secure; and secure. The authors listed blue whales (true or nominate form) as endangered, and humpback, fin and sei whales as vulnerable (table 1). The categorisation of most other species expressly recognised the lack of data available to allow definitive assessment (Bannister et al. 1996).

In Queensland, in accordance with the *Nature Conservation Act 1992*, species are scheduled under the *Nature Conservation (Wildlife) Regulation 1994* as presumed extinct, endangered, vulnerable, rare, or common. Humpback whales are scheduled as vulnerable, and Irrawaddy and Indo-Pacific hump-backed dolphins are scheduled as rare. All other cetacean species recorded from state waters are listed as common. (Blue whales are rarely found in Queensland waters and therefore are not scheduled.)

4.1 Characteristics of Cetaceans Relevant to Management

Although the biology of cetaceans differs significantly among species, they share certain general characteristics. All are long-lived animals; the largest whales may live 70 years or more. All take several years to reach sexual maturity, and, with very rare exceptions, produce only one calf in a season. The interval between successive births is commonly two to three years, and can be considerably longer in some species and individuals. Most species are highly mobile, and many are migratory. All cetaceans are predators, feeding near the middle or the top of the marine food chain. Thus, like all predators, they are vulnerable to perturbations of the marine environment that can affect lower levels of the food chain, and they can acquire significant loads of toxins and contaminants through bioaccumulation of small amounts of such substances found in their prey (see section 5.3.8).

These characteristics have two main implications for management. Firstly, cetaceans are vulnerable not only to short-term or acute impacts, but also to cumulative or chronic impacts. Thus impacts that seem insignificant in isolation or over the short term can become significant when combined with other impacts and accumulated over the life of an animal. Management thus must seek to take a risk-averse, integrated management approach considering the cumulative potential effects of a wide array of human activities, and to focus particularly on cumulative impacts that may accrue over years or even decades and collectively result in significant adverse effects on populations. Secondly, because cetaceans are so mobile, management efforts must be mounted at local, national, and international levels to ensure that they are protected throughout their ranges.

Little is known about most Australian cetaceans, including those in the Marine Park. Cetaceans are difficult to study: they spend large but variable proportions of their time under water, and they are often relatively inaccessible for at least part of the year due to migration. The population sizes of species occurring in the Marine Park remain unknown, except for humpback whales (see section 4.2.3). Because of the difficulty in obtaining accurate counts, population trends can take many years to detect. This presents a challenge for management because it is extremely difficult to assess whether populations are stable, increasing, or declining.

Effective conservation of cetaceans requires protection of key habitats, as is the case with most species. Key habitats include feeding, mating, or calving areas, and migratory pathways. Animals may be particularly sensitive to human activities occurring in key habitats, as these areas may serve important needs not readily met in other areas. Work to identify key habitats for humpback whales has begun, but information for other species is largely lacking.

These and other information gaps must be addressed for management to be successful over the long term, but in the absence of this information the precautionary principle must be applied. Thus, rather than relying solely on detection of problems after they have arisen and subsequent efforts to develop and implement effective solutions, management decisions should strive to prevent significant negative impacts from occurring, where there are risks of serious or irreversible damage. In the context of the Authority's *Whale and Dolphin Conservation Policy*, this is not be taken as a justification for blanket prohibitions on human activities, but rather as a call to employ the best available data and err on the side of caution when considering the likely effects of human activities on cetaceans and to implement prudent management measures.

4.2 Types of Whales and Dolphins of Priority for Management

Four types of whales and dolphins are of particular interest for the purposes of the *Whale and Dolphin Conservation Policy*, and are priorities for management: Irrawaddy dolphins, Indo-Pacific hump-backed dolphins, humpback whales and dwarf minke whales. The following subsections provide select summaries of information considered most relevant for the purposes of the policy. A few of the many sources of additional information are Arnold (1997), dwarf minkes; Bannister

et al. (1996), all species; Hale et al. (1998), Indo-Pacific hump-backed dolphins; Klinowska (1991), all species; and Stacey and Arnold (1999), Irrawaddy dolphins.

4.2.1 Irrawaddy dolphins

Irrawaddy dolphins (*Orcaella brevirostris*) are found in tropical and subtropical waters in the Indo-west Pacific, ranging from the Bay of Bengal through the Indo-Malay Archipelago to northern Australia (Bannister et al. 1996; Stacey & Arnold 1999). In Queensland, there are records extending as far south as the Brisbane River (Stacey & Arnold 1999). Throughout their distribution, Irrawaddy dolphins occur in shallow coastal waters, often within about 1.6 km of the coast, and in lakes and rivers (Stacey & Leatherwood 1997). They are not considered to be highly migratory, although several populations of Irrawaddy dolphins in south-east Asia appear to undertake limited seasonal migrations. They appear to be generalist feeders, consuming mainly bony fishes, but also cephalopods (including octopus and squid) and crustaceans (Bannister et al. 1996; Marsh et al. 1989). Demersal, benthic and pelagic prey items have been recorded from stomach contents (Stacey & Arnold 1999).

The population structure of this species is largely unstudied, but evidence of discrete populations has been reported from south-east Asia, and Hale et al. (1998) suggest that Irrawaddy dolphins, like other species of inshore dolphins, may live in genetically distinct populations that occupy discrete and stable home ranges. This has implications for management, as discussed below in the section on Indo-Pacific hump-backed dolphins (section 4.2.2).

The available evidence suggests that at least some populations are in decline (Stacey & Arnold 1999; Stacey & Leatherwood 1997). However, little detailed information on distribution, abundance or status is available, and the Cetacean Specialist Group of IUCN has designated the species as data deficient because there is inadequate information to make a direct or indirect assessment of the risks of extinction based on distribution and / or population status (IUCN 1996).

Information on Australian populations of Irrawaddy dolphins is also limited, and Bannister et al. (1996) have classified them as insufficiently known but suspected to be vulnerable or endangered. They are not listed under the Australian *Endangered Species Protection Act 1992*. However, they are scheduled in Queensland as rare under the *Nature Conservation (Wildlife) Regulation 1994*.

As elsewhere, Marine Park populations of Irrawaddy dolphins are not well studied. Irrawaddy dolphins occupy a particularly vulnerable habitat (Klinowska 1991). As coastal animals, they are especially susceptible to the effects of human activities, including coastal run-off and pollution, incidental catch in fishing gear, habitat disturbance, underwater noise from a variety of sources, and disturbance from boats (Bannister et al. 1996; Klinowska 1991; Stacey & Leatherwood 1997; see also section 5). Stacey and Leatherwood (1997) have suggested that the Townsville region may be a globally significant area of concentration of Irrawaddy dolphins, based in part on the numbers of animals caught historically in nets set for shark control (see also Marsh et al. 1989). Due to the spatial and temporal overlap of Irrawaddy dolphin habitats and some mesh net fisheries, it is likely they are also caught in fishing nets (see section 5.3.4). There is anecdotal evidence that Irrawaddy dolphins are less common in the Great Barrier Reef Region today than they were previously, but this evidence is difficult to interpret without rigorous scientific evaluation.

Clearly, urgent priority should be placed on gathering accurate and reliable information on the distribution, abundance and conservation status of this species in the Marine Park and adjacent waters. Better information on specific threats is also needed, particularly on the threat to local populations posed by entanglements in shark and fish mesh nets (see section 5.3.4).

4.2.2 Indo-Pacific hump-backed dolphins

Indo-Pacific hump-backed dolphins (*Sousa chinensis*), like Irrawaddy dolphins, are predominantly inshore animals, found in tropical coastal, estuarine and occasionally riverine habitats. They occur in southern China through the Indo-Malay Archipelago to northern Australia, often in waters less than 20 m deep (Bannister et al. 1996). However, like Irrawaddy dolphins, they are occasionally seen several kilometres offshore (Corkeron 1990). In north-eastern Australia, they are found as far south as the Queensland–New South Wales border (Corkeron et al. 1997). They are not known to be highly migratory, although moderate seasonal changes in distribution and abundance have been documented in Hong Kong (Jefferson & Leatherwood 1997). Diet studies have indicated that Indo-Pacific hump-backed dolphins eat bony fishes, especially pelagic shoaling species such as mullet (*Mugil* spp.), some cephalopods, and crustaceans (Bannister et al. 1996; Hale et al. 1998).

As with Irrawaddy dolphins, Indo-Pacific hump-backed dolphins are poorly known globally, and the IUCN Cetacean Specialist Group has classified this species also as data deficient (IUCN 1996). However, in two areas in which the animals are relatively well studied, off South Africa and in Hong Kong, it has been suggested that numbers are declining (Corkeron et al. 1997; Karczmarski et al. 1998).

The limited available information about the population structure of this species suggests that they may occur in discrete, geographically localised populations rather than large populations with extensive ranges (Hale et al. 1998). Preliminary results from studies of Australian Indo-Pacific hump-backed dolphins suggest that the range of genetically distinct populations may be in the order of 120 km (Hale et al. 1998). Thus adverse effects on relatively small numbers of individuals may pose a threat to local populations. For example, an average of 7.5 dolphins per year die in shark control nets set in an area off the Indian Ocean coast of South Africa. This level of mortality is considered to be unsustainable, given that the population is estimated to number only 200 individuals (International Whaling Commission 1994; see also section 5.3.4).

Information on Indo-Pacific hump-backed dolphins in Australia is also limited, although a recent review of the distribution and abundance of this species suggested that numbers may be declining in Australian waters (Corkeron et al. 1997). Bannister et al. (1996) have classified this species as insufficiently known but suspected to be vulnerable or endangered. Indo-Pacific hump-backed dolphins are not listed under the Australian *Endangered Species Protection Act 1992*, but are scheduled in Queensland as rare under the *Nature Conservation (Wildlife) Regulation 1994*.

In the Marine Park, Indo-Pacific hump-backed dolphins are likely to be susceptible to the same types of adverse impacts as are Irrawaddy dolphins, because both species occupy coastal environments, where the effects of human activities tend to be most concentrated (Bannister et al. 1996; Klinowska 1991). Thus pollution, noise, disturbance, incidental catch in shark and fish mesh nets and general habitat degradation are likely to pose serious threats to this species throughout its range (Bannister et al. 1996; Corkeron et al. 1997; Karczmarski et al. 1998; Porter et al. 1997; see also section 5). In Queensland, Indo-Pacific hump-backed dolphins are known to be caught accidentally in shark nets set for bather safety, and are also caught in fishing nets (Hale et al. 1998; see also section 5.3.4). Aerial surveys of the Great Barrier Reef region recorded a decline in sightings of these dolphins between 1987 and 1995 (Corkeron et al. 1997).

Research on Indo-Pacific hump-backed dolphins is urgently needed to determine their distribution and abundance, population genetics and key habitats. Assessment of the conservation status of these animals is required to determine appropriate management actions. Given the considerations discussed above, particular attention should be made to identifying and seeking to reduce likely adverse impacts of human activities on this species. Evaluation of the threat to local populations posed by entanglements in shark and fish mesh nets should be accorded high priority.

4.2.3 Humpback whales

The humpback whale (*Megaptera novaeangliae*) is a cosmopolitan species found in all the world's oceans. Humpbacks occurring in the Marine Park are members of the east Australian population, which forms part of the Antarctic Area V stock (Dawbin 1966). Members of this population generally spend the summer feeding in the nutrient-rich waters of Antarctica, migrate northwards in the autumn, and winter in warm-water breeding areas, including the waters off the coast of Queensland. Humpbacks are usually present in the Marine Park from June to October.

All stocks of humpback whales were seriously depleted by commercial whaling (Klinowska 1991). The IUCN Cetacean Specialist Group has listed humpbacks as vulnerable to extinction, due to observed population reductions of over 20% in the last three generations, due principally to previous commercial whaling activities (IUCN 1996).

The east Australian population is recovering from severe depletion by commercial whaling earlier this century. In 1996, the population was estimated to number 3185 animals (standard error 208, 95% confidence interval 2802–3621, coefficient of variation 0.07). From 1981–1996, the population was estimated to have increased at a rate of 12.26% per year (standard error 0.83, 95% confidence interval 10.12–14.40%, coefficient of variation 6.8%; Bryden et al. 1997). Thus, the conservation status of these animals appears to be relatively secure at present, and in 1998 they were down-listed from endangered to vulnerable under the Australian *Endangered Species Protection Act 1992*. Bannister et al. (1996) also classify humpbacks as vulnerable.

Humpbacks are also listed as vulnerable under the Queensland *Nature Conservation (Wildlife) Regulation 1994*, and a cautious approach to management, supported by close monitoring, is required to ensure that the population continues to recover (Department of Environment 1997). As the population grows, encounters between humans and whales are likely to increase, particularly in coastal waters. Oral history interviews conducted in Queensland in 1982-83 with 36 men indicated that humpbacks used to winter in Marine Park waters in such numbers that they were considered a hazard to fishing (Simmons & Marsh 1986). Adjustments to management measures may be needed to protect the increasing humpback whale population while allowing appropriate growth in human opportunities to observe these animals.
Potential threats to humpbacks in the Marine Park include disturbance by human activities (including that due to human-generated noise), collisions with vessels, and entanglement in lines and fishing gear (Bannister et al. 1996; Klinowska 1991; see also section 5). Humpback whales feed on crustaceans, especially krill, and on fish. However, humpbacks appear not to feed after leaving summer feeding grounds, except perhaps opportunistically.

Of particular concern in the Marine Park are possible adverse effects on pregnant females and cows with young calves. Lactating females typically migrate north before pregnant females, and cows with newborn calves tend to be last to leave the breeding areas to return south to the feeding grounds (Dawbin 1966). Thus, cows who are pregnant or who have young (dependent) calves are present in the Marine Park throughout the season. Reproduction is known to impose high energetic costs on female whales, and pregnant and lactating females may thus be more vulnerable to disturbance and other adverse impacts. A study by Brown et al. (1995) suggested that approximately 50% of the females in the Antarctic Area V stock did not migrate to the northern breeding areas, but remained in the Antarctic feeding grounds. This may reflect their need to build up resources to maximise chances of reproducing successfully in subsequent seasons (Brown et al. 1995).

4.2.4 Dwarf minke whales

The minke whale (*Balaenoptera acutorostrata*) is also a cosmopolitan species with a worldwide distribution. Generally, they are oceanic and undertake extensive seasonal migrations, between

cold-water feeding grounds and warmer-water breeding areas. However, some north Pacific populations apparently are non-migratory (Bannister et al. 1996).

The IUCN Cetacean Specialist Group has listed minkes as lower risk but near threatened, meaning that they are judged to be close to qualifying for listing as vulnerable (IUCN 1996). Minke whales are hunted in several places in the world. Minkes are not scheduled under the Australian *Endangered Species Protection Act 1992*, and are listed as common under the Queensland *Nature Conservation (Wildlife) Regulation 1994*.

There are two types of minke whales in the Marine Park: the dwarf minke whale, which may be an as yet undescribed subspecies of *Balaenoptera acutorostrata*, and the southern hemisphere minke whale (*Balaenoptera acutorostrata bonaerensis*, also known as the ordinary or dark shoulder form), which genetic and morphological studies suggest may in fact be a separate species (Arnold et al. 1987; Best 1985; Wada et al. 1991; Zerbini et al. 1996). The taxonomic status remains unresolved, but it is generally recognised that the dwarf and dark shoulder forms must be considered separately for management purposes (Arnold & Birtles 1999). The International Whaling Commission (International Whaling Commission 1991) and Bannister et al. (1996) have adopted this distinction. Dwarf minke whales are not listed separately by IUCN or under the Australian *Endangered Species Protection Act 1992*. Bannister et al. (1996) list the dark shoulder form as secure and the dwarf form as no category assigned because of insufficient information.

The potential threats to both forms of minke whales are likely similar to those for other baleen species, consisting of effects from human-generated noise, pollution, collisions with vessels, and entanglement in fishing gear (Bannister et al. 1996; Klinowska 1991; see also section 5). Additionally, the Japanese pelagic whaling fleet has caught about 300 minke whales per year since 1987/88 (Klinowska 1991), including a small number of dwarf minke whales taken in the early 1990s (e.g. Kato et al. 1990)

Of particular concern in the Marine Park is a population of dwarf minke whales occurring off northern Queensland, most often seen in the Ribbon Reefs area in June and July although present in the Park from about May to October. The size, composition, and spatial distribution of the population are unknown. The migratory patterns of the animals are poorly documented, although it is clear that they are highly seasonal within the Marine Park (Arnold 1997).

The dwarf minke whales appear to be attracted to boats and to swimmers, snorkellers, and scuba divers; they frequently approach people in the water to distances of less than 10 m (Arnold 1997; Arnold & Birtles 1999). As a result, a small industry has developed to provide opportunities to observe and swim, snorkel, or scuba dive with these animals. Encounters with the dwarf minke whales appear to be largely determined by the animals, and operators frequently have to break off contact with the animals in order to return to port or to moor for the evening. In a recent study, scientific observations of interactions between swimmers and dwarf minkes 'strongly suggest[ed] that approaches and maintenance of contact, both in open water and on reefs, are made by the whales and thus are voluntary'. For example, during the study, the vessel stopped in open water after sighting whales on 14 occasions. In 11 of the 14 occurrences, 'this resulted in approaches by the whales' (Arnold & Birtles 1998).

Although these interactions are largely controlled by the animals, caution and careful monitoring of this new industry and the population are essential because so little is known about dwarf minkes or about the long-term effects of human activities, including in-water interactions, on the animals.

5 General Impacts of Human Activities on Whales and Dolphins

5.1 Terminology: Impacts, Effects and Threats

Human activities may affect cetaceans in many different ways. Any such effects are caused by particular impacts. For example, a dolphin may be killed by getting caught in a shark mesh net set for bather safety. In this case, entanglement is the impact, and death is the effect.

The effect caused by an impact may or may not pose a threat to an animal or a population. For example, a whale may be startled by the noise of a low-flying aircraft. The noise (the impact) causes the startle reaction (the effect), but this may not pose a threat to the survival or wellbeing of the animal. If the noise occurs repeatedly and continues to cause a startle reaction, the animal's behaviour may be disrupted sufficiently to threaten its survival. If a sufficient number of animals in a population are threatened, then the population itself can be threatened.

When assessing the possible consequences of human activities to cetaceans (or any other organisms) and developing management measures, it is important to identify impacts, effects and threats. Generally, management should strive to eliminate or minimise adverse impacts in order to eliminate or minimise consequent effects and threats. It should be noted, however, that not all effects are necessarily adverse.

5.2 Characteristics and Effects of Impacts

Human activities on land and at sea can cause several different types of impacts on cetaceans. Impacts may be direct, meaning that they affect the animals directly, or indirect, meaning that they affect the animals through their effects on the environment. Impacts range in geographic scope from localised, affecting only animals in a limited area, to global, affecting cetaceans around the world. The duration of a particular impact may be short-term, ceasing within minutes or hours of the causal event or activity, or long-term, persisting for months or years. Similarly, effects may be short-term, long-term or permanent (e.g. permanent injury or death).

Impacts that affect one or a few animals are of concern, but particular vigilance is required for impacts that affect many individuals, thereby threatening entire populations and possibly risking species extirpation (loss of a species in an area) or extinction (loss of a species worldwide). Global-level impacts are no less serious than those that operate at a smaller scale (indeed they may be more so), but the purpose of this policy is to provide a basis for managing human activities that will, or are likely to, affect whale and dolphin populations in and around the Great Barrier Reef Marine Park.

Cetaceans vary significantly in their vulnerability to impacts (e.g. Bannister et al. 1996; Klinowska 1991; McCauley et al. 1998; Würsig et al. 1998). Thus the effects resulting from impacts, singly and cumulatively, vary, as do the consequent threats. For example, species or populations that are already endangered, or are confined to limited geographic areas, are generally more vulnerable than are those that are abundant or cosmopolitan in distribution (e.g. Perry 1998). Within a population, animals may be more vulnerable at certain times in their lives, for example when they are very young; at certain times of the year, such as during calving seasons; or when engaged in particular behaviours, such as feeding (e.g. McCauley et al. 1998). Particular species may also be more vulnerable to certain impacts because of physiological, behavioural, or other factors.

Further, exposure to some impacts can lead to habituation, meaning that the effect of the impact on the animal declines with time as animals become 'accustomed' to the specific impact (see review in Richardson et al. 1995). For example, some humpback whales in certain areas seem to habituate to the impacts generated by vessel traffic, and not only cease to avoid boats but actually begin to approach them. However, habituation does not always occur. Moreover, a lack of

observable response of an animal to an impact may indicate either habituation or tolerance, in which the animal 'puts up with' an impact in order to meet ecological needs. For example, if whales initially stop using a particular bay when it becomes an area of high vessel traffic, but then return, it is exceedingly difficult to determine whether this is because the animals have habituated, meaning that they are no longer disturbed by the traffic, or are tolerating the traffic because the bay is key habitat. If the animals have habituated to the traffic, there may little effect of the traffic on the animals. However, if the whales are tolerating the traffic, then the effects of the traffic on the animals can be significant over the long term.

A third possibility is sensitisation, in which the sensitivity or responsiveness to an impact increases with time. This has been demonstrated, for example, by whales becoming increasingly difficult to approach after being hunted recently (Richardson 1995a).

Thus, it is difficult to assess the extent to which a particular impact will affect, or is affecting, individual animals or a population. Possible effects of impacts include mortality, injury or disease, reduced reproductive success, and behavioural modification. Many human activities can cause a cetacean to change its behaviour (e.g. McCauley et al. 1998; Janik & Thompson 1996; Richardson 1995a; Würsig et al. 1998).

Behavioural modifications that are typically reported as a result of human activities include:

- changing swimming speed or direction (for example to approach or avoid a boat);
- changing dive depths or durations;
- changing breathing rates;
- ceasing particular activities (e.g. vocalising, feeding, nursing, socialising);
- leaving an area; and
- beginning or ceasing aerial behaviours (e.g. breaches, tail slaps).

These kinds of behavioural changes may not be significant if they occur infrequently, but may become a serious threat to the animals if they are frequent or persistent. For example, regular interruptions of feeding and other activities could threaten the survival of individual animals and ultimately of populations (e.g. McCauley et al. 1998). Similarly, if human activities cause animals to leave key habitats such as sheltered bays used for calving or protection from predators (i.e. if the animals neither habituate to nor tolerate the impacts), this could have serious consequences for a population.

Thus the precautionary principle must be adopted to take reasonable actions to avoid or minimise potentially serious or irreversible adverse effects. Management decisions must take into account reasonable predictions of likely effects of human activities on the animals, despite a paucity of supporting scientific evidence. Regular evaluation of the effects of human activities on cetaceans, as well as determination and monitoring of the conservation status of the various populations, are essential to facilitate early detection of problems and allow evaluation and modification of management measures.

Following is a discussion of the broad types of impacts to cetaceans that can be caused by human activities on land and at sea, and which can result in the kinds of adverse effects discussed above.

5.3 Specific Types of Impacts and Possible Effects

5.3.1 Deliberate or reckless killing and injuring

Commercial whaling ended in Australia in 1978. However, some of the populations found in the Marine Park may still be hunted outside Australian waters. For example, dwarf minke whales were taken in the early 1990s in the Japanese scientific whaling program in sub-Antarctic and Antarctic waters (e.g. Kato et al. 1990), but it is not known whether these animals were members

of the same population or populations that occur in the Marine Park. The Australian Government is opposed to commercial whaling anywhere in the world, but this matter must be pursued through international fora and is beyond the scope of this policy.

In Australia, there are periodic reports of cetacean carcasses washing ashore with clear evidence of bullet wounds and other injuries indicating deliberate killing or injuring by humans (e.g. Pirzl & Anderson 1997). For example, examination of two dead bottlenose dolphins (*Tursiops truncatus*) found recently in South Australia revealed that they had been shot. Killing cetaceans is prohibited under the Commonwealth *Whale Protection Act 1980* and *Environment Protection and Biodiversity Conservation Act 1999* and, in Queensland, under the *Nature Conservation (Whales and Dolphins) Conservation Plan 1997* except under very limited circumstances (e.g. where necessary for reasons of human safety or for authorised euthansia).

5.3.2 Harassment

Harassment of cetaceans (or other animals) involves disturbing them by altering their normal patterns of behaviour or activity. This can be deliberate, for example through chasing, or inadvertent if people are unaware of the usual behaviour of cetaceans and possible effects of human activities on the animals.

The *Whale Protection Act 1980* and the *Environment Protection and Biodiversity Conservation Act 1999* generally prohibit interfering with cetaceans, which is defined to include harassing, chasing and herding. The Queensland *Nature Conservation (Whales and Dolphins) Conservation Plan 1997* and supporting management program include as an explicit aim the minimising of harm and distress to whales and dolphins caused by human activities (Department of Environment 1997).

5.3.3 Ship and boat strikes

Cetaceans can be struck by any vessel, including commercial ships, fishing vessels and recreational craft. Animals may be struck when they fail to detect an oncoming vessel, or they may perceive a vessel's approach but be unable to avoid being struck. The increasing number of high-speed vessels operating in waters frequented by cetaceans increases the risk of such collisions.

A ship or boat strike can kill an animal outright, or cause serious injury that ultimately results in death due to impairment of critical functions, attraction of sharks, or other factors. Ship strikes are a leading cause of death among adult North Atlantic right whales (*Eubalaena glacialis*), which at an estimated total population size of about 300 individuals are generally considered to be the most endangered of the great whales (Clapham et al. 1999; Klinowska 1991).

Many large commercial vessels travel at high speeds (e.g. over 25 kt) in the Marine Park. The wheelhouse typically is located several stories above the water's surface. Cetaceans lying in the path of vessels generally do not appear on ships' radar, and may be extremely difficult for pilots or operators to detect, particularly at night or if the animals are resting at the water's surface. Indeed, for very large vessels, operators may be unaware they have struck even a large whale. If operators do detect cetaceans lying in a ship's path, they are likely to have limited options for avoiding the animals, depending on the vessel's size, speed and manoeuvrability, and on water depth, weather conditions and other factors. The benefits of avoiding a possible cetacean strike must be balanced against risks to vessel or human safety that could be posed by attempts to avoid animals.

Smaller vessels also strike cetaceans. Even fast-moving animals such as bottlenose dolphins are occasionally hit by boats. For example, in a well-studied community of about 100 dolphins resident off the coast of Sarasota, Florida (USA), injuries believed to have resulted from collisions with boats were documented for four dolphins between 1983 and 1996 (Wells & Scott 1997). There

is also a report of an Indo-Pacific hump-backed dolphin stranding in Hong Kong as a result of a boat collision (Porter et al. 1997)

In Australian waters, ship strikes on cetaceans are not well documented, but are not rare (Bannister et al. 1996). There is little information about ship strikes on cetaceans in the Marine Park and adjacent waters, and this currently may be a relatively uncommon event. However, the increasing numbers of both vessels and humpback whales in the Marine Park increases the possibility of strikes. Vessel strikes would be expected to be most common where recreational and commercial vessel traffic occur in key cetacean habitats, such as calving and nursing sites and along migration routes (Bannister et al. 1996). In August 1998, a humpback whale observed in the Whitsundays had an injury to the dorsal fin thought to be caused by the propeller of a large ship. In August 1999, a Navy vessel reported striking a whale, and, in an unrelated incident, examination of a dead humpback calf from the Mackay region revealed a fractured jaw, consistent with a ship strike.

The Commonwealth *Whale Protection Act 1980* and *Environment Protection and Biodiversity Conservation Act 1999* and the Queensland *Nature Conservation (Whales and Dolphins) Conservation Plan 1997* require that the accidental injuring or killing of a whale be reported.

5.3.4 Accidental entanglement in fishing gear and marine debris

Cetaceans, like turtles, seabirds, and other species, can become entangled in active, lost or discarded fishing gear, shark mesh nets set for bather safety, and marine debris. Entanglement can be immediately fatal, if it prevents an animal from surfacing to breathe, or can cause injury that may or may not ultimately be fatal, depending on the severity of entanglement.

Large and increasing amounts of debris, including plastic objects, enter the marine environment each year (Bannister et al. 1996). Some of this debris, such as discarded lines and fishing nets, can entangle cetaceans (Bannister et al. 1996; Kemp 1996). Cetaceans are also caught in ‘ghost’ fishing gear, i.e. equipment, such as mesh nets, lost or abandoned at sea that continues to fish until it disintegrates or washes ashore (Bryden et al. 1998; Klinowska 1991). Dumping of garbage is prohibited in the Marine Park, but enforcement can be difficult and debris can drift or be blown or washed in from outside the Marine Park boundaries.

Incidental take, i.e. the accidental catching of animals in fishing gear, may now be a more serious problem for cetaceans worldwide than directed or deliberate take (Klinowska 1991). Large numbers of cetaceans are or have been taken incidentally in some fisheries. In some parts of the world, cetacean bycatch in fisheries poses or has posed a serious threat to the survival of local cetacean populations. Examples include the 1986 incidental take of an estimated 129 000 dolphins of various species by the international fleet of tuna purse seiners in the eastern tropical Pacific (Klinowska 1991); at least 230 Hector's dolphins (*Cephalorhynchus hectori*) caught in inshore gillnets in New Zealand between 1984 and 1988 (Dawson 1991a); and harbour porpoises (*Phocoena phocoena*), which have been taken in large numbers in groundfish gillnets in eastern Canada and the north-eastern United States (e.g. 1994 estimate of 1 000 animals taken per year in Bay of Fundy and Gulf of Maine fisheries combined, Read 1994).

Klinowska (1991, p. 15) noted that ‘[s]ome types of fishing gear, particularly set nets of various types, are more dangerous than others’. Read (1996, p. 109) states that ‘in all areas where we have adequate data, dolphins and porpoises are known to be taken in some numbers’. The Report of the Workshop of Mortality of Cetaceans in Passive Fishing Nets and Traps, published in the International Whaling Commission's Special Issue on gillnets and cetaceans, concluded that:

> The incidental capture of cetaceans appears to be almost universal in drift and set gillnets and a common occurrence in some trap fisheries. Wherever

> cetaceans and gillnets are found in the same area, at least some cetaceans are caught.
>
> However, there is no universal cause or solution to the incidental capture of cetaceans in fishing gear. The precise nature of the interaction varies from area to area, fishing gear type to fishing gear type, species to species, culture to culture, and any combination of these (International Whaling Commission 1994, p. 52).

Irrawaddy dolphins, Indo-Pacific hump-backed dolphins, humpback whales and minke whales are all known to be taken incidentally in fishing gear in various places in the world (see comprehensive review in Perrin et al. 1994). However, of these species, the dolphins are likely to be impacted to a greater extent, because much fishing occurs in coastal waters and these species occupy nearshore habitats. There are reports of incidental take of Irrawaddy dolphins throughout their range, including in Australia (Anderson 1995; Anderson & Pirzl 1996; Marsh et al. 1989; Pirzl & Anderson 1997), Laos (Baird & Mounsouphom 1997; Stacey & Leatherwood 1997), India (Lal Mohan 1994), Thailand (International Whaling Commission 1994), Myanmar (Smith et al. 1997) and Bangladesh, Cambodia and Papua New Guinea (Stacey & Leatherwood 1997). Incidental take of Indo-Pacific hump-backed dolphins has also been reported from a number of locations, including Australia (Anderson 1995; Anderson & Pirzl 1996; International Whaling Commission 1994; Pirzl & Anderson 1997), Hong Kong (Porter et al. 1997), and Sri Lanka, India, Pakistan, Thailand and the Arafura Sea (International Whaling Commission 1994). Mortality due to entanglement in shark nets is the main threat to a population of Indo-Pacific hump-backed dolphins off the Natal Coast of South Africa (Karczmarski et al. 1998) and is considered unsustainable, averaging 7.5 individuals per year from a population of 200 animals (International Whaling Commission 1994).

Incidental take of cetaceans in nets in Queensland is a concern (Hale et al. 1998). A total of 650 dolphins, including bottlenose, Irrawaddy and Indo-Pacific hump-backed dolphins, were caught between 1963 and 1996 in shark nets set for bather protection under the Queensland Shark Control Program (Bryden et al. 1998; see also section 6.5). Some of these animals may have been released alive. It has been argued that the effect of this take is 'unlikely to be major' (Gribble et al. 1998). However, this conclusion was based on comparing annual average catch for the entire Queensland coast with anecdotal assessments of dolphin abundance by fishers and shark program contractors. The analysis was constrained by the lack of reliable data on the numbers of each species of dolphin caught and on species distributions and abundances. Nonetheless, evaluation of the threat this level of take poses to dolphin populations requires consideration of data at finer spatial and temporal scales, as is evident from the work done on bycatch of Indo-Pacific hump-backed dolphins in South Africa.

Inshore gillnetting for barramundi, shark and mackerel is believed to pose a serious threat to inshore dolphins in Australasia (Bryden et al. 1998), although exact numbers caught are unknown. The gill net fishery for barramundi and threadfin salmon in tropical waters in Queensland is known to be a cause of dolphin mortality (Environmental Protection Agency 1999). There is little information about the incidence of cetacean entanglement in fisheries occurring in and around the Marine Park (see section 6.5).

Considerable work is being done around the world to reduce incidental take of cetaceans and other species. One promising line of research involves placing sound transmitters, or 'pingers', on nets. Some studies have demonstrated a reduction in bycatch of harbour porpoises in gill nets equipped with pingers compared to nets without pingers (e.g. Kraus et al. 1997; Lien et al. 1995). Pingers are being evaluated in Queensland to determine their effectiveness in reducing marine mammal bycatch (McPherson et al. 1999).

However promising some results, other studies have been less conclusive. In a recent review, Dawson et al. (1998, p. 141) note that 'some 15 years of experiments with various acoustic methods have shown little promise of providing substantial or consistent reductions in entanglement rates'. Moreover, there are concerns about possible adverse effects of pingers. In a 1996 workshop, it was noted that any introduction of artificial sound into the underwater environment may harm marine mammals, as well as other species (Reeves et al. 1996; see also section 5.3.6). Pingers may alter the behaviour and distribution of cetaceans and other species, possibly displacing animals from key habitats. For example, acoustic deterrent devices used in mariculture operations may be altering the distributions of harbour porpoises and killer whales in Canadian waters (Baird 1999; Johnston & Woodley 1998). Moreover, where bycatch is posing a serious threat to a population, testing of various pinger designs and deployments may endanger the survival of a population (Dawson 1991b). Clearly, use of pingers should be undertaken cautiously, with rigorous monitoring of their effectiveness and any adverse effects on the target animals and other species, and should be accompanied by consideration of other ways to reduce bycatch, such as modifications to fishing practices (Dawson et al. 1998; Reeves et al. 1996).

5.3.5 Ingestion of marine debris

Cetaceans have been known occasionally to ingest discarded fishing gear and other waste materials (Bannister et al. 1996; Klinowska 1991; Secchi & Zarzur 1999). Ingested debris may interfere with feeding, cause stomach or intestinal blockages, toxicity, or other injuries that may or may not result in death (Bannister et al. 1996). Plastic debris from shipping and terrestrial sources is emerging as a significant threat to cetaceans globally, causing mortality through ingestion or entanglement (Kemp 1996).

5.3.6 Noise

Concern about the potential adverse effects of human-generated sound on cetaceans is increasing worldwide (Gordon & Moscrop 1996; Ketten 1998). Cetaceans, like many marine and aquatic organisms, rely heavily on the use of sound. Sound, unlike light and other possible communication media, travels very efficiently in water and can therefore be used over long distances (Richardson 1995b). Sound is used by cetaceans not only for communication, but also for navigation and locating food. Underwater noise, whether produced underwater or produced in air and transmitted underwater (e.g. through the hulls of boats), can interfere with all of these activities. In-air noise (e.g. from aircraft) can also affect cetaceans.

Adverse effects of noise on cetaceans can range from behavioural modification, including mild disturbance, disruption or impairment of activities (such as feeding, resting or social interaction), and displacement from key habitats, to injury, such as temporary or permanent hearing losses, or even death (see Richardson et al. 1995 for a comprehensive review). Effects may be short- or long-term, and the severity of the effect depends on the characteristics of the noise (e.g. intensity or volume, frequency or pitch, duration, frequency of occurrence, distance between sound source and cetaceans), the physical environment (e.g. water depth, bottom type), the sensitivity of the animals involved and the distance between the sound source and the animals. Short-term disturbance reactions by cetaceans to noise have been well documented, and there are also a few reports of probable or possible long-term displacement of marine mammals from areas that become subject to high levels of noise (e.g. see reference to Guerrero Negro Lagoon below), but causal relationships are difficult to demonstrate conclusively (Richardson 1995c). Documented cases of injury or mortality caused by noise are rare (but see section 5.3.7).

Different species of cetaceans have different hearing capabilities, use sound in different ways, and thus are likely to be affected differently by different types and levels of noise (Richardson 1995d). The dolphin species that have been studied all hear sounds over a wide range of frequencies (e.g. bottlenose dolphin, from 50 Hz or lower to 100 kHz or higher). Dolphins have exceptional high-frequency hearing abilities (corresponding to their echolocation capabilities, which rely upon

production and detection of high-frequency signals) but tend to be relatively insensitive to low-frequency sounds (less than 10 kHz). Sensitivity is generally poor below 1 kHz, where most industrial noise energy is concentrated. In contrast, baleen whales are thought to be sensitive to low-frequency sounds, based on ear anatomy, types of sounds produced by the animals (e.g. less than 8 kHz, and often less than 1 kHz) and observed reactions to low-frequency sounds (Richardson 1995d). Baleen whales are thought to be relatively insensitive to high-frequency sound (e.g. above 36 kHz). It has been suggested that baleen whales use low-frequency sounds to communicate over great distances.

Cetaceans may be more vulnerable or responsive to noise during some seasons, for example when seeking mates, or when performing certain behaviours or activities, such as finding food or undertaking migrations (e.g. McCauley et al. 1998; Würsig et al. 1998). Individual experience may also be important, as animals may habituate to sounds, such as those generated by steady vessel traffic. Unfortunately, it is difficult or impossible for human observers to differentiate habituation from tolerance, or even from a lack of response due to hearing impairment (see section 5.2).

It has been suggested that human-generated underwater noise, in conjunction with the effects of other human activities, may also be causing an increase in incidents of entanglement in fishing gear, collisions with vessels, and mass stranding events (Perry 1998). Any such effect is likely to be most pronounced in the coastal zone, due to the combined effects of pollution, increasing vessel traffic, coastal development and climate change, particularly where cetacean populations are already depleted. Certainly the available evidence suggests that some cetaceans are exposed to high levels of human-generated noise over a large percentage of important feeding and breeding habitats, thus potentially threatening entire populations by disrupting feeding and breeding behaviours (Perry 1998).

Most human activities in the ocean generate underwater sound. Substantial evidence indicates that the overall level of sound in the oceans has increased significantly over the last 50 years, and the effects of this on marine organisms are of concern (Popper et al. 1998). Most human-generated noise likely to affect cetaceans arises from a few types of activities: transportation, dredging, construction, hydrocarbon and mineral exploration and recovery, geophysical surveys, sonars, ocean science studies and explosions (Greene & Moore 1995). Hydrocarbon exploration and recovery and mining are prohibited in the Marine Park. Explosions are treated in section 5.3.7. The remaining activities are discussed briefly below.

Most of the increase in underwater noise is attributable to shipping (Popper et al. 1998), and shipping is the major overall source of human-generated noise in the marine environment (Gordon & Moscrop 1996). All vessels produce noise, and the amount of noise generally increases with vessel size, load and speed (Greene & Moore 1995). Changes in vessel speed or direction cause increased noise due to cavitation, the generation of tiny air bubbles. Much of the noise produced by vessels is caused by propellers, which generate more noise if they are damaged, operate asynchronously or lack nozzles. However, various types of machinery found on vessels can radiate noise through the hull into the water. Vessel noise is typically concentrated at low frequencies (less than 500 Hz: Greene & Moore 1995; Popper et al. 1998), and may therefore tend to affect baleen whales more severely than toothed whales or dolphins. However, both baleen whales and toothed whales have been documented actively to avoid vessels at distances of 2 km or more (Richardson 1995a). Conversely, approaches to vessels are also common, especially for some species (including humpback whales and several dolphin species that commonly approach vessels to ride the bow or stern pressure wave, e.g. Würsig et al. 1998). Some species seem to habituate to vessel noise, at least for some individuals in some locations, while others remain evasive (e.g. Würsig et al. 1998). The way in which the vessel is operated may influence the animals' responses. It has been suggested that rapidly approaching vessels, or sudden changes in vessel noise resulting from abrupt changes in vessel speed or direction, more often trigger avoidance reactions (McCauley et al. 1996; Richardson 1995a).

The amount of noise entering the water from aircraft varies with altitude, with the strongest sounds being received just below the water's surface, immediately beneath the aircraft (Greene & Moore 1995). Larger aircraft tend to be noisier than smaller aircraft, aircraft that are taking off or climbing are noisier than when cruising or landing, and helicopters tend to be noisier than similarly sized fixed-wing aircraft. Documented responses of cetaceans to aircraft are highly variable, and include no observable reaction, diving, slapping the water's surface with flukes or flippers, and swimming away from the aircraft's track (Richardson 1995a, Würsig et al. 1998). Sonic booms, the sharp, low-frequency pressure pulses produced by aircraft flying supersonically, can generate momentary but significant levels of underwater noise (e.g. 50 dB above ambient: Greene & Moore 1995). The high levels and sudden onset of sonic booms and similar events, such as rocket launches (Richardson 1995a), are potentially very disruptive to cetaceans, at least over the short term.

Dredges can be strong sources of predominantly low-frequency noise in the nearshore environment, but dredge noise is usually undetectable at ranges beyond 20–25 km (Greene & Moore 1995). Construction activities, whether in the water or on the shore, typically generate relatively low levels of low-frequency sound, which attenuates quickly with distance from the sound source. The effects of dredging and other construction operations on cetaceans generally have not been well documented (Richardson 1995a). However, industrial activities, including shipping and dredging, conducted in the Guerrero Negro Lagoon in Baja California appeared to displace gray whales for several years. After the levels of shipping and associated dredging were reduced, the whales returned (Richardson 1995a).

Marine geophysical surveys use pulses of high-energy sound to generate seismic waves in the sea floor, which are then analysed to provide information on geophysical structures and processes (Greene & Moore 1995). Seismic exploration generates extremely loud sounds, which are often detectable tens or even hundreds of kilometres from the source. Large whales vocalise extensively in the same frequency range as is used in seismic surveys (McCauley et al. 1998). Behavioural reactions of some species of cetaceans to seismic exploration have been documented to occur over long distances. Sperm whales have been observed to move as much as 50 km away from seismic surveys, and have ceased calling apparently in response to seismic surveys occurring over 300 km away (Richardson 1995a). Avoidance reactions at distances of two to five kilometres have been observed in several species, including humpback whales, and less dramatic reactions (such as changes in surfacing patterns) may occur at greater distances. Seismic pulses have been shown temporarily to affect the migration of gray whales (Richardson 1995a), but the level of threat posed by such effects is unknown.

A study of the reactions of migrating humpback whales to seismic surveys off Western Australia documented avoidance behaviours at ranges extending to 5–8 km, with animals generally remaining 3–4 km from the vessel. No obvious change to the migratory path was seen, and the authors concluded that effects on migrating animals were probably geographically localised and of relatively brief duration. However, the observed displacement of animals by the survey vessel could have 'profound and serious effects on individual animals and the population' if it occurred in areas in which whales are not migrating but engaging in key activities such as calving (McCauley et al. 1998). Clearly this would be a consideration for seismic surveys proposed to occur in the Marine Park, for example in the area of the Whitsundays, which appears to be a calving ground for humpback whales.

Sonars are used for many purposes, including measurement of water depth and detection of underwater objects (including fish). The two basic types of sonars are passive, which employ only listening devices to detect underwater sound, and active. Active sonar involves the generation of a pulsed sound signal, or 'ping', and the detection of reflections, or echoes, of the ping. The time between the emission of the ping and the returning echo indicates the distance to the target

(Greene & Moore 1995). The reaction of humpback whales to sonar pulses has been documented to vary with pulse frequency (Richardson 1995a). Whales moved away from pulses with a centre frequency of about 3 kHz, but did not obviously react to pulses at 27 kHz and above. Some dolphins have demonstrated avoidance reactions to sonars (pulse frequency 20 kHz and above: Richardson 1995a).

The American military has developed a Low Frequency Active (LFA) sonar to improve detection of increasingly quiet submarines. This sonar system is designed to produce extremely loud pings of 6–100 seconds duration at frequencies of 100–500 Hz (Department of the Navy 1999). The system is proposed to be used in various locations around the world, including in Australia. (It is proposed that the sonar system would not be operated in locations that would result in sound levels of 180 dB within 22 km of land.) The draft Environmental Impact Statement (EIS) for the system concludes that risks to marine mammals comprise only 'non-serious injury' and 'non-serious harassment', but that the proposed monitoring and mitigation would minimise this risk 'to a negligible level' (Department of the Navy 1999, p. ES-21). This conclusion, however, is contested in submissions on the EIS (e.g. submission by Natural Resources Defence Council, a non-governmental conservation organisation). Testing of the LFA system in the Mediterranean Sea has been proposed as the most likely cause of an atypical mass stranding of 12 Cuvier's beaked whales (*Ziphius cavirostris*: Frantzis 1998).

Some ocean science studies employ various types of sound to study the characteristics of water masses and the sea floor (Greene & Moore 1995). Of particular concern over the last few years have been some studies of acoustic investigations of water temperature, including the project entitled Acoustic Thermometry of Ocean Climate, or ATOC. These studies involve generating extremely loud, low-frequency (e.g. 57 Hz) sounds that can be detected at distances of hundreds or even thousands of kilometres (Richardson 1995a). However, studies of the effects of these activities on cetaceans and other animals have been equivocal (Richardson 1995a), and claims of both minimal effect and severe disturbance have been made by different researchers (Gordon and Moscrop 1996).

5.3.7 Explosions

Underwater explosives have been used routinely for decades, principally for defence and demolition (Greene & Moore 1995). More recently, explosions were used in seismic exploration, although modern systems tend to employ other means. Explosions have also been used in ocean science, for example to study the way in which sound travels in the sea.

Explosions generate both noise and a shock wave or front. Both the acoustic and shock waves can cause temporary, recoverable effects (such as temporary hearing loss), permanent physical injury that may be mild or severe, or death (Ketten 1995; Richardson 1995a). Other potential effects are similar to those described for noise (section 5.3.6), and include disturbance and disruption of behaviours, and displacement.

The effects of an explosion on an animal depend on the size and type of the explosive, the location of the explosion (e.g. water depth), the topography around the blast site, the location of the animal relative to the blast site, characteristics of the animal, and other factors (Ketten 1995). Several humpback whales exposed to explosions off eastern Canada sustained severe blast injuries, and died within three days of the explosions (Ketten 1995). However, explosions are probably unlikely to threaten cetacean populations, except for very small populations that cannot readily sustain the loss of one or a few individuals.

Small explosives are sometimes used in deliberate attempts to scare away marine mammals, for example from fishing gear or detonation sites of larger charges (e.g. Alaska, Gulf of Mexico, Eastern Tropical Pacific, see Richardson 1995a). However, blasts often must be repeated frequently to be effective even in the short term, and can injure or kill animals. Animals may also habituate to

the blasts, rendering them ineffective. Attempts to scare marine mammals, whether by use of explosives or noise, are prohibited or restricted in many jurisdictions (Richardson 1995a).

5.3.8 Pollution

Cetaceans, like other predators, can be affected by pollution both directly and indirectly, through contamination of prey. Toxic substances may be introduced directly into the sea, for example as industrial waste and sewage discharges, or they may be the result of terrestrial activities. The sea is the ultimate destination for many toxic substances produced or used on land. Some of the more common chemical contaminants include biocides (e.g. tributyl tin, or TBT), hydrocarbons (e.g. oil) and organochlorines.

There is no unequivocal evidence that any wild cetacean has been killed by a build-up of toxic substances. However, cetaceans are known to have extremely high rates of contaminant accumulation (Tanabe et al. 1994). As a result, cetaceans living far from industrial centres can contain much higher levels of substances such as polychlorinated biphenyls (PCBs) than terrestrial mammals living near pollution sources. This is likely due to three factors (Tanabe et al. 1994). First, many contaminants are stored in fatty tissues, such as blubber, which cetaceans possess in abundance. Second, milk produced by cetaceans is very high in fat, and therefore certain contaminants. Thus, bioaccumulation begins at a very young age, when calves suckle, and may continue over many generations as contaminants are repeatedly transmitted from mother to calf. Third, compared to humans, many other terrestrial mammals, and many species of fish, cetaceans have a reduced capacity to metabolise toxic substances, such as PCBs (Tanabe et al. 1994).

The effects of pollution in cetaceans can include development of cancers, disruption of reproduction, impairment of immune systems and neurological disorders. There are strong indications that pollution is linked to a variety of cetacean diseases, including liver disease and reproductive disorders (Hartmann 1997; Reijnders 1996). High levels of organochlorines have been found in Indo-Pacific hump-backed dolphins in Hong Kong (Parsons & Chan 1998) and in South Africa (Karczmarski et al. 1998). It has been suggested that the high mortality rate of dolphin neonates in Hong Kong may be partly due to compromised immune function resulting from exposure to organochlorines (Parsons 1998a, Parsons & Chan 1998). Hong Kong Indo-Pacific hump-backed dolphins have been found to have high tissue levels of mercury as well, which is also of concern (Parsons 1998b). Exposure to PCBs has been associated with mass mortalities in marine species, including dolphins (Hartmann 1997; Tanabe et al. 1994; see also section 5.3.9), and has also been suggested to be a predisposing factor for cetacean mortality due to infectious diseases (Jepson et al. 1999)

Baleen whales have been found to have lower levels of contamination than dolphins. This can be attributed to the fact that they generally feed lower on the food chain, typically consuming more crustaceans than fish; to their typically pelagic distribution compared to the coastal habits of many dolphin species; and to their undertaking of seasonal migrations to less contaminated areas, such as the Arctic or Antarctic (O'Shea & Brownell 1994). In the Marine Park, pollution would be expected to be more of a threat to the non-migratory coastal dolphins, particularly the Irrawaddy and Indo-Pacific hump-backed dolphins, than to dwarf minke or humpback whales. However, heavy metal pollution in the Mediterranean appears to be contaminating the prey consumed by fin whales, which either die or become debilitated and are at greater risk of being struck by vessels (Klinowska 1991).

The limited and fragmented available evidence suggests that pollutant levels in the water and sediments of the Marine Park are generally low, although some areas of high human use show localised contamination (Brodie 1995; Haynes & Johnson, in review). However, the region is a focus of commercial shipping and tourism activities and coastal population centres discharge pollutants associated with recreational, urban and industrial activities (Haynes & Johnson, in review). Many of the contaminants entering the Marine Park come from land, including

agricultural run-off and industrial discharges. As coastal development continues and human use of the Marine Park increases, it is critical to minimise, and where possible, prevent pollution at the source. This is particularly important in light of the fact that aerial deposition of contaminants in the Marine Park from distant sources is likely to increase with increasing industrial development around the world.

Oil spills are of particular concern for the Marine Park. Oils vary in their toxicity (Geraci 1990). Some types of oil release toxic vapours that can damage respiratory tissues. Harmful oil fractions may be ingested or consumed through eating contaminated prey. Thicker oily substances, such as tar balls, may remain at the water's surface, clogging baleen. However, Geraci (1990, p. 191) notes that '[i]n spite of numerous observations of cetaceans in spills, none of these effects has been…recorded with any certainty'. While the common assumption that whales and dolphins will always avoid oil spills is clearly in error (e.g. see reviews in Geraci & St Aubin 1990; Loughlin 1994a), evidence of direct mortality of cetaceans exposed to oil is circumstantial at best. For example, after the 1989 grounding of the *Exxon Valdez*, resulting in the largest oil spill in the history of the United States, 37 dead cetaceans were found, including 26 gray whales. However, no causes of death could be determined, despite testing tissues from seven carcasses for hydrocarbon analysis. The large number of gray whale carcasses was attributed to the coincidence of the intensive search with the natural migration season (Loughlin 1994b). Work done to date thus suggests that any threat to cetaceans from oil in the Marine Park may be secondary, resulting from the damage to the ecosystem as a whole.

An oil spill contingency plan, called Reefplan, has been developed for the Great Barrier Reef World Heritage Area. Reefplan outlines the policies and strategies which will be implemented for effective and timely response to a marine or land-sourced oil spill occurring in the waters of the GBRWHA (AMSA 1997).

Although major oil spills pose serious risks to marine ecosystems, including cetaceans, small but frequent operational discharges introduce far greater quantities of oil into the sea on an annual basis. Under the *International Convention for the Prevention of Pollution from Ships* (MARPOL 73/78), all ships, including fishing vessels and recreational craft, are prohibited from operational discharges of oily wastes between the coast and the outer edge of the Reef.

Non-toxic pollutants that are introduced into the sea, such as nutrients and sediments, can also affect the environment dramatically, for example causing algal blooms or smothering coral reefs. Declines in water quality will affect cetaceans, along with the rest of the marine ecosystem.

5.3.9 Disease

A great variety of infectious and non-infectious diseases have been documented in cetaceans worldwide (see review in Hartmann 1997). Disease outbreaks have been responsible for mass die-offs of cetaceans, such as the dolphin morbillovirus outbreaks that caused large-scale mortalities of bottlenose dolphins in the United States in 1987–88 and 1994 and of striped dolphins in the Mediterranean Sea in 1990–1991 (Bannister et al. 1996; Wilkinson 1996; Worthy 1998). No such outbreaks have been demonstrated in Australia. However, it has been suggested that the incidence of such epidemics, and marine diseases in general, is increasing. Climate variability, associated with the current warming trend, and human activities, including those resulting in habitat degradation and marine pollution, may facilitate disease outbreaks (Harvell et al. 1999).

Pollution can cause disease directly or indirectly. The presence of toxic substances in the environment, or other factors that impose physiological stress on cetaceans, may increase susceptibility to disease, for example by impairing the immune systems of the animals.

Precise causal links between pollution and disease in marine mammals have been difficult to demonstrate due to the number of factors that can contribute to the cause of disease, including

environmental factors (e.g. changes in climate or prey availability) physiological factors, and interactions between different chemicals in the environment (Hartmann 1997). However, in many dolphins, pollutant levels are high enough that disease is to be expected. Further, high levels of pollutants and high levels of disease often co-occur, as with beluga whales in the St Lawrence River, on the US–Canadian border, or during the Mediterranean Sea striped dolphin morbillovirus outbreak (Hartmann 1997).

Cetaceans exposed to human or animal wastes may be at risk of contracting diseases, but the degree of risk is difficult to assess. A study of bottlenose dolphins in the Moray Firth, Scotland, revealed a high incidence (70 of 74 animals observed in a population of 130 individuals) of skin lesions and physical deformities (Wilson et al. 1997). Although the cause was not determined, it was noted that human and agricultural sewage enters the bay, and that natural pathogens and pollutants had been identified.

Disease outbreaks can also affect cetaceans indirectly, for example through mass mortality of prey such as particular fish species.

5.3.10 Live capture

Capturing cetaceans affects not only individual animals, but also to some extent the populations from which they are removed. Further, the act of capturing or attempting to capture animals can involve repeated chasing and trapping or netting of individuals or groups of animals, until the desired animals are successfully captured. These activities generate noise, cause physical disturbance and behavioural modification, and are stressful and disruptive to the animals. High-speed vessel manoeuvring in close proximity to animals is often required, which poses the additional risk of boat strikes.

The capture of live cetaceans from Commonwealth waters, whether for public display or other purposes, requires a permit under the *Whale Protection Act 1980*. However, Government policy and practice are that no further permits are to be granted for the capture of cetaceans in Commonwealth waters for purposes of public display. The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, which takes effect in July 2000, states that permits must not be granted to take a cetacean for live display.

In Queensland waters, a permit under the *Nature Conservation Act 1992* is required to capture whales and dolphins, but, under the Management Program for the Conservation of Whales and Dolphins in Queensland 1997–2001, capture for purposes of public display is not permitted. The Program provides for permits to be issued for the rescue of sick or injured animals, conditional upon the animals not being made available for public display and on the animals being released into the wild when fully recovered (Department of Environment 1997.

5.3.11 Physical habitat degradation or destruction

In addition to declines in water quality and increases in noise discussed above, other forms of habitat degradation or destruction (e.g. Bannister et al. 1996; Klinowska 1991) may adversely affect cetaceans. For example, coastal development may modify shorelines or water depths, which may degrade or destroy key cetacean habitats such as bays used by animals to shelter from predators or to calve. Land reclamation, construction, dredging, and dumping can all result in habitat loss in the coastal zone (Kemp 1996).

The effects of physical habitat degradation or destruction depend on a variety of factors, including:

- whether the degraded areas are key habitats;
- the size of the degraded area; and
- the degree and persistence of the degradation.

Key habitats remain largely unknown for cetaceans. However, inshore species, such as the Irrawaddy dolphin and the Indo-Pacific hump-backed dolphin, are clearly most at risk from this type of impact because they live in the coastal zone, which is typically subject to the highest levels of use, construction, and other modifications (Bannister et al. 1996; Karczmarski et al. 1998; Klinowska 1991; UNEP 1996). However, even oceanic species may be vulnerable when they move inshore at specific times, such as during calving seasons (Kemp 1996).

Habitat disruption or destruction can also affect cetaceans indirectly. For example, coastal developments can destroy fish nurseries, resulting in depletion of prey available to dolphins (Bannister et al. 1996; Klinowska 1991; see section 5.3.12). Further, coastal waters are the most productive ecosystems in the marine environment, so degradation of coastal habitats can have a disproportionately adverse effect on overall marine productivity and entire ecosystems (Kemp 1996).

5.3.12 Prey depletion

Cetaceans are predators; their prey includes small shrimp-like crustaceans (eaten by baleen whales), fish (eaten by baleen and toothed whales, dolphins), squid (eaten by toothed whales and dolphins), and mammals (eaten by orcas). Thus depletion of prey species can affect cetaceans (Bannister et al. 1996; Klinowska 1991).

The effects of prey depletion on cetaceans will depend on many factors, including:

- the areal extent and magnitude of the depletion;
- the duration of the depletion; and
- whether alternative prey species are available.

The effects of prey depletion may range from mortality of vulnerable individuals (e.g. very young or old animals, injured animals), to reproductive failure for a season or longer, to mass mortality. Prey depletion may also make animals more susceptible to other impacts, for example if animals are consuming inferior food items (e.g. items of lower caloric or energy value). Cetaceans that are restricted to narrow and specific habitats, such as Irrawaddy dolphins and Indo-Pacific hump-backed dolphins, may be particularly at risk (Bannister et al. 1996).

A study of a decline in sperm whales, seals and other marine mammal populations in the Bering Sea revealed that reductions in prey abundance can quickly reduce marine mammal populations. However, marine mammals are unable to recover quickly when prey abundance increases (Trites et al., in press).

Significant changes in prey species abundances and distributions can result from natural causes, such as the periodic warming of waters in the southern oceans referred to as El Niño events or southern oscillations. Depletion of prey can also be an indirect result of human activities, such as through pollution or other environmental changes, or a direct result, such as through overfishing of particular species.

Modern fisheries have the potential to compete with cetaceans for some prey species (Bannister et al. 1996). Possible threats to some cetacean populations from depletion of prey stocks due to fishing are receiving increasing consideration in the scientific community, but conclusive evidence of any such effect is so far lacking (e.g. Earle 1996; Hutchinson 1996; Porter et al. 1997).

Fisheries competition for prey species is suspected to be a threat to Indo-Pacific hump-backed dolphins in Hong Kong (Porter et al. 1997), where animals are commonly observed following fishing trawlers (Parsons 1998c). Bottlenose dolphins in Moreton Bay, Queensland, also feed in association with trawlers, and it has been suggested that this may be a response by the animals to a change, or decrease, in available prey (Corkeron 1997). However, cetacean exploitation of

fisheries, including gillnets and trawls, for food is widespread and may simply reflect the ability of the animals to take advantage of concentrated food resources (Fertl & Leatherwood 1997).

Currently, there is no evidence that cetacean populations in the Marine Park are threatened by prey depletion.

5.3.13 Physical displacement

Cetaceans may be physically displaced by vessels, structures, or people occupying or seeking to occupy the same physical space. For example, shipping and other activities related to an evaporative salt works apparently caused gray whales to stop wintering in the Guerrero Negro Lagoon in Mexico; when shipping decreased a few years later, the whales returned (Richardson 1995a; see also section 5.3.6).

The effects of physical disturbance or displacement depend on a variety of factors, including:

- whether animals are displaced from key habitats;
- the frequency of displacement;
- the duration of displacement;
- the size of the area from which the animals are displaced; and
- the number of animals in a population that are displaced.

5.4 Summary and Conclusions

The potential impacts of greatest relevance to cetacean populations in the Marine Park are noise, harassment and additionally, for Irrawaddy and Indo-Pacific hump-backed dolphins, entanglement in shark and fish mesh nets. Vessel strikes could become a concern for humpback whales as the numbers of whales increase, but are not currently considered to pose a threat to the population. For inshore dolphins, particularly Irrawaddy dolphins and Indo-Pacific hump-backed dolphins, pollution, habitat degradation, physical habitat degradation or destruction and displacement have the potential to threaten at least some populations. Other potential threats, such as those arising from disease, could develop in the future.

Management measures aimed at conserving whales and dolphins in the Marine Park should focus on gathering better information on cetacean distributions, abundances and threats, and taking prudent and appropriate measures to reduce impacts judged to be most significant. However, management also needs to take reasonable measures to anticipate and respond to future issues, such as disease outbreaks or unfavourable environmental change. Management measures should reflect the level of threat, the degree of certainty, and incorporate the precautionary principle.

6 Human Activities In the Great Barrier Reef Marine Park

A variety of human activities occurring in and around the Marine Park are known, or thought likely, to adversely affect cetaceans. It is important that management measures consider not only the potential impacts of individual activities, but also the potential cumulative impacts of all activities that are likely affecting each population, over both the short and long terms.

There is insufficient scientific information to determine definitively whether adverse effects on cetaceans from human activities are sustainable, or, in some cases, whether they are actually occurring. In the absence of such information, because there is a risk of serious or irreversible damage to cetacean populations, the precautionary principle must be employed. The absence of scientific certainty must not be used as a reason for failing to take prudent measures to conserve cetaceans, while allowing for reasonable human use of the Marine Park and all that it contains.

Following is a discussion of the types of potential impacts of human activities on cetaceans in the Marine Park. It should be noted that many of the impacts identified may apply not only to cetaceans, but also to other animals, such as dugongs and turtles.

The following discussion is based largely on effects of human activities on cetaceans documented in other parts of the world, because few data on specific impacts are available from the Marine Park or from Australia generally. Thus, the lack of information about specific impacts is an issue for management of all activities. Management must evolve as more information becomes available on the distribution and abundance of cetacean populations in the Marine Park, key habitats for cetacean populations and specific threats to particular populations.

Effective management requires a variety of approaches and elements. Conservation of cetaceans in the Marine Park will depend heavily on educating people about the whales and dolphins in the Marine Park, the potential adverse effects of human activities on the animals, and ways to reduce those effects. For particular groups of people, such as recreational boaters, commercial tour operators or fishers, implementation of appropriate codes of practice can be very effective in reducing impacts on cetaceans. Permits are required for commercial tourist operations in the Marine Park, and are an important management element. For commercial tour operators, and perhaps especially for those operators conducting whalewatching, a training and accreditation process could be an effective approach to minimising adverse impacts on cetaceans while promoting public understanding and appreciation of the animals.

Legislative measures, such as regulations made under the *Great Barrier Reef Marine Park Act 1975*, are necessary to underpin other measures. However, regulations should be used sparingly, and only for those elements currently considered essential for cetacean conservation.

Table 2 provides a summary of the main potential impacts of specific human activities on cetaceans in the Marine Park.

6.1 Use of Vessels and Aircraft

Vessels using the Marine Park range from surfskis and personal watercraft to ocean-going freighters, cruise ships, and military vessels (see section 6.6). Vessels are operated in association with a variety of activities, including recreational use, commercial tours, public transport (ferries), cruise ships, commercial and recreational fishing, and commercial shipping.

Recreational boaters in the Marine Park constitute a large and diverse group. They include experienced boaters and relative novices, and they operate a wide variety of vessel types, including motorised and non-motorised vessels, ranging in size from personalised watercraft and sailboards to large ocean-going yachts of various sizes and configurations. Recreational vessels may be privately owned or chartered from companies offering crewed boats and bareboats (not crewed) for hire. With the advent of relatively inexpensive and sophisticated navigational aids (e.g. GPS) and other technological advancements, recreational boaters can venture further from shore, operate under a wider variety of weather conditions, and stay at sea for longer periods of time.

Chartering companies require permits to operate within the Marine Park. Some privately owned vessels, such as speedboats, require licences from Queensland Transport. All vessels having motors with greater than 4 hp or 3 kW braking power must be registered with the State.

Commercial tour operators undertake a wide variety of activities, including whalewatching, scenic cruises, island and reef trips, glass-bottomed boat rides, snorkelling and diving trips, and marine thrill rides. Trips may last an hour or less, or extend for a few days, weeks, or even

months. The sizes and types of vessels used similarly vary. All Marine Park tour operators require permits. Some activities, such as whalewatching, require specific permissions (see section 6.2).

There are a number of passenger and vehicle ferries operating in the Marine Park. These vary in size, speed and capacity. All ferries require permits to operate in Marine Park waters.

The Marine Park contains several major shipping routes and reef passages utilised by commercial ships. An estimated 3000 large ships transit the Inner Route of the Great Barrier Reef annually. All Australian-owned commercial ships 24 m and over in tonnage length, capable of navigating the high seas, must be registered with the Australian Register of Ships. All cruise ships require permits if they wish to operate or anchor in the Marine Park.

The Great Barrier Reef poses numerous challenges to navigation, including shoals and reefs, strong trade winds, fast-running tidal streams and occasional cyclones, and has been designated as a Particularly Sensitive Sea Area by the International Maritime Organization (IMO). This allows special marine environmental protection measures to be applied to shipping activities. Some vessels are required to use licensed pilots in specified areas; the Australian Maritime Safety Authority (AMSA) strongly recommends that all ships' masters unfamiliar with routes and reef passages use licensed pilots (Queensland Transport & the Australian Maritime Safety Authority 1997). The IMO has also designated a central portion of the Capricornia/Bunker Islands and Reefs of the Marine Park as an Area to be Avoided by ships over 500 tons gross tonnage.

Additionally, there are special requirements under the *International Convention for the Prevention of Pollution from Ships* (MARPOL 73/78) for ships navigating in the Great Barrier Reef World Heritage Area, including restrictions on operational discharges.

Air traffic in the Marine Park includes scheduled commercial flights, Defence activities (see section 6.6), small passenger charters, and aircraft used to support commercial operations (passenger transport, whale spotting and supply and maintenance). Both fixed-wing craft and helicopters are used, being equipped for landings on the ground and/or the water. Permits are required for any aircraft operating as or in conjunction with commercial tour operations.

6.1.1 Types of potential impacts

All vessels have the potential to affect whales and dolphins. Possible impacts of vessels on cetaceans include:

- ship and boat strikes on cetaceans;
- noise;
- harassment;
- pollution (air and water); and
- physical displacement.

The types and magnitudes of impacts generated by a vessel are largely determined by characteristics such as size, speed, hull composition and propulsion system. Large vessels can pose a greater risk of serious injury or death in the event of a strike on cetaceans, and can also produce higher levels of noise and pollution. Fast vessels generally are noisier (section 5.3.6), and may be more at risk of striking cetaceans than are slower craft; many cetaceans are relatively slow swimmers, and even the fastest dolphins are slower than high-speed vessels. Additionally, faster vessels allow people to travel greater distances in shorter time periods, thereby increasing use of areas that were previously inaccessible and extending the geographic extent of human activities and consequent impacts on cetaceans and the environment generally. Hull composition affects the amount of noise that is transmitted into the water; motorised aluminium skiffs or ‘tinnies’ typically produce very high levels of underwater noise for small craft.

Some outboard engines are highly inefficient at fuel combustion and discharge up to a third of the fuel consumed directly into the water. However, sailing vessels and other quiet watercraft can be difficult for cetaceans to detect, thus increasing the risk of striking or startling animals. Small, fast, highly manoeuvrable vessels with shallow draughts, such as jet skis, may pose particular risks to dolphins in nearshore and estuarine environments. Preliminary evidence from Moreton Bay suggests that bottlenose and Indo-Pacific hump-backed dolphins will move away from shallow areas when a vessel approaches at high speed (greater than 30 km / h), and will avoid entering areas when high-speed boat traffic is present. In a study of dolphins in Moreton Bay, Hale et al. (1998, p. 483) concluded that '[i]t is likely that the operation of high speed vessels, including jet skis, has a negative impact on habitat use by dolphins'.

Aircraft are principally of concern when flying at low altitudes (see discussion in Richardson 1995a). The main impact generated by aircraft is noise (section 5.3.6), but strikes on cetaceans are possible for aircraft that land on the water. Shadows of low-flying aircraft passing overhead or nearby have been known to startle cetaceans and cause short-term avoidance behaviour (e.g. hasty dives, slapping water's surface with fluke or flippers, change of swim speed and / or direction). Helicopters are often more disturbing to animals than fixed-wing craft at low altitudes. This may be due to the noise and / or the downdraught created by the rotors (Richardson 1995a).

Impacts also depend on the purpose of the vessel or aircraft, or the activity in which it is engaged. Activities such as whalewatching and fishing can generate impacts additional to those discussed above, and are discussed in subsequent sections.

The behaviour and experience of operators can also influence the impacts of vessels and aircraft on cetaceans. For example, some boaters are unfamiliar with the area, and some are unfamiliar with basic boat-handling practices. Boaters and pilots may also be unfamiliar with cetaceans and not realise the possibility or potential effects of disturbing cetaceans. If vessel or aircraft operators are not aware that cetaceans are in the area, do not know about the potential impacts of vessels and aircraft on cetaceans, and are unaware of practices to minimise such impacts, the risks to cetaceans are higher than with better-informed operators. Thus vessel and aircraft operator education and licensing programs can be effective tools to minimise impacts on cetaceans.

The potential effects of the above impacts on cetaceans include injury or death (from vessel strikes) and behavioural modification, such as interruption of activities or displacement from areas of high traffic (see sections 5.3.2, 5.3.3, 5.3.6, 5.3.8, and 5.3.13). The type and extent of effects depend on factors such as:

- the numbers and types of vessels and aircraft;
- the routing of vessel and air traffic relative to key cetacean habitats; and
- the timing of vessel and aircraft traffic and activity relative to migration patterns.

The Cairns and Whitsundays areas are the focal points for most tourism activities in the Marine Park. Plans of Management have been developed for both of these areas. A central objective of both Plans is to limit and manage vessel access to, and use of, the areas in order to allow reasonable, sustainable human use while protecting natural, cultural, social and scientific values for all time. Additionally, the *Whitsundays Plan of Management* implements specific limitations on approaching whales, in recognition of the apparent importance of this area as a calving ground for humpback whales. The Plan establishes a Whale Protection Area within which vessels and aircraft must not approach closer than 300 m to whales. In the remainder of the area covered by the Plan, vessels and aircraft must not approach closer than 100 m to whales. Additional Whale Protection Areas may be considered in future in other areas of the Marine Park if other key cetacean habitats are identified.

The Australian National Guidelines for Cetacean Observation (Environment Australia 1999) also specify minimum approach distances to cetaceans for vessels and aircraft. No vessels are to

approach closer than 100 m to a whale or 50 m to a dolphin (distances do not apply if animals approach vessels). Fixed-wing aircraft are not to operate lower than 1000 feet within a 300 m radius of a cetacean, and helicopters are to remain at least 1000 m away from animals and maintain an altitude of at least 1000 feet. The National Guidelines also contain recommendations for operating vessels and aircraft near cetaceans. These guidelines apply to the Marine Park, and some will be implemented as regulations under the *Great Barrier Reef Marine Park Act 1975*.

In Queensland waters, under the *Nature Conservation (Whales and Dolphins) Conservation Plan 1997–2001*, boats generally must not approach closer than 100 m to a whale. Jet skis generally must not approach closer than 300 m to a whale or 100 m to a dolphin. Fixed-wing aircraft generally must not be closer than 300 m or 1000 feet to a whale. For helicopters, the limit on approaching whales is 1000 m or 2000 feet. However, these provisions do not apply to persons acting under specified permissions.

6.2 Whalewatching

Both recreational and commercial whalewatching occur in the Marine Park. (For the purposes of this document and the policy, the term 'whalewatching' is used to refer to observation of whales and / or dolphins.) Within the Marine Park, whalewatching may be conducted from vessels or aircraft.
Recreational whalewatching does not require a specific permit. It likely occurs primarily on an opportunistic basis and principally in the areas of the Marine Park that are subject to the highest levels of use by recreational and tourist vessels, namely the Whitsundays and Cairns areas.

Most commercial tour operators within the Marine Park focus on providing access to the reef, often with snorkelling and / or scuba diving, and watch whales or dolphins only if convenient and as an opportunistic element of their main operations. These 'incidental' whalewatching operators do not require specific whalewatching permissions unless they advertise whalewatching, employ spotter aircraft to locate whales, and / or operate vessels or aircraft in a manner to actively search for and observe cetaceans. Aircraft-based whalewatching occurs mainly on an opportunistic basis.

A few operators conduct trips that are dedicated to whalewatching, and therefore require specific whalewatching permissions. These 'dedicated' operators may advertise that they offer whalewatching, and may employ spotter aircraft to locate cetaceans. Currently, one tour operator in the Marine Park routinely employs spotter aircraft.

The different levels of effort that dedicated and incidental commercial operators expend on whalewatching have two main implications for management. Because the dedicated whalewatching boats seek to, and generally do, spend more time close to cetaceans in order to allow observation, they are, other things being equal, likely to cause greater cumulative impacts on the animals than are the opportunistic or incidental whalewatchers. However, the dedicated whalewatchers often have more experience with locating and watching whales and dolphins with minimal disturbance to the animals. Incidental whalewatchers may cause greater disturbance to the animals per whalewatching event or period because they are less familiar with the behaviour of the animals and with operating practices that minimise disturbance.

Most dedicated and incidental commercial whalewatching operations in the Marine Park are in the Whitsundays and Cairns areas, which are the areas of the Marine Park that are subject to the highest levels of human activity generally. In the Whitsundays, whalewatchers generally focus on humpback whales. In the Cairns area, there are dedicated whalewatching operations focused on the dwarf minke whales that occur in the Ribbon Reefs area in June and July. These operations often involve people observing the animals not only from vessels, but also whilst in the water. The latter is considered a specialised form of whalewatching, and is discussed in section 6.3.

Whalewatching of humpback whales and other species in the Cairns area occurs principally on an opportunistic (incidental) basis.

If properly managed, whalewatching can benefit cetaceans through promoting increased public understanding and appreciation of the animals and their needs (e.g. IFAW et al. 1997). Watching whales and dolphins provides people not only with the opportunity to enjoy observing the animals, but also to learn about them and their roles in the marine ecosystem. Commercial whalewatching operations can be a significant source of revenue, which can in turn provide increased incentive to conserve whales and dolphins to ensure the industries remain viable. Further, whalewatching operations can provide useful information on the distribution, relative abundance, and behaviour of cetaceans, information that is needed for effective management (Leaper et al. 1997). However, these benefits must be weighed against the variety of potential adverse effects of this activity, which require careful management in cooperation with the industry.

6.2.1 Types of potential impacts

The potential impacts of vessels and aircraft on cetaceans discussed in section 6.1 apply to commercial and recreational whalewatching, but may be intensified because whalewatching vessels and aircraft spend more time looking for, and operating in close proximity to, whales and dolphins in order to observe the animals.

The types and magnitudes of impacts caused by whalewatching are highly dependent on the way that vessels or aircraft are operated. For vessels, high-speed manoeuvring or pursuit and constant and rapid changes of vessel speed and direction are generally more disruptive to the animals than slow, quiet manoeuvring (e.g. McCauley et al. 1996). Aircraft can disturb cetaceans when flying at low altitudes overhead or nearby (section 5.3.6). As mentioned previously, helicopters are often more disruptive to cetaceans at low altitudes than are fixed-wing aircraft.

Injury and mortality of animals are possible effects of whalewatching. In 1998, in the north-eastern United States, a 24 m whalewatching vessel struck and killed a minke whale and a 37 m whalewatching vessel struck and injured a two-year-old humpback whale calf. A commercial whalewatching vessel struck a humpback whale in Hervey Bay in 1992, resulting in ‘minor injury’ to the whale (Jeffery 1993).

However, the most likely and best-documented effects of whalewatching on cetaceans are short-term behavioural changes, which have been described for a variety of species (see reviews in IFAW et al. 1995 and Findlay 1997). Typical behavioural changes include active avoidance of vessels or aircraft, and changes in diving or breathing patterns, group size and cohesion (e.g. groups forming or splitting), and the occurrence of aerial behaviours (such as tail slaps or breaches). For humpback whales, the most common focus of whalewatching activities globally, it is not disputed that commercial whalewatching can cause short-term behavioural impacts (Corkeron & Bryden 1998; see also Corkeron 1995). Animals in some cases react more strongly to whalewatching boats than to other vessels (e.g. fishing boats, ferries). This is probably due to the tendency of whalewatching vessels, unlike other craft, to follow their subjects, reacting to the movements of the animals (Janik & Thompson 1996).

The cumulative long-term effects of these short-term reactions are not clear, and population-level effects have not been demonstrated (Baird 1999; Corkeron & Bryden 1998). However, there is growing concern that whalewatching, if not properly managed, may threaten cetacean populations (e.g. Baird 1999; Smith 1997). Long-term effects could include displacement from important habitats and stress, which can interfere with reproduction and immune function (Findlay 1997). In 1996, the International Whaling Commission (IWC) formally recognised ‘the need for precautionary measures to ensure that the continuing development and expected expansion of whalewatching activities do not adversely affect cetacean populations, individual

animals, or their environment, or significantly increase the risk to the survival or ecological functioning of such populations' (International Whaling Commission 1997a: IWC Resolution 1996–2). The IWC established a Whalewatching Working Group, to, among other tasks, assess the potential impacts of whalewatching on cetaceans and develop guidelines for its management. The Working Group developed three general principles for whalewatching, which were agreed by the IWC Scientific Committee in 1996. The first principle is directed primarily at managers, the second and third mainly at operators (International Whaling Commission 1997a, see box).

General Principles for Whalewatching Agreed by the IWC Scientific Committee

1) Manage the development of whalewatching to minimise the risk of adverse impacts:

i) implement as appropriate measures to regulate platform[1] numbers and size, activity, frequency and length of exposure in encounters with individuals and groups of whales;
- management measures may include closed seasons or areas where required to provide additional protection;
- ideally, undertake an early assessment of the numbers, distribution and other characteristics of the target population/s in an area;

ii) monitor the effectiveness of management provisions and modify them as required to accommodate new information;

iii) where new whalewatching operations are evolving, start cautiously, moderating activity until sufficient information is available on which to base any further development;

iv) implement scientific research and population monitoring and collection of information on operations, target cetaceans and possible impacts, including those on the acoustic environment, as an early and integral component of management;

v) develop training programs for operators and crew on the biology and behaviour of target species, whalewatching operations, and the management provisions in effect;

vi) encourage the provision of accurate and informative material to whalewatchers, to:
- develop an informed and supportive public;
- encourage development of realistic expectations of encounters and avoid disappointment and pressure for increasingly risky behaviour.

2) Design, maintain and operate platforms to minimise the risk of adverse effects on cetaceans, including disturbance from noise:

i) vessels, engines and other equipment should be designed, maintained, and operated during whalewatching, to reduce as far as practicable adverse impacts on the target species and their environment;

ii) cetacean species may respond differently to low and high frequency sounds, relative sound intensity or rapid changes in sound;
- vessel operators should be aware of the acoustic characteristics of the target species and of their vessel under operating conditions; particularly of the need to reduce as far as possible production of potentially disturbing sound;

iii) vessel design and operation should minimise the risk of injury to cetaceans should contact occur; for example, shrouding of propellers can reduce both noise and risk of injury;

iv) operators should be able to keep track of whales during an encounter.

3) Allow the cetaceans to control the nature and duration of 'interactions':

i) operators should have a sound understanding of the behaviour of the cetaceans and be aware of behavioural changes which may indicate disturbance;

ii) in approaching or accompanying cetaceans, maximum platform speed should be determined relative to that of the cetacean, and should not exceed it once on station;

iii) use appropriate angles and distances of approach; species may react differently, and most existing guidelines preclude head-on approaches;

iv) friendly whale behaviour should be welcomed, but not cultivated; do not instigate direct contact with a platform;

v) avoid sudden changes in speed, direction or noise;

vi) do not alter platform speed or direction to counteract avoidance behaviour by cetaceans;

vii) do not pursue[2], head off, or encircle cetaceans or cause groups to separate;

viii) approaches to mother/calf pairs and solitary calves and juveniles should be undertaken with special care; there may be an increased risk of disturbance to these animals, or risk of injury if vessels are approached by calves;

ix) cetaceans should be able to detect a platform at all times;
- while quiet operations are desirable, attempts to eliminate all noise may result in cetaceans being startled by a platform which has approached undetected;
- rough seas may elevate background noise to levels at which vessels are less detectable.

The extent to which animals and populations are affected by whalewatching depends on factors such as:

- the type of whalewatching platform (e.g. type of vessel or aircraft);
- how often and for how long individual animals are watched;
- the percentage of the population that is watched;
- the number of boats and / or aircraft in close proximity to the animals at any one time;
- whether the animals have access to areas in which they will be relatively free from human activities, including whalewatching;
- the behavioural or activity state of the animals;
- whether whalewatching is occurring in key habitats; and
- the responses of the animals to being watched, including the frequency with which whalewatching causes the animals to actively avoid the vessels or aircraft or to suspend important behaviours, such as feeding, nursing or mating.

It is essential therefore for management to take account of these factors. Around the world, in an increasing number of countries, whalewatching management regimes are being developed or strengthened (see review in Carlson 1996). Among the most common management measures are minimum approach distances (ranging from 50 to 500 m, but 14 of 38 regimes surveyed specified 100 m), and a prohibition on chasing whales, altering whales' behaviour or separating a whale from a group (Carlson 1996).

One of the most critical but challenging aspects of managing whalewatching is determining the 'carrying capacity', or the amount of whalewatching that is ecologically sustainable over the long term. Carrying capacity clearly depends on the sensitivity of the particular cetacean population, characteristics of the whalewatching operations (e.g. frequency of trips, duration of trips, noise generated by vessels, manner in which vessels are operated), the local environment (e.g. whether the animals can be 'herded' against land), the health of the population, other threats to the population, and a host of other factors. However difficult to determine, the need to set appropriate limits to whalewatching effort (including, but not limited to, restrictions on the number of boats) is recognised (e.g. IFAW et al. 1995; International Whaling Commission 1997a; Karczmarski et al. 1998).

In Australia, whalewatching is recognised as a potential threat to cetaceans (Australian National Parks and Wildlife Service 1989; Bannister et al. 1996; Marsh et al. 1994). The Australian National Guidelines for Cetacean Observation (Environment Australia 1999), which apply to the Marine Park, contain detailed and comprehensive guidelines for vessel and aircraft approaches to cetaceans, including vessel and aircraft approach limits for whales and dolphins (see section 6.3), operating procedures for vessels when close to animals, and many other aspects of whale and dolphin watching. The National Guidelines are intended to apply both to commercial and recreational whalewatching activities, and to minimise harmful impacts on cetacean populations while ensuring that opportunities for watching or interacting with wild whales and dolphins can be sustained.

In Queensland waters, commercial whalewatching operations require permits and are restricted to operating within State Marine Parks. The Management Program for the Conservation of Whales and Dolphins in Queensland 1997–2001 includes permit assessment guidelines to be used for all applications for new commercial whalewatching permits or for renewals of existing permits. Factors to be considered in permit assessments include previous experience, knowledge of the animals and the environment, quality of education / interpretive programs, characteristics of the vessel, and frequency of operation (Department of Environment 1997).

In the Marine Park, the principal consideration is the effects of whalewatching on priority species: humpback whales, dwarf minke whales, Irrawaddy dolphins and Indo-Pacific hump-backed

dolphins (section 4.2). Most whalewatching activities focus on humpback whales, but dwarf minke whales are also watched, as are various species of dolphins when the opportunity arises. Irrawaddy and Indo-Pacific hump-backed dolphins are not known to be subject frequently to whalewatching, but this could develop in future. An industry based on observing Indo-Pacific hump-backed dolphins has been suggested for South Africa (Karczmarski et al. 1998), and Irrawaddy dolphins, along with bottlenose and common dolphins, are listed in *Whales and Whalewatching in Australia* as the species of dolphins most likely to be seen in Australia (Australian National Parks and Wildlife Service 1989).

Areas of the Marine Park in which there are high levels of human activity are also areas in which whalewatching tends to be concentrated. Care must be taken to ensure that effects of vessel traffic on cetaceans are managed effectively, and that whalewatching is properly regulated to ensure ecological sustainability. One of the busiest areas of the Marine Park is the Cairns Area. The *Cairns Area Plan of Management* limits commercial whalewatching permits within the Plan Area to those already issued. This will allow development of long-term strategies for managing this activity.

Of particular concern in the Marine Park are the potential effects of whalewatching on pregnant humpback whales and mothers with young calves, which may be particularly sensitive to disturbance.

The Whitsundays are a humpback calving area, and cows with young calves are frequently the focus of commercial whalewatching activities. Much of the area is quite shallow, and there are numerous islands, many of which have bays frequented by whales. This geography restricts to some extent the animals' movements, and whales or dolphins may be deliberately or inadvertently trapped between vessels and land. For these reasons, caution is required in managing whalewatching in the area. Accordingly, inside the Whale Protection Area established under the *Whitsundays Plan of Management*, commercial whalewatching is not allowed and no vessel may approach closer than 300 m to a whale. In the remaining portion of the Planning Area (outside the Whale Protection Area), commercial whalewatching is allowed, but no vessel may approach closer than 100 m to a whale. The Plan also limits the number of commercial whalewatching permissions in the Plan area to those already issued, places restrictions on how close fixed wing aircraft and helicopters may approach a whale, and prohibits commercial tourism operations from using helicopters for whale spotting.

Given that humpback whales migrate up and down the eastern Australian coast and that whalewatching presently occurs in New South Wales, Hervey Bay, Moreton Bay, and in the Whitsundays, it is possible that individual animals could be subject to whalewatching virtually throughout their journeys. This would be of particular concern considering that whales travelling to and from the Whitsundays calving grounds will include pregnant females during the northward migration, and mothers with young calves during the southward migration. This situation should not be permitted to develop, and whales should be provided with some refuges from the impacts generated by whalewatching.

The Management Program for the Conservation of Whales and Dolphins in Queensland 1997–2001 states that '[i]n response to the high level of existing and potential whale watching in Queensland and New South Wales, the Department of Environment will not permit commercial whale watching north of the southern boundary of the Great Barrier Reef Marine Park through the Capricorn and Bunker Groups, in Keppel Bay and through the Swain Reefs and reefal lagoon (i.e. central Queensland coast offshore from approximately Gladstone to Mackay)' (Department of Environment 1997, p. 3).

Over the long term, a Reef-wide strategy for managing commercial whalewatching is required. This strategy should draw upon the best available scientific information, review existing management measures, and consider appropriate limits on whalewatching, including

establishment of whalewatching refuges or additional Whale Protection Areas. It is possible that the levels of permitted whalewatching in the Marine Park may be increased without unduly threatening cetacean populations, particularly if the numbers of humpback whales continue to increase. However, it must be remembered that the humpback population, although growing, is still severely depleted. Therefore, management of whalewatching activities should proceed cautiously, and possible growth in the scale, number or geographic extent of whalewatching operations should consider the conservation status of the animals and the cumulative effects of the activity on cetacean populations. Possible expansion of the industry into observation of other species should similarly be considered carefully.

Whalewatching should be managed to avoid causing changes in cetaceans' population characteristics, such as birth rates and mortality, and in the animals' distribution, habitat use and behaviour (IFAW et al. 1995). If such changes are detected, whalewatching management should respond quickly and decisively, even in the absence of definitive proof that the changes are due to whalewatching. Of course, changes in management of other human activities affecting cetaceans may also be necessary.

6.3 Whalewatching Including Swimming, Snorkelling or Scuba Diving with Cetaceans

A specialised type of whalewatching activity has recently developed in the Ribbon Reefs area, in the Cairns Section of the Marine Park. In this area, generally in June and July, dwarf minke whales commonly approach scuba divers, allowing people in the water to watch the whales at close distances. Some tourist operators in the area have altered their programs to take advantage of this unusual opportunity. Although swim-with-dolphin programs have developed in several countries, including Australia and New Zealand, there are few swim-with-whales programs (Arnold & Birtles 1999).

Observing cetaceans under water can provide better understanding of the animals, and can be a particularly exciting and rewarding experience for people. However, it provides increased incentive to get close to the animals in order to be able to see them under water (see below), and there are additional potential risks posed by having people in the water in close proximity to cetaceans.

While the focus of swimming-with-whales activities (here taken to include swimming, snorkelling, scuba diving with whales or dolphins) is on dwarf minke whales in the Ribbon Reefs, it is likely that it occurs opportunistically with other species and in other locations, on both a commercial and recreational basis.

The *Environment Protection and Biodiversity Conservation Act 1999* defines whalewatching to include 'being in the water for the purposes of observing or swimming with a whale'. The Australian National Guidelines for Cetacean Observation (Environment Australia 1999), which apply in the Marine Park, provide detailed recommendations designed to protect both the animals and people during swims, and incorporate many of the practices developed for swimming with dwarf minke whales.

Under the Queensland *Nature Conservation (Whales and Dolphins) Conservation Plan 1997* (Department of Environment 1997), a person generally may not enter the water closer than 300 m to a whale or 100 m to a dolphin, nor, if in the water, approach closer than these distances. However, these provisions do not apply to person acting under specified permissions.

In the Marine Park, swimming-with-whales is a specialised type of whalewatching, and requires a specific permission if conducted commercially on a dedicated basis. Incidental commercial swimming-with-whales activities do not require additional specific permission. Minimum vessel

approach distances apply to all vessels, including those permitted to conduct dedicated commercial swimming-with-whales activities.

6.3.1 Types of potential impacts

The impacts, effects and threats of whalewatching are potentially much greater when swimming-with-whales activities are involved. The distance over which a cetacean can be seen under water varies with water clarity and the species of cetacean observed, but will seldom be greater than 30 m and will usually be much less. Thus, swimming-with-whales programs typically require closer and more direct approaches to animals than do other forms of whalewatching, and this must be taken into account in managing this activity (International Whaling Commission 1997b). There are also potentially elevated risks of vessel strikes because vessels must operate in close proximity to the animals. Similarly, the effects of vessel noise, pollution and other impacts may be much greater.

There are additional risks of swim interactions for both people and animals. If humans and cetaceans come into physical contact, there is the risk of physical injury to the animals and to humans. Cetaceans are wild animals, and have been known in rare instances to injure or even kill people in the water who were physically interacting with them (e.g. Santos 1997). It is also possible that diseases could be transferred from people to cetaceans, or even from cetaceans to humans.

Swimming or diving with whales has been banned in at least six locations, including Western Australia, New Zealand and the United States (Carlson 1996). Swimming with dolphins is allowed under permit in several places, including in Western Australia, New Zealand and the United States. Studies of the effects of swimming-with-dolphins programs in New Zealand and Australia have documented active avoidance of swimmers or vessels by the animals, with more direct vessel approaches more often resulting in avoidance (Constantine & Baker 1996; Weir et al. 1996).

The key management challenge for this activity, as with vessel-based whalewatching, is to ensure that interactions are largely controlled by the animals. Deliberate attempts by people to swim with cetaceans are unlikely to be successful unless the animals choose to remain nearby; unless animals are trapped or entangled, they will generally be able to readily avoid people in the water. Nonetheless, repeated vessel approaches by people attempting to swim with cetaceans could be a serious source of disturbance to the animals and must be managed accordingly. In a study of dolphins' responses to boats and swimmers in New Zealand, most swim-with-dolphin attempts did not appear to disturb the dolphins, but 24 of 56 encounters were judged to be disturbing or potentially disturbing because the animals left the area immediately or within a few minutes (Bejder et al. 1999). Of particular concern are the cumulative effects of such avoidance behaviour, if animals spend large amounts of time and energy avoiding vessels.

Swimming with cetaceans without violating the minimum approach distance requires that the animals approach the swimmers or the vessel. If the approach distance is adhered to, the initiation and duration of swim interactions are largely under the control of the animals. Indeed, the dwarf minke whalewatching and swimming industry developed in response to these whales repeatedly approaching divers and snorkellers. Many of the swim encounters are initiated by the whales, which approach the boat or the people while they are diving on the reef (Arnold & Birtles 1998). Given that the encounters are frequently initiated by the whales and terminated by the operators (e.g. at the end of the day), this activity seems unlikely to be generating significant adverse effects on the animals at present.

For the dwarf minke swim industry, a code of practice has been developed that is designed to minimise risks to humans and whales from this activity. Investigations to date suggest that the practices that promote safety also lead to longer encounters with the animals. Under the code, people must hold on to lines attached to the vessel when swimming with the whales, and must

not swim towards or attempt to touch the animals (Arnold & Birtles 1998). Research is ongoing to learn more about the population and about the effects of swims on the animals.

The successful swim operations focused on dwarf minkes, coupled with the increasing population of humpback whales, may provide incentive to expand the dwarf minke swimming-with-whales industry or to begin commercial swimming-with-whales operations focused on humpbacks or other species. However, given the limited information available on dwarf minke whales and species other than humpbacks, the potential adverse effects of swimming-with-whales activities on all species, and the possible risk of human injury, proposals for growth should be treated with particular caution.

Given the greater risk to cetaceans posed by swimming-with-whales as compared to other forms of whalewatching, these activities will be distinguished for management purposes as required. This may mean, for example, that greater restrictions may be required for swimming-with-whales activities compared to other forms of whalewatching. Commercial tour operators wishing to conduct dedicated swimming-with-whales activities will require specific permission to do so.

6.4 Deliberate Feeding of Cetaceans

Dolphins, porpoises, and the toothed whales eat fish, which allows the possibility of people providing food to these animals. There are dolphin feeding programs in Australia (e.g. Monkey Mia, Western Australia, and Tangalooma, Queensland), but none in the Marine Park.

Individual people may attempt to feed animals in the Marine Park, for example by tossing fish to dolphins that approach vessels, but there is little information available on the prevalence of such activity. Animals may feed on the discards from commercial fishing vessels; this is discussed in section 6.5.

Neither the *Whale Protection Act 1980* nor the *Environment Protection and Biodiversity Conservation Act 1999* explicitly prohibit deliberate feeding of cetaceans in Commonwealth waters. However, the Australian National Guidelines for Cetacean Observation (Environment Australia 1999) generally recommend against feeding programs, and also recommend that current feeding programs not be expanded and that no additional feeding programs be developed.

The Queensland *Nature Conservation (Whales and Dolphins) Conservation Plan 1997* generally prohibits intentional feeding of whales or dolphins in the wild.

Deliberate feeding and attempted feeding of cetaceans within the Marine Park will be prohibited.

6.4.1 Types of potential impacts

The problems arising from feeding of wild dolphins are similar to those documented for other species. The types and magnitudes of potential impacts on cetaceans of feeding by humans arise from the type, quality, and amount of food, as well as the circumstances under which feeding occurs, such as whether animals are fed in a high-traffic or polluted area (Neil & Brieze 1998). The potential effects on a population of animals are influenced by the number and demographic characteristics of provisioned individuals (e.g. whether mothers with young calves are being fed).

Studies of provisioned dolphins in the United States have amply documented four broad categories of problems, all of which typically result from habitual feeding of wild animals by people. These include substantial alterations in natural behaviour, including feeding and migration; loss of wariness of humans, leading to increased risk of injury from vessels; deliberate or inadvertent feeding of inappropriate or contaminated food, including confirmed reports of people feeding dolphins poor quality fish, beer and pretzels; and increased injuries to humans, as animals accustomed to feeding become more aggressive (National Marine Fisheries Service 1994).

Studies of the effects of feeding on dolphins at Monkey Mia showed an increased mortality of calves among provisioned animals. Subsequent modifications to the feeding program seem to have reduced this effect. However, provisioned mothers can be less vigilant, and their calves are then at greater risk from shark predation or other threats. Animals may become dependent on the food provided, and may therefore be at greater risk if the food supply is interrupted. Provisioned immature animals may not learn to forage for live fish adequately, and it has been suggested that at least one young dolphin in Monkey Mia died for this reason (National Marine Fisheries Service 1994).

Provisioned dolphins have been known to bite or hit people. Some feeding programs avoid feeding male dolphins for this reason, as males are more often associated with this kind of behaviour.

In the United States, the *Marine Mammal Protection Act* prohibits the feeding of whales and dolphins in the wild 'unless the feeding is incidental to another activity such as the routine discharge of fish bycatch or discharges from processing plants or vessels'. Feeding includes 'offering, giving, or attempting to give food or non-food items to marine mammals in the wild' (National Marine Fisheries Service 1994).

6.5 Fishing, Shark Control Programs and Aquaculture

Fishing is a major activity in the Marine Park and is second only to tourism in economic importance. Recreational and commercial fishers target a variety of species using a wide range of fishing gears. Indigenous fisheries also occur in the Marine Park.

Under the Offshore Constitutional Settlement between the States and the Commonwealth Government, the Commonwealth (via the Australian Fisheries Management Authority) manages the commercial harvest of tuna and billfish species in and adjacent to the GBRWHA. Management of the remaining fisheries within the Marine Park is the responsibility of the Queensland Government, through the Queensland Fisheries Management Authority (QFMA) and the Department of Primary Industries (DPI). Fisheries management arrangements in Queensland, including within the Marine Park, will be contained in statutory management plans being developed under the Queensland *Fisheries Act 1994*. Zoning Plans in the Marine Park effectively restrict fishing activities throughout many areas.

All commercial fisheries require authorities (licences, permits) and are limited entry. Fish size limits and gear, area and seasonal restrictions apply to both recreational and commercial fishers.

Considerable work is being undertaken by fisheries management agencies and scientists to ensure fisheries in the Marine Park are ecologically sustainable. Included in this work are efforts to develop sustainability indicators, investigate possible effects of fishing on fish habitat and populations, determine the effect of area closures on fish stocks, and minimise bycatch (catch of species other than target species).

Fishers spend a great deal of time at sea, and could be extremely helpful in collecting data on the distribution and relative abundance of cetacean species. Also, resource management agencies typically employ patrol vessels and aircraft for surveillance and enforcement purposes. These too could be used to collect cetacean sighting data. For example, Customs Coastwatch flights record cetacean sightings.

Shark control programs are in place for bather safety at many Queensland beaches, and make use of mesh nets and drum lines to target sharks that may pose a threat to humans. Reporting of cetacean bycatch in all shark control equipment is mandatory.

Aquaculture also occurs in and adjacent to the Marine Park. Operations vary significantly depending on the species being cultured. The most common types of aquaculture in the area are prawn and barramundi farming in land-based ponds with associated seawater intake / discharge, and sea-based long-line culture of pearl oysters. There is currently one barramundi sea cage operation in State waters (none in the Marine Park). Research and development of cage culture techniques for coral reef finfish species are currently in progress and may result in future pressure for the expansion of cage-culture operations.

6.5.1 Types of potential impacts

Fisheries have the potential to affect cetaceans both directly and indirectly. Direct effects may include accidental entanglement in fishing gear, modifications to cetacean behaviour, and, if vessels are used, the potential impacts associated with vessels (see section 6.1). Indirect effects include possible habitat degradation and potential effects on the ecosystem, such as depletion of cetacean prey species.

Accidental catch in fishing gear is widespread globally, and poses a serious threat to some cetacean populations (see review in Perrin et al. 1994). Accidental entanglement of humpback whales, minke whales, Irrawaddy dolphins and Indo-Pacific hump-backed dolphins occurs in various places around the world, and may threaten some dolphin populations (see section 5.3.4). However, data on accidental catch of cetaceans in the Marine Park are limited.

However, from 1962 to 1997, the Queensland Shark Control Program caught a total of 219 cetaceans in the areas of Cairns, Townsville, Rockhampton and Mackay (DPI, pers. comm. 1998). Irrawaddy dolphins were the most common cetacean species taken in shark nets set in the Townsville area (Marsh et al. 1989). The effect of this catch is difficult to assess, given the limited information on cetacean population structures in the Marine Park (see section 5.3.4). Since 1993, changes to the program have been made and catches of cetaceans have been significantly lower. Shark control programs in place for bather safety employ mesh nets and drum lines. Mesh nets are associated with higher levels of bycatch than are drum lines and, consequently, have been replaced by drum lines in some places, including the Townsville area. Today, no shark mesh nets are set within the waters of the Marine Park, but 10 nets operate seasonally in waters adjacent to the Marine Park: five in the Mackay area and five in the Cairns area. The DPI is currently investigating the effectiveness of acoustic transponders or 'pingers' on shark mesh nets in reducing bycatch of cetaceans and other species; preliminary results suggest that fewer cetaceans are caught in nets equipped with pingers. However, there may be adverse effects associated with widespread use of pingers (see section 5.3.4).

One of the major fisheries occurring in the Marine Park is the Queensland East Coast Trawl fishery, which targets prawns, scallops, bugs and squid. Little information is available on the accidental take of cetaceans in this fishery. Elsewhere in the world, cetaceans are occasionally caught in trawlers, but smaller numbers of cetaceans are caught by trawls than by other types of gear, such as purse seines and mesh nets (Fertl and Leatherwood 1997; International Whaling Commission 1994). Moreover, cetacean bycatch more often occurs in mid-water trawlers targeting pelagic species than in prawn trawlers (Fertl & Leatherwood 1997). Fertl and Leatherwood (1997) recently reviewed data available on cetacean interactions with trawls globally, and documented bycatch of 25 cetacean species, including bottlenose dolphins, in various locations. There were no recorded incidents of Irrawaddy or Indo-Pacific hump-backed dolphins being caught in trawlers. There is no evidence that trawling poses a significant threat to cetacean populations in the Marine Park.

Purse seines have been documented to catch large numbers of cetaceans in some areas (e.g. Mulvaney 1996). Purse seines are typically used to catch small fishes that are important prey of many cetaceans, particularly dolphins (Read 1996). An experimental purse-seine fishery for pilchards in southern Queensland waters resulted in the deaths of at least nine dolphins in six

months, with an additional 76 animals caught but released alive. As a result, the Queensland government stopped the fishery from operating. Purse-seine fisheries do not presently occur in the Marine Park.

The greatest potential threat to cetacean populations in the Marine Park from fisheries is associated with mesh net fisheries, particularly those employing nets with large mesh sizes, such as are used to catch barramundi, shark and grey mackerel. There are anecdotal reports of such nets catching cetaceans, particularly inshore dolphins such as Irrawaddy and Indo-Pacific hump-backed dolphins. However, there is little information on the numbers of animals caught, and the level of threat posed by mesh netting to local cetacean populations is unknown. More information is urgently needed, given the threat posed by mesh nets to some cetacean populations elsewhere in the world and the spatial and temporal overlap of inshore dolphin habitats and some mesh net fisheries (section 5.3.4).

Aquaculture operations involving the use of sea pens or cages (typically termed mariculture) can result in entanglement of cetaceans or other marine mammals in the net walls of the cages or in protective netting placed around the cages, but the reported incidence of this globally is very low. There is no information on the incidence of such entanglements in and around the Marine Park, but mariculture cages are uncommon in the area and are unlikely to pose a significant threat to local cetacean populations. Pingers are used in some aquaculture operations to deter seals and other animals from damaging stocks or equipment, and these may adversely affect cetaceans (see section 5.3.6). However, seals are not normally found in the Marine Park and the use of pingers in mariculture operations is uncommon. Other potential impacts of aquaculture on cetaceans are indirect, resulting from impacts on the habitat or ecosystem, and include pollution (see section 5.3.8).

The degree to which the distributions of various fisheries and cetaceans overlap in space and time should be evaluated, particularly for priority cetacean species such as Irrawaddy and Indo-Pacific hump-backed dolphins, and an assessment made of the risks posed by various types of fisheries to cetaceans occurring in the Marine Park, including possible disturbance and entanglement. Reliable information on any cetacean bycatch in fisheries in the Marine Park would be useful, both to evaluate possible direct impacts on cetaceans and to help gather information on cetacean species distributions and habits. Cetaceans accidentally killed in shark control and fishing gear are extremely valuable sources of basic information about the animals. In contrast to stranded animals, animals caught in nets are more likely to be fresh when discovered and less likely to be diseased. Thus, these animals can be rare and valuable sources of information on basic biology (e.g. age at sexual maturity). Additionally, levels of contaminants, such as pesticide residues, in net-caught animals may be more representative of the population at large.

If cetacean populations are small or localised, or if they are threatened by other impacts, such as pollution and coastal development, then even minimal losses due to mortality in fisheries gear may become important and it may become necessary to consider possible options to reduce the bycatch, such as modifications to equipment (e.g. use of pingers) or fishing practices. In addition, the increasing population of humpback whales may increase the potential for interactions between humpbacks and fisheries.

Possible indirect effects of fishing on cetaceans result from competition between cetaceans and fishers for common target or prey species, and from any detrimental effects of fishing on the ecosystem. Declines in the abundance of species consumed by cetaceans, whether due to fishing or other causes, can adversely affect cetaceans (see section 5.3.11). There is no evidence of such indirect effects on cetaceans from fisheries in and around the Marine Park. The ongoing efforts to ensure Marine Park fisheries are ecologically sustainable are likely to minimise these types of impacts.

Globally, cetaceans are known to feed around a variety of fishing gear types, including prawn trawlers (e.g. Fertl & Leatherwood 1997). Indo-Pacific hump-backed dolphins feed around prawn trawlers in Hong Kong (Parsons 1998c) and in Moreton Bay, Queensland (Corkeron 1990). Irrawaddy dolphins have been reported to follow shrimp trawlers in Malaysia (Dolar et al. 1997). The extent to which this occurs in the Marine Park is unknown, but there is no evidence that this results in any adverse effects on local cetacean populations. Current bycatch reduction programs, including the planned introduction of bycatch reduction devices (BRDs) in trawls, will reduce the discards available to cetaceans. The Queensland government is progressively introducing compulsory use of BRDs in the State's commercial trawl fleet, and BRDs will be required on all trawl nets within the Great Barrier Reef Marine Park by March 2000.

Fishers and resource management agencies are valuable sources of information about marine species, including cetaceans. Fishers spend vast amounts of time on the water, and often are well attuned to the habits of non-target species such as cetaceans. Any opportunities to incorporate this information should be explored, along with the possible participation by fishers and associated organisations in collection of data on cetaceans in the Marine Park.

6.6 Defence Activities

There are eight designated Defence Areas within the Marine Park, established in the interest of public safety to regulate public use of and entry into these areas while they are being used for the practice of defence operations. Most areas are invoked only for short periods. For example, the Defence Area over Flora, Coates, Gibson and part of Maori Reefs in the Cairns Section is invoked for weapons testing on an average of one day per month, and rarely for more than about three hours on that day.

Defence activities may include naval exercises, low-altitude flights, high-speed flights generating sonic booms, detonations of explosives for a variety of purposes, use of active sonar and other underwater acoustic devices, use of infra-red laser sighting devices, and firing of live munitions. In addition, there are areas in the Marine Park in which unexploded ordnance is located. Accidental or deliberate detonation of these devices could pose threats to cetaceans and other species.

Under the Marine Park zoning plans, Defence operations may be undertaken in the Marine Park ‘after notification to the Authority or its delegate and subject to any directions the Authority or its delegate may impose as are reasonably necessary for the conservation, protection and preservation of the Marine Park’.

6.6.1 Types of potential impacts

Many military vessels operate at high speeds. Naval exercises may involve large numbers of vessels operating intensively in a particular area for days or even weeks.

Many of the potential impacts arising from Defence activities are due to the vessel and / or aircraft traffic (see section 6.1) and relate to noise (see section 5.3.6). Additional impacts result from detonations of explosives or use of live munitions. Shock waves generated by detonation of high explosives can kill or injure cetaceans, or be disturbing to the animals over great distances, possibly resulting in disruptions of activities and displacement of animals from areas. Even small (0.5 kg) explosions are sometimes detectable thousands of kilometres away under certain circumstances and at specific locations in the oceans that facilitate long-range propagation of underwater sound (Greene & Moore 1995). Use of active sonar and other acoustic devices can also be disturbing to animals, depending on the characteristics and use of the sound sources. As described in section 5.3.6, use of Low Frequency Active Sonar (LFAS) in particular is a concern. The American Navy participates in military exercises conducted in the Marine Park, and it is

possible that these exercises could involve the use of LFAS. This should be carefully evaluated in view of its serious potential adverse effects not only on cetaceans, but on many marine species.

The Department of Defence has agreed to restrict the use of explosives and ordnance within the GBRWHA to limited areas. The Department also is undertaking Environmental Impact Assessments for a number of training areas in Australia, including within the GBRWHA. Environmental Management Plans will be prepared in order to identify the environmental impacts of Defence activities and to determine procedures to minimise and mitigate those impacts.

Ideally, exercises or activities likely to pose the greatest threats to cetaceans, and particularly to priority species, should be avoided in key cetacean habitats and/or (where relevant) seasons. Such activities include high-speed vessel operations, high-speed low-altitude flights, underwater explosions, ship-shock trials, use of intense underwater sound sources (such as LFA sonar, see section 5.3.6) and live firing into the water or water-based targets. Cetacean surveys before, during, and after the activities will allow more accurate prediction of the risk to cetaceans, modification of schedules, locations or activities to reduce risks to cetaceans, and evaluation of the effects on cetaceans.

Any opportunities for Defence operations to contribute to collecting data on cetacean distribution, relative abundance, and behaviour should be explored.

6.7 Research

Marine research includes not only biological studies, but also studies of physical and chemical oceanography, marine geology and geophysics, marine archaeology, underwater acoustics, and a host of other areas of investigation.

Studies that contribute to the understanding of marine systems will ultimately benefit cetaceans. Studies of cetaceans and their use of the marine environment, including estimates of relative and absolute abundance, distribution, ecology, and behaviour are needed to assess the conservation status of cetacean species, to support management, and to allow evaluation of the effectiveness of conservation measures.

Research involving interfering with cetaceans, as defined under the Commonwealth *Whale Protection Act 1980* or, after July 2000, the *Environment Protection and Biodiversity Conservation Act 1999* requires a permit from the Commonwealth Department of the Environment and Heritage, and the proposed research must be advertised to allow public comment on the proposed research. For example, persons who for scientific purposes wish to approach whales closer than 100 m in Commonwealth waters (including in the Marine Park) currently require a permit.

Research to be conducted in the Marine Park may also require a permit under the *Great Barrier Reef Marine Park Act 1975*, depending on the activities and locations proposed. Exemptions to the minimum approach distance will require specific permission. Part of the permit assessment process involves an evaluation of whether the proposed research should be reviewed by the Authority's independent Great Barrier Reef Environmental Research Advisory Ethics Committee. All research proposed for the Marine Park is, when appropriate, evaluated for potential adverse impacts on cetaceans. Proposed research involving seismic exploration or other intense sound sources will be subject to particular scrutiny to balance the benefits of the research against the risks to cetaceans and other species.

6.7.1 Types of potential impacts

The types of impacts on cetaceans generated by research are dependent on the type of research. Vessels or aircraft used for research pose similar threats to cetaceans as those used for other

purposes (see section 6.1), but the level of risk depends on the vessels and aircraft used and the manner in which they are operated.

Cetacean research often requires close approaches to animals, for example to take identifying photographs, to attach radio or satellite tags that allow animals to be tracked, or to obtain skin and blubber samples used for genetic analysis, feeding studies, and assessments of contaminant loadings. Some research requires the temporary capture of animals, for example for taking of physical measurements or blood samples. These kinds of activities may be highly disruptive to the animals. The effects of these activities depend on the number of animals involved and the duration of the study. However, the information resulting from these studies can be invaluable for management.

Many research programs involve the generation of underwater sound. Studies of hydrocarbon distribution and marine geology and geophysics often involve seismic profiling of the sea floor, in which very loud sounds are bounced off the sea bottom and reflected sounds examined to gain information about bottom composition. Seismic sound sources are among the loudest sounds produced by human activities, and can be highly disturbing to cetaceans (section 5.3.6). Active avoidance of seismic sound sources by cetaceans has been documented to occur over tens and even hundreds of kilometres (Richardson 1995a). Additionally, some seismic sources are loud enough to cause injury or even death if the animals are close to the sound source.

6.8 Professional Filming and Photography of Cetaceans

Professional filming and photography of cetaceans typically involve close approaches to animals by vessels and / or aircraft, and may also involve placing people in the water close to animals to obtain underwater images.

The public interest in cetaceans is generally high, so this type of activity is likely to persist and perhaps increase. Additionally, technological improvements allow filming and photographing of cetaceans under an increasing variety of conditions, which may also lead to growth of the industry.

If the activity involves interfering with cetaceans, as defined under the Commonwealth *Whale Protection Act 1980* or, after July 2000, the *Environment Protection and Biodiversity Conservation Act 1999*, application must be made for a permit from the Commonwealth Department of the Environment and Heritage. For example, persons who for educational purposes wish to approach whales closer than 100 m in Commonwealth waters (including in the Marine Park) currently require a permit.

This type of activity commonly occurs in the Marine Park, and may also require a permit under the *Great Barrier Reef Marine Park Act 1975*, depending on the activities and locations proposed. Exemptions to the minimum approach distance will require specific permission.

6.8.1 Types of potential impacts

If close approaches to animals are involved, then, similar to any activities involving close approaches, impacts depend on factors such as:

- the type of activity (e.g. vessel- or aircraft-based, whether in-water filming is involved);
- the number of vessels or aircraft involved;
- the way in which vessels or aircraft are operated around cetaceans;
- the number and species of animals involved; and
- the number of close approaches required.

6.9 Marine Construction

Marine construction includes building of wharves and piers; dredging; filling; and establishment of offshore structures, such as artificial islands.

Assessments of marine construction projects proposed for the Marine Park include, where appropriate, evaluation of potential adverse effects on cetaceans and key cetacean habitats, and, where necessary, consideration of mitigative measures.

6.9.1 Types of potential impacts

The most significant potential impacts to cetaceans from marine construction are likely to result from large-scale projects. The types of impacts depend on the type of project, and may range in magnitude and duration. For example, changing the configuration of the shoreline can change hydrodynamics, thus affecting inshore currents and sediment rates. This may in turn affect key cetacean habitats or result in other environmental changes that adversely affect cetaceans (e.g. changes in abundance or distribution of cetacean prey species).

6.10 Land-based Activities

Coastal developments and land-use practices can have marked effects on marine ecosystems. Nutrient inflows, sediment transport, freshwater discharges and other fundamental ecological processes that strongly influence coastal ecosystems can be profoundly affected by land-based activities, such as farming, logging, grazing, damming and aquaculture. Additionally, some land-use practices result in the discharge of pollutants, such as fertilisers and biocides, into the marine environment. Sewage discharge is also an issue, because it poses risks of disease outbreaks as well as disruption of natural nutrient balances.

Over 410 000 km^2 of land are contained within the catchments that drain into the Great Barrier Reef lagoon (Creighton et al. 1997). Within these catchments are some of Queensland's most extensive river systems, including the Burdekin and Fitzroy Rivers. Work with land-owners, municipal governments, and other stakeholders to reduce adverse impacts on the Marine Park resulting from land-use practices is in progress.

6.10.1 Types of potential impacts

In general, land-based activities are likely to pose indirect impacts on cetaceans through changes in the marine ecosystem of which the animals are a part (section 5.3.11). Direct impacts are likely to result from pollution and were discussed earlier (section 5.3.8).

The magnitudes and types of impacts on cetaceans depend on the type of activity and its location relative to the coast or within the catchments supplying different parts of the coastal areas adjacent to the Marine Park.

7 Strandings, Live Entanglements and Mortalities

Cetaceans, particularly some species, strand on beaches or become trapped in rivers and other areas periodically. Strandings may involve single animals, or dozens or even hundreds of individuals. The reasons for strandings are not well understood, and are likely to vary. Disease and pollution have been implicated in, but not conclusively proven to cause, some stranding events, while other events have shown no obvious contributory factors (e.g. see summary in Wilkinson 1996; see also sections 5.3.8 and 5.3.9).

For the purposes of the *Whale and Dolphin Conservation Policy*, strandings include animals that swim into shallow waters and beach themselves, wholly or partially, as well as animals that become trapped in reef lagoons and similar structures. Stranded animals may live for many hours, especially if prevented from overheating, and can sometimes be successfully returned to deeper waters or temporarily captured, rehabilitated and released.

Cetaceans that become entangled, for example in fishing nets or lines, may survive at least temporarily, if they are able to breathe. Animals are sometimes found trapped in fishing gear, or swimming around with pieces of net, lines, or other debris wrapped around their bodies.

These events pose important issues for management for several reasons, including the threatened status of some of the species that tend to strand, the effort and resources required to respond to strandings or entanglements, the high public and media interest in these events, the possibility of contributing to or prolonging the suffering of animals, and the risk to humans of trying to free entangled or trapped animals or return them to deeper waters. In addition, stranded or entangled animals can be valuable sources of information, and measurements and samples should be taken whenever possible without further jeopardising the health of the animals or the safety of people involved.

Dead whales and dolphins are often valuable sources of information, and can provide insight into causes of mortality as well as basic information about cetacean biology and ecology. Most of our information about most cetacean species has come from examination of dead animals. The amount and quality of information that can be retrieved depend to a large extent on how fresh and intact is the carcass. Speedy detection and reporting of carcasses facilitates collection of useful data.

For both live and dead animals, it is essential that samples and measurements are collected according to agreed, standardised procedures to ensure that the data will be useful and comparable to that collected from other sites. Some kinds of information (e.g. pollutant loads) can only be retrieved if samples are collected, stored and analysed properly.

In 1996, a workshop was held in Jervis Bay National Park to review scientific and veterinary activity for both live (stranded) and dead animals (Australian Nature Conservation Agency 1996). This and other workshops have produced detailed recommendations for responding effectively and appropriately to strandings, including guidelines for determining the likelihood of success for possible rescue or rehabilitation attempts, humane methods of euthanasia and proper collection and storage of biological samples (e.g. Geraci & Lounsbury 1998; Smith 1997; Wilkinson 1996). It should be recognised that not all live stranded animals can be saved (Geraci & Lounsbury 1998). A recent review of cetacean mass strandings in Hawaii showed that over 80% of 91 animals that stranded alive in various incidents were known to have subsequently died, despite prompt human intervention (Mazzuca et al. 1999).

Guidelines have also been developed detailing appropriate procedures for responding to incidents involving dead cetaceans, including performing necropsies (animal autopsies), taking measurements and collecting and storing biological samples. Thorough post-mortem examinations of cetaceans by qualified personnel, accompanied by follow-up pathology testing, should be carried out whenever possible, with the primary objective of determining a cause of death. Particular care should be taken to detect the presence or absence of indications that death was due to human activities, such as through a vessel strike or entanglement in fishing gear (see sections 5.3.3 and 5.3.4). Reference materials should be consulted to assist in such examinations (e.g. Geraci & Lounsbury 1998; Hare & Mead 1987; Kuiken 1996; Read & Murray, in prep).

In the GBRWHA, strandings that occur in State waters or on State beaches are the responsibility of the Queensland Government, whereas strandings that occur in Commonwealth areas (e.g. in reef lagoons) are the responsibility of the Authority. In Commonwealth waters, the *Whale Protection Act 1980* and the *Environment Protection and Biodiversity Conservation Act 1999* prohibit killing, injuring, taking, or interfering with any whale. Thus a delegation under the appropriate Act is required to treat, move or take samples from an animal.

The Queensland *Nature Conservation (Whales and Dolphins) Conservation Plan 1997* includes provisions allowing a conservation officer to take any measures deemed reasonably necessary to protect an animal that, in the officer's opinion, is sick, injured or at risk of harassment. A whale or dolphin is deemed to be at risk of harassment if, for example, it has recently given, or is about to give, birth. The legislation also provides for appointment of a stranding coordinator, who may take measures he or she considers necessary to protect a stranded cetacean or a cetacean at risk of being stranded. Measures that can be taken include moving or treating an animal. Management of strandings is currently governed by the *Queensland Contingency Plan for Dealing with Stranded Marine Mammals* (cited in Department of Environment 1997).

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9. Tables

Table 1. Whale and dolphin species known or suspected to occur in the Great Barrier Reef Marine Park and their conservation status in the *1996 IUCN Red List of Threatened Animals*, under the Australian *Endangered Species Protection Act 1992*, in *The Action Plan for Australian Cetaceans*, and under the Queensland *Nature Conservation (Wildlife) Regulation 1994*

Common Name	**Scientific Name**	**Conservation Status in the *1996 IUCN Red List of Threatened Animals*[1]**	**Scheduling Under the Australian *Endangered Species Protection Act 1992*[2]**	**Conservation Status in *The Action Plan for Australian Cetaceans*[3]**	**Scheduling Under the Queensland *Nature Conservation (Wildlife) Regulation 1994*[4]**
Baleen Whales					
Blue whale	*Balaenoptera musculus*	Endangered	Endangered	Endangered	Rarely found in Qld so not scheduled
Bryde's whale	*Balaenoptera edeni*	Data Deficient	not scheduled	No category assigned because of insufficient information	Common
Dwarf minke whale	*Balaenoptera acutorostrata*	not considered separately from minke whales	not scheduled	No category assigned because of insufficient information	Common
Fin whale	*Balaenoptera physalus*	Endangered	Vulnerable	Vulnerable	Common
Humpback whale	*Megaptera novaeangliae*	Vulnerable	Vulnerable	Vulnerable	Vulnerable
Minke whale	*Balaenoptera acutorostrata*	Lower Risk (near threatened)	not scheduled	Secure	Common
Sei whale	*Balaenoptera borealis*	Endangered	Vulnerable	Vulnerable	Common
Toothed Whales and Dolphins					
Blainville's beaked (or dense-beaked) whale	*Mesoplodon densirostris*	Data Deficient	not scheduled	No category assigned because of insufficient information	Common
Bottlenose dolphin	*Tursiops truncatus*	Data Deficient	not scheduled	No category assigned because of insufficient information	Common
Cuvier's beaked whale	*Ziphius cavirostris*	Data Deficient	not scheduled	No category assigned but possibly secure	Common
Dwarf sperm whale	*Kogia simus*	not evaluated	not scheduled	No category assigned because of insufficient information	Common
False killer whale	*Pseudorca crassidens*	not evaluated	not scheduled	No category assigned because of insufficient information	Common

Common Name	**Scientific Name**	**Conservation Status in the *1996 IUCN Red List of Threatened Animals*[1]**	**Scheduling Under the Australian *Endangered Species Protection Act 1992*[2]**	**Conservation Status in *The Action Plan for Australian Cetaceans*[3]**	**Scheduling Under the Queensland *Nature Conservation (Wildlife) Regulation 1994*[4]**
Fraser's dolphin	*Lagenodelphis hosei*	Data Deficient	not scheduled	No category assigned because of insufficient information	Common
Indo-Pacific hump-backed dolphin	*Sousa chinensis*	Data Deficient	not scheduled	Insufficiently known but suspected endangered or vulnerable	Rare
Irrawaddy dolphin	*Orcaella brevirostris*	Data Deficient	not scheduled	Insufficiently known but suspected endangered or vulnerable	Rare
Killer whale (or orca)	*Orcinus orca*	Lower Risk (conservation dependent)	not scheduled	No category assigned but probably secure	Common
Long-beaked common dolphin	*Delphinus capensis*	not evaluated	not scheduled	not classified	Common
Long-finned pilot whale	*Globicephala melas*	not evaluated	not scheduled	No category assigned but possibly secure	Common
Longman's beaked whale	*Mesoplodon pacificus*	Data Deficient	not scheduled	No category assigned because of insufficient information	Common
Melon-headed whale	*Peponocephala electra*	not evaluated	not scheduled	No category assigned but possibly secure	Common
Pantropical spotted dolphin	*Stenella attenuata*	Lower Risk (conservation dependent)	not scheduled	No category assigned because of insufficient information	Common
Pygmy killer whale	*Feresa attenuata*	Data Deficient	not scheduled	No category assigned because of insufficient information	Common
Pygmy sperm whale	*Kogia breviceps*	not evaluated	not scheduled	No category assigned because of insufficient information	Common
Risso's dolphin	*Grampus griseus*	Data Deficient	not scheduled	No category assigned because of insufficient information	Common
Rough-toothed dolphin	*Steno bredanensis*	Data Deficient	not scheduled	No category assigned because of insufficient information	Common

Common Name	**Scientific Name**	**Conservation Status in the *1996 IUCN Red List of Threatened Animals*[1]**	**Scheduling Under the Australian *Endangered Species Protection Act 1992*[2]**	**Conservation Status in *The Action Plan for Australian Cetaceans*[3]**	**Scheduling Under the Queensland *Nature Conservation (Wildlife) Regulation 1994*[4]**
Short-beaked common dolphin	*Delphinus delphis*	not evaluated	not scheduled	No category assigned but possibly secure	Common
Short-finned pilot whale	*Globicephala macrorhynchus*	Lower Risk (conservation dependent)	not scheduled	No category assigned but possibly secure	Common
Sperm whale	*Physeter macrocephalus*	Vulnerable	not scheduled	Insufficiently known but suspected endangered or vulnerable	Common
Spinner dolphin	*Stenella longirostris*	Lower Risk (conservation dependent)	not scheduled	Insufficiently known but suspected endangered or vulnerable	Common
Striped dolphin	*Stenella coeruleoalba*	Lower Risk (conservation dependent)	not scheduled	No category assigned because of insufficient information	Common
Strap-toothed (or Layard's) beaked whale	*Mesoplodon layardii*	Data Deficient	not scheduled	No category assigned but possibly secure	Common

1. IUCN Red List categories: Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Lower Risk, Data Deficient. The Lower Risk category is divided into three subcategories: conservation dependent, near threatened and least concern. (Source: *1996 IUCN Red List of Threatened Animals*, IUCN 1996.)
2. Australian *Endangered Species Protection Act 1992* schedules: Presumed Extinct, Endangered, Vulnerable. (Note that the *Endangered Species Protection Act 1992* will be replaced by the *Environment Protection and Biodiversity Conservation Act 1999* in July 2000.)
3. *The Action Plan for Australian Cetaceans* threat categories: Extinct, Endangered, Vulnerable, Insufficiently known but suspected of being endangered or vulnerable, No category assigned because of insufficient information, No category assigned but possibly secure, No category assigned but probably secure, Secure. (Source: Bannister et al. 1996.)
4. Queensland *Nature Conservation (Wildlife) Regulation 1994* schedules: Presumed Extinct, Endangered, Vulnerable, Rare, Common.

Table 2. Summary of the main potential adverse impacts of human activities on whales and dolphins in the Great Barrier Reef Marine Park

Human Activity	**Potential Types of Impacts**							
	Harassment	Vessel Strikes	Accidental Entanglement	Noise	Pollution	Disease	Displacement	Habitat Degradation
Whalewatching and Swimming-with-whales	•	•		•	•		•	
Other Forms of Marine Tourism	•	•		•	•		•	
Recreational Boating	•	•		•	•		•	
Deliberate Feeding of Cetaceans	•	•			•	•		
Fishing and Shark Netting		•	•	•	•			
Defence Activities		•		•	•		•	•
Commercial Shipping		•		•	•			
Research	•	•		•	•			
Professional Filming and Photography of Cetaceans	•	•		•	•			
Marine Construction		•		•	•		•	•
Land-based Activities					•	•		•

Additional Policy Concerning Management of Swimming-With-Whales Activities Conducted with Dwarf Minke Whales in the Vicinity of the Ribbon Reefs

Issue

A specialised type of commercial whalewatching activity has recently developed in the Cairns Section of the Great Barrier Reef Marine Park. In the vicinity of the Ribbon Reefs, generally in June and July, dwarf minke whales have been approaching snorkellers and scuba divers, allowing people in the water to watch the whales at close distances. Approaches by dwarf minke whales to boats and swimmers in the area were first documented in the early 1980s, but these encounters did not become regular until the early 1990s.[1] Since then, some commercial tour operators in the area, particularly in the Offshore Cooktown, Ribbon Reefs and Offshore Port Douglas Sectors of the Cairns Section of the Marine Park, have taken advantage of this opportunity, resulting in the development of a small, specialised, swimming-with-minke-whales industry. Further details of this activity and the industry are provided in section 6.3 of the *Supporting Document for the Whale and Dolphin Conservation Policy* (the Supporting Document).

Under section E.2 of the *Whale and Dolphin Conservation Policy* (the Policy), commercial tour operations will require a permit specifically allowing the activity of **swimming-with-whales** if:

- swimming, snorkelling or scuba diving with whales and / or dolphins is advertised; and / or
- a spotter aircraft is used to locate whales and / or dolphins for the purpose of swimming, snorkelling or scuba diving with the animals; and / or
- people are placed in the water for the express or primary purpose of observing whales and / or dolphins (e.g. from a vessel that is not moored or anchored at a reef location).

Swimming-with-whales activities that are conducted incidentally to the core activities of a permitted commercial tour operation do not require a specific swimming-with-whales permission (Policy, section E.2).

Under these criteria, the swimming-with-minke-whales activities historically conducted by some tour operators can not be considered incidental and therefore should require specific swimming-with-whales permissions in order to comply with the Policy.
However, swimming-with-whales permissions are permissions to conduct a specialised form of whalewatching. Currently, the granting of additional whalewatching permissions (including swimming-with-whales permissions) in the Cairns Planning Area is prohibited under the *Cairns Area Plan of Management*.

[1] Arnold, P.W. & Birtles, R.A. 1999, *Towards Sustainable Management of the Developing Dwarf Minke Whale Tourism Industry in Northern Queensland*, CRC Reef Research Centre, Townsville, CRC Reef Research Technical Report No. 27. 30 pp.

Thus section E.4 of the Policy further states:
An amendment to the whale conservation strategy established in the *Cairns Area Plan of Management* will be sought to allow consideration of the granting of specific permissions to conduct commercial swimming-with-whales activities focusing on dwarf minke whales in the vicinity of the Ribbon Reefs. Such permissions will be limited to actual levels of use as of 1 January 2000.

To implement this part of the Policy, it is necessary to limit the number of permissions that will be granted and to develop criteria for determining the eligibility of applicants.

Limiting the number of permissions to be granted

Scientific evidence suggests that the existing (prior to 1 January 2000) commercial swimming-with-whales activities are not posing a threat to the dwarf minke whales. However, as discussed in section 6.3 of the Supporting Document, swimming-with-whales activities may adversely affect the animals in a number of ways. Therefore, in accordance with section E.4 of the Policy and application of the precautionary principle, the Authority will seek to avoid an increase in any potential adverse effects of this activity on the animals.

Increases in potential adverse effects of this activity could arise in a number of different ways, relating both to the ways in which swimming-with-whales activities are conducted and to the effective size of the industry. As described in section E.2 of the Policy, regulations, permit conditions, codes of practice and other measures as appropriate will be used to manage the conduct of swimming-with-whales activities.

Current information on the effective size of the industry indicates that approximately six commercial tour operators have regularly conducted swimming-with-whales activities with dwarf minke whales in the vicinity of the Ribbon Reefs for several years (during the June–July season). Perhaps another two or three operators have recently begun to engage frequently in this activity. In addition, up to 50 or 60 additional operators may engage infrequently in swimming-with-whales activities with dwarf minke whales in the vicinity of the Ribbon Reefs on an opportunistic or incidental basis.

Increases in the effective size of the industry could therefore occur in a number of ways, including the following:

- existing (before 1 January 2000) tourism operators could use larger vessels or vessels with greater passenger capacities;
- existing regular tourism operators could increase the frequency and / or duration of their swimming-with-whales operations within their tourist programs (which have frequently included swimming-with-whales activities but also other activities such as snorkelling and scuba diving);
- existing tourism operators could use additional vessels;
- existing tourism operators previously engaging only infrequently in swimming-with-whales activities with dwarf minke whales could increase the frequency and / or duration of swimming-with-whales activities within their tourist programs (which previously seldom included swimming-with-whales activities);
- new tourism operators could join the industry.

The last three possibilities are of greatest concern because they constitute the greatest potential for increasing the effective size of the industry.

Therefore, based on information about the current industry and on the results of scientific studies conducted to date on the dwarf minke whales and the effects of the activity on the animals (see section 6.3 of Supporting Document), the Authority should issue only up to a maximum of **10**

permissions specifically allowing the conduct of commercial swimming-with-whales activities with dwarf minke whales in the vicinity of the Ribbon Reefs. Such permissions should be considered only for applicants able to demonstrate that they meet the eligibility criteria to be developed as described below. Each permission should be valid for the operation of a single vessel, as specified in the application, and should be subject to conditions regarding the conduct of the activity, including that the permission may be used only for the purposes of conducting swimming-with-whales activities with dwarf minke whales in the vicinity of the Ribbon Reefs.

Continued scientific investigation of the dwarf minke whales and the effects of this activity on the animals may in future indicate that managed growth of the industry will be ecologically sustainable and compatible with application of the precautionary principle. The Authority may review the limit of 10 permissions as more scientific information becomes available about the dwarf minke whales and the effects of this activity on the animals.

Eligibility criteria

The specified maximum of 10 permissions to conduct swimming-with-whales activities with dwarf minke whales in the vicinity of the Ribbon Reefs should be granted only to applicants able to demonstrate to the satisfaction of the Authority that they have been engaging historically in this activity on a regular basis (prior to 1 January 2000). Specific criteria will be developed to differentiate the regular historic operators from those who have engaged infrequently in the activity. Applicants should be required to provide objective and / or independent evidence to support claims that they have engaged regularly in swimming-with-whales activities with dwarf minke whales in the vicinity of the Ribbon Reefs prior to 1 January 2000.

Application period

To facilitate the assessment of the eligibility of applicants and the timely issuing of permissions, a deadline should be established for lodgment of applications for permission to conduct swimming-with-whales activities with dwarf minke whales in the vicinity of the Ribbon Reefs. To minimise uncertainty for operators and implement improved management measures for this new activity as soon as reasonably possible, and considering the small size of the industry, the application period should be limited to one month and should commence as soon as possible.

Legislation and international conventions relating to the *Whale and Dolphin Conservation Policy*

Convention on Biological Diversity, Rio de Janeiro, 1992

Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington, 1973 (CITES)

Convention on the Conservation of Antarctic Marine Living Resources, Canberra, 1980 (CCAMLR)

Convention on the Conservation of Migratory Species of Wild Animals, Bonn, 1979 (Bonn Convention)

Endangered Species Protection Act 1992 (Cwlth)

Environment Protection (Impact of Proposals) Act 1974 (Cwlth)

Environment Protection and Biodiversity Conservation Act 1999 (Cwlth)

Fisheries Act 1994 (Qld)

Great Barrier Reef Marine Park Act 1975 (Cwlth)

Intergovernmental Agreement on the Environment (1992)

International Convention for the Prevention of Pollution from Ships (MARPOL 73/78)

National Parks and Wildlife Conservation Act 1975 (Cwlth)

Nature Conservation (Whales and Dolphins) Conservation Plan 1997 (Qld)

Nature Conservation (Wildlife) Regulation 1994 (Qld)

Nature Conservation Act 1992 (Qld)

Whale Protection Act 1980 (Cwlth)

World Heritage Properties Conservation Act 1983 (Cwlth)

Cairns Area Plan of Management 1999 (Cwlth)

Whitsundays Plan of Management 1999 (Cwlth)