The Action Plan for Australian Cetaceans

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The views and opinions expressed in this report are those of the authors and do not necessarily reflect those of the Commonwealth Government, the Minister for the Environment, Sport and Territories, or the Director of National Parks and Wildlife.

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Foreword

It seems appropriate that Australia, once an active whaling nation, is now playing a leading role in whale conservation. Australia is a vocal member of the International Whaling Commission, and had a key role in the 1994 declaration of the Southern Ocean Sanctuary.

The last commercial Australian whaling station ceased operations in Albany in 1978, and it is encouraging to see that once heavily exploited species such as the southern right and humpback whales are showing signs of recovery.

Apart from the well-known great whales, Australian waters support a rich variety of cetaceans: smaller whales, dolphins, porpoises and killer whales. Forty-three of the world's 80 or so cetacean species are found in Australia. This diversity is a reflection of our wide

range of coastal habitats, and the fact that Australia is on the main migration route of the great whales from their feeding grounds in the south to warmer breeding grounds in northern waters.

While this report recommends that only five species or subspecies be listed as Endangered or Vulnerable under the Endangered Species Protection Act, this does not mean that cetaceans are relatively secure. Four species are classified here as Insufficiently Known, while a further 22 species or subspecies have no category assigned because of insufficient information. Only 1 subspecies is classified as Secure.

Although killing of cetaceans in Australian waters is now illegal, many die after becoming entangled in fishing nets, buoy-nets and long-lines. A less obvious threat is ghost nets – large amounts of fish netting lost at sea which may drift for years, entangling marine life.

There are a host of other threats to cetaceans including shipping strikes, oil spills and chemical pollutants, acoustic pollution from vessels and the depletion of cetacean food stocks through commercial fishing operations.

Cetaceans are particularly vulnerable to broad-scale changes in the marine environment because of their high positions in marine food chains. Furthermore, cetacean populations are difficult to monitor, making it hard to evaluate the effects of threatening activities on populations.

Because of this lack of information about cetaceans, and the uncertainty about their status, this Action Plan presents species synopses of all Australian cetacean species, rather than recovery outlines of threatened taxa only.

The Action Plan for Australian Cetaceans is the fifth in a series of action plans commissioned by the Australian Nature Conservation Agency. Already published are action plans for birds, freshwater fishes, reptiles and rodents, as well as one for marsupials and monotremes prepared by WWF/IUCN. In preparation are action plans for frogs, bats, seals and dugongs, and a revised action plan for marsupials and monotremes. Conservation overviews for non-marine invertebrates and non-marine non-vascular plants are also being prepared.

This Action Plan has a key role to play in the conservation of cetaceans. It provides strong recommendations for the management and research actions most likely to protect cetaceans, at least in Australian waters. I hope this Plan will go a long way towards raising awareness of these elusive and graceful creatures.

Peter Bridgewater
Chief Executive Officer
Australian Nature Conservation Agency

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Executive Summary

Background

This report forms one of a series of action plans for Australian fauna being developed for the Endangered Species Unit, Australian Nature Conservation Agency (ANCA), by consultancy.

The project's aim was to develop a national overview of the conservation status of Australian cetaceans and recommend conservation priorities, and research and management action, with particular emphasis on endangered and vulnerable taxa.

Scope

The consultancy was to:

- overview the conservation status of Australian cetaceans
- identify key habitats for endangered or vulnerable taxa
- identify threatening processes
- review current conservation research and management action
- recommend future priorities
- identify two or more flagship taxa
- develop a list of relevant experts.

Work program

Three collaborators, Mr John Bannister, Dr Catherine Kemper and Mr Robert Warneke, were appointed to undertake the consultancy.

Initial contacts were made with over 50 relevant organisations and individuals, with a response from 67 per cent. Data were obtained from state museums and other organisations. Preliminary drafts of report sections were considered at a small workshop in Canberra in March 1994, attended by a broad range of individuals. Twenty-five responses, many detailed and comprehensive, and including some from overseas, were received to a draft report circulated in April 1994. Progress was reviewed at an Australian Mammal Society (AMS) marine mammal symposium in Hobart in July 1994.

Other ANCA action plans have included ‘recovery outlines’ for threatened taxa. Given the small number (three) of Australian cetaceans already listed as endangered—the blue whale, the southern right whale and the humpback whale—and the likelihood that many would be considered insufficiently known, the decision was made to prepare species synopses for all 43 Australian species, thus providing a comprehensive basis for future research and management.

To set the exercise in context, four overviews were prepared: Zoogeography, Threatening processes, Legislation and Community involvement. Given the considerable public interest in cetaceans generally, statements were sought from a number of prominent non-government organisations on their views of their role; the six received are included as Appendix 3.

Definition of region

For the purposes of this plan, the Australian region is taken to comprise waters under Australian jurisdiction, i.e. within the 200 nautical mile Exclusive Economic Zone (EEZ) around continental Australia and its External Territories, including Christmas and Cocos Islands in the Indian Ocean, the Coral Sea island territories and waters off the Australian subantarctic islands (Heard and Macdonald, and Macquarie) and off the Australian Antarctic Territory (Figure 1).

Overviews

Under Zoogeography (Item 2.1), the Australian cetacean fauna is shown to be moderately rich (with 43, i.e. 54 per cent, of the 79 species recognised worldwide), although there are no endemics. Seven families are well represented, and, as to be expected, Australia shares many faunal elements with the other southern continents and New Zealand. With the generally cosmopolitan nature of the Australian cetacean fauna and late history of scientific discovery, only three currently accepted taxa have Australian type specimens: the pygmy right whale, the southern bottlenose whale and Longman’s beaked whale. Distribution patterns are described and where possible linked to prey distribution, water temperature and depth, and coastal regions. Cetacean diets and food resources are reviewed. The overview emphasises the need for more information on taxonomy, distribution, habitat preference and diet in Australian waters for most of the fauna.

Threatening processes (Item 2.2) are reviewed in detail, and addressed as immediate (direct killing, entanglement/incidental take, shipping strikes); intermediate (competition from commercial fisheries, oil spills, disturbance and harassment—including whale watching, degradation of habitat and exposure to infectious human disease); and long-term (environment contamination by chemicals and plastic debris, reduced genetic variation in depleted populations, commercial whaling and global climate change). The categories adopted are not mutually exclusive, and the degree to which any or all actually impinge on a species or population is difficult to evaluate in the generally poor state of knowledge of the fauna’s biology and status. Clearly, however, as long-lived predators at mid- to high trophic levels, cetaceans are particularly vulnerable to broad-scale environmental changes that have medium to long-term effects on marine environments.

Legislation (Item 2.3) summarises Australia’s leading role in international forums, particularly the International Whaling Commission (IWC), and regionally. At a national

level, cetaceans have been protected since 1981, under the Commonwealth Whale Protection Act. Commonwealth jurisdiction extends seawards from the 3 nautical mile limit to the limit of the 200 nautical mile Australian Fishing Zone. From 1 August 1994, Australia has established an Exclusive Economic Zone around the continent and all external territories and the Commonwealth Act applies within this zone. Beyond the zone the Act applies to Australian vessels and all Australian citizens normally resident in the country. Provisions in the Act to permit some activities that would otherwise be an offence (e.g. interference for scientific or educational purposes) are described, as well as provisions for conservation-related research and monitoring. State and territory legislation generally mirrors the Commonwealth Act, but there are differences in approach, machinery and coverage. The need for greater uniformity or complementarity in provisions is evident, and is the subject of specific recommendations later in the report.

In Community involvement (Item 2.4) the role of the public in a number of areas is described. These include conservation and welfare, political, legal, administrative and management issues, consumptive and non-consumptive use. The role of Aboriginal and Torres Strait Islanders is emphasised, including their concerns at the persistently held Eurocentric view of their involvement with cetaceans as a source of food. The review stresses the need to consider a wide diversity of views and the interactive nature of participation—between individuals, communities and community groups, tertiary institutions, private enterprise and government; the public role cannot be considered in isolation from that of government. Appendix 3 provides statements from six non-government organisations on their views of their public role.

Conservation status

Item 3.1 describes the process by which current definitions of categories of threat were reviewed as they might apply to Australian cetaceans. Attempts were made to apply the more quantitative approaches developed since 1991 for terrestrial animals, but all require good estimates of numbers, distribution and range size, as well as detailed knowledge of reproductive parameters and diet or food sources. The lack of adequate data for most cetaceans frustrated the ranking of species by those means. A revision of the 1991 World Conservation Union (IUCN) Red Data Book categories (*Dolphins, Porpoises and Whales of the World,* Klinowska 1991) was eventually adopted. Four categories—extinct, endangered, vulnerable and insufficiently known, were accepted as defined by IUCN. A further two, one with three subcategories, were developed: they were—no category assigned, with the three subcategories (a) because of insufficient information, (b) but possibly secure, (c) but probably secure; and secure. The distinction between insufficiently known and no category assigned rests on the suspicion under the former that taxa may belong to one of the three threatened categories, but are not definitely known to do so. Details of the definitions are provided in Appendix 2 and a comparison with other recent categorisations is given in Table 3.

Item 3.2 and Table 4 summarise the results of applying the accepted threat categorisations, as follows.

Of the 45 ‘Australian’ taxa recognised (43 species, one subspecies and one form) none is regarded as extinct.

One taxon is regarded as endangered: the nominate ('true') form of the blue whale *Balaenoptera musculus musculus*.

Four taxa are categorised as vulnerable: the southern right whale *Eubalaena australis*, the humpback whale *Megaptera novaeangliae*, the sei whale *Balaenoptera borealis*, and the fin whale *Balaenoptera physalus*.

Four taxa are categorised as insufficiently known: the Indo-Pacific humpbacked dolphin *Sousa chinensis*, the Irrawaddy dolphin *Orcaella brevirostris*, the spinner dolphin *Stenella longirostris*, and the sperm whale *Physeter macrocephalus*.

The majority (35) of Australian taxa is included in no category assigned. Of those, most (22) are in subcategory **(a) because of insufficient information.** They include the spectacled porpoise, several oceanic dolphins, the bottlenose dolphin, the pygmy and false killer whales, seven of the 12 beaked whales, the dwarf and pygmy sperm whales, and three baleen whales—the diminutive form of the minke whale, Bryde's whale, and the pygmy blue whale. Twelve taxa are in **(b) but possibly secure.** They include the two cold water dolphins, the common dolphin, the two pilot whales, the remaining five beaked whales and the pygmy right whale. Only one taxon appears in **(c) but probably secure** —the killer whale.

One taxon, the dark-shoulder form of the minke whale, is regarded as secure**.**

Species synopses

Species synopses for the 43 species in the Australian fauna appear as Item 4. For each species, information is summarised under 18 headings. Included, as far as we have been able to ascertain it, is material on: taxonomy; survival status; distribution and habitat; biology (including population status); past, current and potential threats; objectives, action already initiated and required, and resources required, for conservation and management; organisations responsible for the species' conservation; and selected references. Under resources required, funding implications are not included, but appear in Item 5.1 for those given priority for action.

Conclusions and recommendations

Priority action

Priority action is recommended for nine taxa—those in the endangered, vulnerable and insufficiently known categories (Item 5.1). They are as follows.

Endangered—one subspecies:

- blue whale (nominate or 'true' form) *Balaenoptera musculus musculus*

Vulnerable—four species:

- southern right whale *Eubalaena australis*
- humpback whale *Megaptera novaeangliae*
- sei whale *Balaenoptera borealis*

- fin whale *Balaenoptera physalus*

Insufficiently known—four species:

- Indo-Pacific humpbacked dolphin *Sousa chinensis*
- Irrawaddy dolphin *Orcaella brevirostris*
- spinner dolphin *Stenella longirostris*
- sperm whale *Physeter macrocephalus*

Not all nine species, however, are equally amenable to research and management within Australian waters. Two of the vulnerable species, fin and sei whales, and, to a lesser extent, the endangered 'true' blue whale require actions extending well beyond the limits of Australian jurisdiction, into international waters. Action on those will be covered by proposals for activities within the Southern Ocean Sanctuary (see Item 5.4.6) that are currently under consideration by ANCA for recommendation to the Commonwealth Government.

The other six species are more appropriately targeted within the EEZ adjacent to the Australian continent. Recommendations for those species, and where practicable for 'true' blue, sei, and fin whales, are given in Item 5.1.

The recommendations cover required research objectives, actions and resources, and management objectives and actions.

For the 'true' blue whale, the main research objective is to provide information on current status, particularly by comparison with the pygmy blue whale. That will require investigation of the feasibility of undertaking acoustic, shipboard and aircraft surveys in areas near Australia where the species is known to occur (e.g. off Eden, NSW, in Bass Strait, in the eastern Great Australian Bight, and off south-western Western Australia), as well as ensuring continued cooperation with other agencies conducting research in the southern ocean in the context of research initiatives in the Southern Ocean Sanctuary, together with regular collation of strandings and sightings data. The estimated first-year cost, including the feasibility study, is $30 000.

For the southern right whale, research objectives cover continued population monitoring, refinement of biological information, including critical habitat, and assessment of possible disturbance in key areas. Estimated costs of conducting the recommended comprehensive program are $455 000 in one year. Recommended actions include: continuation of aerial surveys and photo-identification, and of behavioural and ecological studies at preferred locations such as Head of the Bight, SA and Doubtful Island Bay, WA; genetic analyses; investigation of short- and longer-term movements using telemetry; quantification of preferred calving location parameters; investigation of the effects of whale watching and of industrial development; and obtaining information from stranded specimens.

For the humpback whale, research objectives are as for the southern right whale, for each of the two Australian populations, i.e. those wintering off the east and west coasts of the continent. A comprehensive research program as recommended has an estimated full-year cost of $410 000. Included are recommendations on continuing current initiatives such as aerial survey, photo-identification, establishment of breeding area locations, studies of population size, and genetic analysis; and on undertaking projects to assess the impact of whale watching, to determine migration routes and possible non-migratory summer

dispersal using telemetry, and to quantify environmental and geographic parameters of breeding grounds.

Recommended activities on the sei whale and the fin whale, species encountered less frequently within Australian waters than the three above, will occur in the context of proposals being developed separately by ANCA for the Southern Ocean Sanctuary. Data on both should, however, be obtained in any strandings or sightings programs or analyses, and further information on sei whales should be sought from areas such as south of Tasmania and in the eastern Great Australian Bight where they have been reported recently.

For the Indo-Pacific humpbacked dolphin and the Irrawaddy dolphin, comprehensive programs are recommended for each species, to provide information on basic biology, population trends and size and habitat requirements, and to monitor impacts and their effects. Including the necessary aerial surveys and habitat studies, the recommended programs would cost $380 000 and $345 000 for each species respectively, that for the Irrawaddy dolphin not including photo-identification studies.

The recommended program for the spinner dolphin concentrates on the assessment of the possible impact of threats. It requires determination of distribution, abundance, diet, and taxonomic relationships from animals in northern waters, including incidentally-caught and stranded specimens from the Arafura and Timor seas. The one-year cost is estimated at $270 000, and includes obtaining information from incidental catch, undertaking dedicated surveys, and operating sightings programs from existing platforms of opportunity.

For the sperm whale, the recommended research objectives concentrate on establishing the current population status of the population off Albany, WA, for comparison with that at the end of whaling in 1978, and on assessing possible effects on food resources in areas of likely fisheries importance in the Australian EEZ, for example, off the south-east coast of South Australia, off western and southern Tasmania, and off south-eastern New South Wales. The recommended actions include undertaking a previously recommended aerial survey program off Albany, WA, reviewing existing information on distribution and abundance off South Australia, Tasmania and southern New South Wales, and undertaking yacht-based studies of behaviour and ecology in suitable areas, for example—off southern New South Wales and south-east Queensland.

Habitats

Given that for most Australian cetaceans effective conservation is likely to involve conservation of appropriate habitat, identification of key habitats is important in developing relevant conservation strategies. But with only a few exceptions, knowledge has been insufficient to pinpoint resources or localities essential to cetaceans, except on a very broad scale (as in Table 2).

Very few reserves have been specially set aside for Australian cetaceans, but even with the current lack of detailed knowledge, information on the distribution requirements of several species is adequate for a number of additional areas to be considered. Item 5.2 reviews examples, including coastal areas for inshore species and coastal calving areas for southern right whales and near coastal migration routes for humpback whales. It includes a recommendation on the need for urgent consideration of nomination of such areas, including, where necessary, maintenance of water quality.

Disturbance and harassment

Item 5.3 reviews these under two main subject headings: acoustic effects (5.3.1) and whale and dolphin watching (5.3.2).

Very loud sounds and certain frequencies are likely to disturb or even injure cetaceans, and are likely to increase in the marine environment as human activities increase there. Nevertheless, the extent and nature of their impact on cetaceans is little known. A double recommendation seeks discussions between responsible agencies on avoiding or ameliorating possible detrimental effects, and a cooperative approach to obtaining and assessing quantitative information on sounds and their impacts on cetaceans.

The recent rapid expansion of the Australian whale watching industry reflects both the public's wide and growing interest in cetaceans, and the increasing availability of two species in particular, humpbacks and southern right whales, as suitable subjects in Australian waters. Bottlenose dolphins are also accessible for observation from vessels, and are exploited in interactive situations such as dolphin swims and shore-based hand feeding. A series of recommendations covers necessary Commonwealth and state controls, including the need for the conversion of existing guidelines to enforceable regulations, the need for closer regulation, or banning, of hand feeding or burleying with dead fish, the levy of a proportion of whale watching fees to fund necessary investigations and partly defray supervision costs, assessment of possible conflicts between commercial and recreational interests, and assistance to local bodies in developing controls and promotional material.

Research

Item 5.4 draws together material from the species synopses (Item 4) on priority topics common to a number of species. Six sub-items cover strandings, incidental take, distribution and abundance, ecosystems, photo-identification catalogues, and the Southern Ocean Sanctuary.

Strandings

Given the importance of strandings as a source of information not otherwise available for many species, data collection and sampling from dead stranded animals must be maximised. Special efforts need to be made to deal with large specimens at the site and subsequently, including curation in suitably equipped museums.

Live strandings provide equally unique and non-invasive opportunities to obtain physiological and other information. Rescued animals should be appropriately marked or tagged (including with radio tags) for monitoring of progress following release and for recognition in the event of restranding.

There is need for greater coordination and standardisation between existing manuals and contingency plans. A major recommendation covers the need for two national workshops, to be held consecutively to allow cross-participation. One workshop would review scientific and veterinary aspects of dealing with strandings (and entanglements), the other would review operational aspects and rescue techniques. Recommended agenda topics are listed for each (Item 5.4.1).

Incidental take

Reported by-catches of cetaceans in fishing operations are very low, but there are concerns about whether this reflects the true picture. Inshore netting and aquaculture also pose threats to coastal species. There is a need first to establish the true incidence and species identity of such takes, and then to research ways of reducing it, involving on the one hand the cooperation of commercial and recreational fishermen, and on the other—in the case of international waters—agreements between neighbouring countries.

To handle this complex problem, it is recommended that the responsible Commonwealth and state and territory authorities establish a Fisheries Incidental Take Working Group, with an agenda to cover a broad range of concerns, as detailed in Item 5.4.2.

Distribution and abundance

Three sources of information are discussed: sightings surveys, acoustic studies and telemetry (Item 5.4.3).

Under sightings surveys, the use and relative merits of platforms of opportunity and dedicated synoptic surveys are reviewed, including short- and long-term options for the latter. Recommendations cover the need for the production of a comprehensive field guide, the convening of a workshop representing Commonwealth and state governments, industry and the research community to examine the potential and costs of both kinds of surveys, determination of the reliability of using already existing surveys (e.g. as already conducted for tuna off South Australia), and encouragement for state agencies to provide financial support for observer programs in coastal waters.

Reference is made under acoustic surveys to the recent use of existing North Atlantic passive array data to provide information on distribution, movement and behaviour for three oceanic species—blue, fin and minke whales. Although such systems do not exist in the southern hemisphere, it is recommended that the potential should be investigated for using passive hydrophone facilities already established near the Australian coast, and for towed arrays in more distant waters.

Telemetry is referred to in several species synopses as a required conservation action. It has been proposed for determining movement patterns, and locating breeding grounds and summer feeding grounds. It could also be important in studying the behaviour, physiology and ecology of inshore and offshore species, as well as of those favouring the continental slope. Its use in monitoring stranded animals after release has already been recommended (Item 5.4.1). Recommendations cover the need for greater employment of the technique in Australian waters, and for developmental emphasis on one of its current major weaknesses—an effective attachment system, particularly for the larger whales.

Ecosystem context

Poor knowledge of the status and biology of most cetaceans has led to little understanding or recognition of their role within marine ecosystems. In the face of increasing human impacts, particularly the expansion of fisheries, on the resources on which cetaceans depend, the resource needs of cetaceans should be taken into account.

Recommendations in Item 5.4.4 draw attention to the need for the expanding exploitation of living marine resources to take such ecological relationships into account and for advice to be sought from cetacean biologists in the design of fisheries, and other marine organism,

research. Relevant authorities are encouraged to regulate and monitor pollutant entry into, and levels in, aquatic environments, and to consult with industry to minimise the risks of accidents and disasters that could have a detrimental impact on cetaceans and their habitats.

Photo-identification catalogues

Questions have been raised over the nature and usefulness of 'national' catalogues of identification photographs of species such as humpbacks and southern right whales, which a number of separate research groups expend considerable energy obtaining each year. Recent discussions among right whale researchers have indicated that the greatest need is for the establishment of a central archive, to ensure the future availability of photographs.

A review of photo-identification in Australian waters is recommended. It should include the need for national catalogues, and should consider the short- and long-term effects of field methods used to obtain photographs, as well as the numbers of identified animals and the effort required to derive population estimates.

The Southern Ocean Sanctuary

Item 5.4.6 reviews the establishment by the International Whaling Commission, in May 1994, of the Southern Ocean Sanctuary. In combination with the existing Indian Ocean Sanctuary, for waters of special interest to Australia commercial whaling is now prohibited in the Indian Ocean bordering Western Australia and south of that state east to 130°E, and thence south of 40°S eastwards into the Tasman Sea (Figure 8, p. 216). The Southern Ocean Sanctuary provision applies whatever the status of individual whale stocks, but is to be reviewed after 10 years and then at 10 year intervals.

Implicit in the sanctuary's adoption was the understanding that there would be an increase in research effort, particularly on those greatly depleted species, blue, fin, sei and humpback, for which the area is their main feeding ground. Proposals being developed by ANCA, in conjunction with other relevant agencies, to mount a major research effort on populations of direct interest to Australia provide the immediate framework for integrated research on those great whales which otherwise would have been recommended on a species-by-species basis in this report. That was taken into account in the priority recommendations for 'true' blue, sei and fin whales in Item 5.1.

Legislation

Australia's international, regional and national activities and responsibilities have already been reviewed in Item 2.3. Clarification is needed, at a national and state level, of agency roles in respect of cetaceans. There are three major concerns at the state and territory level: lack of legislative uniformity or complementarity across Australia; access to material by scientific institutions, and reporting of incidental captures. There are also serious concerns about the existing capacity of agencies, both Commonwealth and state, to administer legislation and to support major programs, including long-term monitoring and management-related research.

Recommendations in Item 5.5 cover: the need for uniform or complementary legislation; the enforcement of reporting of strandings and incidental captures and the need for lodgement of material in appropriate scientific repositories; and the need for a review of existing resource allocations—Commonwealth and state and territory—to include the role to be played by industry and other organisations in supplementing such resources.

Education

The current wide community interest in and concern for cetaceans often leads to conflicting interpretations of events and issues, in which over-simplification and inaccurate reporting may too frequently result. Misconceptions and inaccuracies are to be found in many texts, and the purpose, relevance and results of much research are not generally well-publicised by scientists.

In Item 5.6, relevant institutions and scientists are strongly encouraged to publicise their objectives and methods, and to interpret their results beyond their scientific peers to the wider community. Other recommendations include the need for school education programs to include cetacean and other marine topics, and community attitudes; the latter should include material on Aboriginal attitudes. Publications should be balanced, and scientifically accurate. There is a need for the production of an authoritative and comprehensive field guide, as already recommended (in Item 5.4.3.1).

Advisory body

Government currently receives advice on cetacean conservation from a number of independent sources, as various as the results of research, public opinion, and government agencies other than those specifically concerned with fauna conservation.

There is a need for independent and broadly-based advice, drawing on a wide variety of sources. The establishment of a cetacean advisory body is recommended (Item 5.7).
It should, at the least: continue review of existing and potential threats to cetaceans; advise on national priorities for action; advise on regional and international policies and action, particularly in relation to the IWC; and provide a continuing forum for exchange of views between government, non-government organisations (NGOs) and the scientific community. It should provide its advice direct to the Chief Executive Officer, ANCA, and be serviced and resourced by that agency. Its composition should be drawn from a wide range of interests to provide a balance, and it should include representatives of Commonwealth and state and territory agencies, NGOs, industry, and the research community.

Flagship taxa

To meet the requirements to identify two or more flagship taxa for public education programs, four are recommended: the southern right whale, the humpback whale, the bottlenose dolphin and the Irrawaddy dolphin. The first three have special significance in the Australian context and are subject to whale watching. The last is little known, is likely to be under threat and would benefit from exposure to a wider public.

Appendices

The six appendices cover the consultancy's scope, details of threat categories, statements by community-based organisations, lists of workshop participants and those responding to the draft report, a list of bodies and individuals involved in Australian cetacean conservation, and a glossary and key to acronyms. The list of bodies and individuals (Appendix 5) has been prepared to meet the requirement (Scope Item 6) to contribute a list of experts on the biology, ecology and conservation of Australian taxa.

AcknowledgementsMany people have assisted in this project. We acknowledge the cooperation of all who responded so generously to our first approach for assistance: of those who provided data and information, especially state and territory museums and wildlife authorities; of the participants in the Canberra workshop, who constructively tolerated our early attempts at defining categories of threat, wrestling with overviews and compiling species synopses; and of the non-government organisations who provided statements on their roles.

We express our appreciation to Stephen Burnell, Martin Cawthorn, Peter Corkeron and Graham Ross who compiled, or assisted us in compiling, material in the report, and to James Mead and Bill Perrin for providing copies of their extensive bibliographies.

We are specially grateful to those, listed in Appendix 4, who took the time to review our draft report, some very comprehensively. In particular, we acknowledge the comments and assistance of ANCA staff Gordon Anderson, John Hicks, Bruce Male and Astrida Mednis for their review of the draft and for other assistance.

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1. Introduction

Background

Early in 1993, the Australian Nature Conservation Agency (ANCA) announced its decision to develop an action plan for Australian cetaceans. The project was to be one of a series already under way to review the conservation status of the Australian fauna. Projects already in progress or completed included bats, birds, freshwater fishes, frogs and reptiles. The work was to be carried out by a consultancy under the Endangered Species Program, administered by ANCA's Endangered Species Unit (ESU) under the Commonwealth Endangered Species Act.

The aim of the project was to develop a national overview of the conservation status of Australian cetaceans and recommend conservation priorities, and research and management action, with particular emphasis on endangered and vulnerable taxa.

Scope of the consultancy

The consultancy's scope, as detailed in the Consultancy Agreement Item 2 (reproduced here as Appendix 1) was, in summary, to:

- overview the conservation status of Australian cetaceans, where possible listing
  - endangered
  - vulnerable
  - potentially vulnerable species
- identify key habitats for endangered or vulnerable taxa
- identify threatening processes
- review current conservation research and management action
- recommend future priorities
- identify two or more flagship taxa
- develop a list of relevant experts.

Appointment of consultants

Under a Consultancy Agreement signed on 2 June 1993, three collaborators, Mr John Bannister, Dr Catherine Kemper and Mr Robert Warneke, were appointed to undertake the consultancy.

As outlined in their proposal to undertake the work, the task was originally divided on general taxonomic lines, as follows.

Physeteridae, Kogiidae, Balaenopteridae, Balaenidae—Bannister

Neobalaenidae, Delphinidae excluding *Globicephala* and *Pseudorca*—Kemper

Globicephala, *Pseudorca*, Ziphiidae, Phocoenidae—Warneke

The arrangement is significant mainly in relation to the preparation of Species Synopses (see below and Item 4).

Approach

Bearing in mind the requirement for wide participation in the project, the initial approach adopted was to contact relevant organisations and persons, seeking their support and assistance. Fifty-four organisations / persons were approached, covering museums, universities, government departments / agencies, zoos, royal societies / naturalists clubs and other non-government organisations, corporations, marine aquaria and individuals. Included among those approached were scientists in New Zealand. Thirty-six (67 per cent) responded initially, almost all very positively.

For those with data likely to be relevant, details were sought, with an indication of costs of providing them to the project team. The data of the greatest significance proved to be held in state museums. Significant information also exists in some universities. For those without large amounts of data, but with likely relevant experience—for example, some individual scientists and university departments—cooperation was sought in reviewing draft material, and in a few cases, of actually drafting material, either individually or with one of the collaborators. The contributions of those specifically involved in that way are recorded in the Acknowledgements and in the relevant items.

Work program

Following an initial meeting with ANCA representatives in Canberra in July 1993, the collaborators met on a number of occasions. Teleconferences were a useful adjunct to meetings. Progress was reviewed in a first progress report submitted to ANCA on 30 January 1994, and in a second progress report submitted on 20 April 1994. Preliminary draft sections of the report were reviewed at a small workshop in Canberra in March (see below). A draft report was circulated for comment to a representative sample of those initially approached, late in April, for response in late June, later extended to early August. The opportunity was taken to review progress and seek comment at a Marine Mammal Symposium held in Hobart by the Australian Mammal Society in early July. A resulting draft was provided to ANCA in November 1994 and circulated to a number of organisations and individuals for comment. A final draft, taking those comments into account, was forwarded to ANCA in April 1995.

Particular considerations

Degree of threat

A requirement for the first progress report (Consultancy Agreement Item 5.1a) was ‘a list outlining the proposed conservation status of taxa’. Item 2.2 of the agreement required the collaborators to ‘overview the conservation status of Australian cetaceans, and where the information is available, develop a list of extinct, endangered, vulnerable and potentially vulnerable species…’

It was clear at the first meeting with ANCA officers that at least at the outset a major expected element of the consultancy would be the preparation of ‘recovery outlines’ for threatened taxa. Examples were provided of completed or ongoing consultancies, for example, birds, fishes, reptiles, where the work had concentrated on such taxa. However,

early in the collaborators' deliberations, it became obvious that such an approach was unlikely to be practicable for cetaceans, given that only three of the 40 or so Australian species were already included in the list of Australian endangered vertebrate fauna and that many were likely to be categorised as 'insufficiently known' or not obviously threatened. The collaborators therefore proposed, and ANCA accepted, that 'recovery outlines' for only threatened fauna should be replaced with 'species synopses' for all 43 Australian species. While this led to a more comprehensive review than first envisaged, it was considered appropriate given the current state of knowledge of the cetacean fauna. Those few species likely to fall into the 'endangered' or 'vulnerable' categories (however finally defined) could be considered for the category of 'flagship taxa' as required under the scope of the Consultancy Agreement, Item 2.6.

Species synopses

Given acceptance of the proposal to develop species synopses for all the Australian fauna, they became the backbone of the report, and it is therefore built around the 43 species synopses contained in Item 4. The synopsis format was developed from the recovery outlines adopted for the action plan for Australian Freshwater Fishes (Wager and Jackson 1993).

To help particularly in the compilation of species synopses, copies of two major cetacean bibliographies were obtained from overseas. The honorarium to Kemper was used largely to employ an assistant to transfer the material to, and augment it on, a computerised Australian database.

Categories of threat

This topic became of particular concern, mainly for two reasons. First was the developing state of definitions of 'threat'. The collaborators were shown, for example, the differences in approach of the reptile and marsupial/monotreme action plans—the latter prepared by the IUCN, and using modifications of the IUCN categories 'endangered' and 'vulnerable'. They were encouraged to consider the theoretical discussions of Mace and Lande (1991) leading to the more practical conclusions of the IUCN Working Group (Mace et al. 1993). The details of the deliberations leading finally to the adoption of a modification of the existing IUCN categories are documented in Item 3.1.

Secondly, as outlined above, it seemed likely that only a small number of cetaceans would fall within the 'threatened' category, at least as currently understood, leading to the rather different approach to the project as a whole, by comparison with other action plans developed for ANCA.

Overviews

In developing an outline for the draft and final reports, it seemed desirable to provide a number of 'overviews' to set the exercise in context. In particular, there was a need to review the cetacean fauna in an international context, as well as on an Australia-wide basis. 'Key habitats' and 'Threatening processes' were already to be reviewed as a specific requirement; although at first treated as a separate item, the former topic was subsumed within Zoogeography (Item 2.1), while the latter remained separate (Item 2.2). There seemed also to be a need to review the legislative and management processes already in place (Item 2.3), in addition to whatever conservation actions or concerns might be noted for individual taxa. Additionally, given the considerable public interest in cetaceans

generally, it was important to review the role of the public in their conservation (Item 2.4). Statements from a number of NGOs on their view of their role were sought, and are included in Appendix 3.

Drafts of the outlines were prepared by individual collaborators (Zoogeography: Bannister, Kemper, assisted by G J B Ross; Threatening processes: Warneke; Legislation: Bannister, assisted by G R V Anderson; Community involvement: Warneke).

Workshop

The proposal for a workshop to involve a number of interested individuals and organisations was included in the collaborators' original project outline, and endorsed at the first meeting with ANCA officers. It seemed advisable to hold it at a stage in the project when ideas were being formed but were still capable of transformation, and to seek wide but not too voluminous representation. In the event, some 20 participants were invited, representing state and territory and Commonwealth organisations, the scientific community and NGOs. Those attending are listed in Appendix 4.

Particular topics considered at the workshop included draft overviews, draft species synopses, categories of threat, possible conclusions and recommendations, especially for threatened species (however defined), flagship taxa and the list of experts.

Draft report

Item 2.9 of the Consultancy Agreement (Appendix 1, Scope Item 8, this report) required the circulation of a draft report to state and territory conservation agencies and up to 10 other nominated persons for comment. Given the wide interest in the topic, the draft was circulated rather more widely, including to some overseas scientists. Comments, many of them detailed and several substantial, were received from 25 persons, listed in Appendix 4.

Detailing all the comments received, and the responses to them, has not been attempted here. All have been considered carefully and, to the best of the collaborators' abilities, the text has been amended as appropriate to take them into account.

Conclusion

Preparation of this Cetacean Action Plan has occurred in the context of ongoing interest by a wide spectrum of organisations and individuals in cetaceans and their conservation, management and welfare. A revised IUCN/SSC Cetacean Specialist Group's Action Plan, 1993–1997, was being prepared in 1994 (it was published in 1995). The International Whaling Commission's 1994 decision on the Southern Ocean Sanctuary has again focused attention on the importance of habitats within, or close to, Australian waters, with legal commercial whaling now prevented in the designated area for at least the next 10 years. Indirect take, however, in the form of accidental entrapment in fishing and shark nets, remains a threat for some cetaceans, particularly inshore and tropical species.

Australia has an unenviable reputation in terms of extinction of terrestrial mammals, which has come about largely indirectly, through destruction of their habitat. In the case of marine mammals, including cetaceans, the greatest effect so far has been a direct one, on their actual numbers, particularly in respect of the great whales. Once an active whaling nation, Australia has recently played a major role in their protection.

We hope that the compilation of this Action Plan will provide the background to ongoing measures to ensure that cetaceans, which include the largest animals ever to have lived on this planet, remain secure from preventable pressures, able to live their lives accordingly while remaining a continuing source of interest, wonder and enjoyment for the future.

Postscript

The main body of the Plan was completed in mid- to late 1994 and it should be regarded as up to date to that time. An attempt has been made to include some developments and records since then, but it has not been possible to achieve a comprehensive revision to the date of printing.

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2. Overviews

2.1 Zoogeography*

In the course of this project it became apparent that several aspects of general importance warranted review, particularly to give a wider perspective to our discussions of special concern to the Australian cetacean fauna. This, the first of our overviews, initially surveys the diversity of the fauna. It then discusses distributional patterns, and the factors underlying them, as far as they can be determined from the available information. The final section reviews the importance of particular kinds of food resource.

Faunal diversity

The recent Australian cetacean fauna is moderately rich by world standards.** Although it has no endemic species, it contains eight (62 per cent) of the world's 13 cetacean families, 27 (68 per cent) of the 40 genera, and 43 (54 per cent) of the 80 or so species currently recognised.

The number of cetacean species worldwide is the subject of continuing debate. Recently, two species of common dolphin (genus *Delphinus*) have been recognised, a new species of beaked whale has been described, and at least one other ziphiid species probably remains to be identified. The number of species in some groups, e.g. the delphinid genus *Stenella*, has only recently been determined and some other groups, e.g. the delphinid genus *Sousa*, have yet to be studied adequately. Doubt also exists over the number of species of bottlenose dolphin, genus *Tursiops.* Other concerns include uncertainty over the status of diminutive, or offshore and inshore, forms of some species, such as the blue whale, *Balaenoptera musculus*, the minke whale, *B. acutorostrata*, and Bryde's whale, *B. edeni.*
In this project we follow the classification adopted in the most recent IUCN review (Klinowska 1991), but with the inclusion of the new beaked whale, *Mesoplodon peruvianus*, and the long-beaked dolphin, *Delphinus capensis.* We have not included the unidentified bottlenose whale, *Hyperoodon* sp., listed by IUCN, given the opinion of some authors that this may represent tropical specimens of the southern bottlenose whale, *H. planifrons.* Given all the above we arrive at a worldwide total of 79 species, as listed in Table 1.

In the current Australian fauna we have recognised 43 cetacean species, in seven families and 27 genera (Table 1). Two additional species may well occur in the region: the newly described beaked whale *M. peruvianus* has recently been recorded from New Zealand and the phocoenid *Neophocoena phocoenoides* occurs in coastal Indonesian waters. For the purposes of the action plan, the Australian region is taken to comprise waters under Australian jurisdiction, i.e. within the 200 nautical mile Exclusive Economic Zone around continental Australia and its External Territories, including Christmas and Cocos Islands in the Indian Ocean, the Coral Sea island territories and waters off the Australian subantarctic islands (Heard and Macdonald, and Macquarie) and off the Australian Antarctic Territory (Figure 1).

Of the world's 13 cetacean families, five are absent from Australian waters (Figure 2). They are the northern hemisphere Eschrichtiidae—gray whale—the exclusively Arctic Monodontidae—white whales and narwhal—and the largely freshwater Platanistidae, Pontoporiidae, and Iniidae—river dolphins and Franciscana. Another family, the

Phocoenidae—the true porpoises—is represented by a single species (*Australophocoena dioptrica*), occurring only in the subantarctic.

The remaining seven families are well represented here (Figures 2 and 3). That is not surprising, given Australia's position in the path of main migration routes of great whales from cold water feeding grounds to warm water breeding grounds, and its wide range of coastal habitats, from cool temperate to tropical.

As also is to be expected, Australia shares many cetacean fauna elements with the other southern continents and with New Zealand (Table 1). Tropical and temperate elements are rather better represented here than in the Southern African subregion (comprising the area south of 18°S). On the other hand, New Zealand, South Africa and South America all have representatives of the coastal delphinid genus *Cephalorhynchus*, which is quite absent from Australian waters.

Well-represented in relative numbers of species are four families—the Physeteridae and Kogiidae (sperm whales), the Neobalaenidae (pygmy right whale) and the Balaenopteridae (rorquals and humpback whale). Their 10 species all occur within the area covered by this report (Figure 3). At least one kogiid (*Kogia breviceps*) the pygmy sperm whale) is relatively common in the stranding record, and Australia has the largest incidence of pygmy right whale strandings, but within the four families only two species, the humpback whale and the sperm whale, have been sufficiently abundant close to the coast to be commercially significant to Australia. That is in contrast with the situation off South Africa, for example, where six balaenopterids (blue, fin, sei, Bryde's, minke and humpback whales) and the one physeterid (sperm whale) have been commercially important this century.

The only other cetacean of commercial significance in the Australian region—the single southern balaenid, the southern right whale—was once sufficiently common off the Australian south coast, as elsewhere in the southern hemisphere, as to be the first and most vulnerable species to be exploited. Its numbers suffered accordingly, so much so that combined with illegal catches in the 1960s, signs of recovery have only been detected within the last 20–30 years.

With the fauna's generally cosmopolitan nature and the relatively late history of scientific research on Australian marine fauna, it is not surprising that relatively few taxa have first been described from this region. Only three currently accepted taxa have Australian type specimens. They are *Caperea marginata*—the pygmy right whale, described by J E Gray in 1846 from three baleen plates collected from the Swan River, WA; *Hyperoodon planifrons*—the southern bottlenose whale, described by W H Flower in 1882 from a beach-worn skull from Lewis Island, Dampier Archipelago, WA; and *Mesoplodon pacificus*—Longman's beaked whale, described by the Director of the Queensland Museum in 1926 from a skull collected from the beach at Mackay, Queensland in 1882. Being only one of two specimens ever described, and never having been recorded in the flesh, *M. pacificus* is the least known recent cetacean.

Distribution patterns

As shown in Table 1, which is based mainly on specimen records and some sightings and strandings data, Western Australia has the most comprehensive cetacean fauna of all the states, reflecting its long coastline covering a wide latitudinal range and a broad range of

habitats. It has the same number of confirmed species, 37, as Queensland, New South Wales and Victoria combined. The Northern Territory fauna is strikingly depauperate, presumably reflecting both its relatively uniform habitat and a lack of observers along a remote coastline. Indeed the whole of the Australian north coast, from North West Cape to beyond Cape York, is poorly sampled by comparison with the more heavily settled southern areas.

Cetacean distribution patterns are widely diverse, from the broad migration patterns of the large baleen whales—involving some of the longest mammalian migrations known—to the relatively restricted distributions of coastal dolphins. The factors underlying these distributions have not been studied in Australian waters. Such studies are generally only in their infancy elsewhere, although a starting point for studying the relationship between cetacean distribution and the environment could be to review what is known of sea bird distributions. Sea birds and cetaceans often form feeding associations in areas of nutrient enrichment; anecdotal examples of such associations in Australian waters include the continental slopes off south-east South Australia and south-east Tasmania.

Early studies of the relationships between oceanography and cetacean distribution were carried out by Japanese workers in the North Pacific and Antarctic, dealing primarily with baleen whales. Off Japan, sei and Bryde's whales generally inhabit waters of temperatures less than 20°C and greater than 20°C respectively. Also in the North Pacific, baleen whales are found to be associated with upwelling areas in the Aleutian Islands. Circumstantial evidence has for a long time suggested that upwelling areas are important cetacean habitats. For example, a well-known blue whale feeding ground occurs along the edge of the continental shelf off Baja, California. In the summer whaling grounds of the South Pacific sector of the Antarctic, blue and fin whales were found associated with higher salinities and higher water temperatures.

Recent studies, mostly off North America, have described cetacean habitats in terms of measurable oceanographic features. Statistical analyses of features such as depth, ice cover, thermoclines, water temperature and current flow have yielded significant associations between cetaceans and aspects of their environment. High use areas often include banks, basins, escarpment edges, ice edges, and near- and offshore submarine canyons, where increased productivity or prey consumption results from upwelling, eddies, convergences and river plumes. Several studies have shown that habitat and resource partitioning are recognisable components of cetacean ecology.

Mysticete distributions, at least for those undertaking long latitudinal migrations, are obviously linked to the extensive colder water concentrations of their prey—mostly Antarctic euphausiids in the southern hemisphere—and suitable warmer water breeding grounds. For the more coastal species, such as the humpback and right whale, mating and calving grounds are highly significant in the Australian context. However, no concentrated humpback mating or calving areas have yet been identified off Australia, as they have been for northern hemisphere animals in the Caribbean or off Hawaii, and while a small number of localities can be identified off the south coast as right whale calving areas, such as Head of the Bight, SA, and Doubtful Island Bay, WA, what specifically determines those localities' significance for calving is so far not known.

For other species, water temperature and depth are clearly important in determining distribution. Australia and its territories span the full range of temperature zones—tropical, subtropical, temperate, subantarctic and polar (Figure 4). Sea surface temperatures range

from –2°C (Antarctic) to 32°C (northern Australia). Within these broad regions inshore temperatures can vary considerably through heating and cooling of shallow water. Temperature and salinity are closely linked, with generally low salinities in the tropics and high salinities in cold waters. In Australia, two main current systems bring warm, low salinity water from the tropical to the temperate region. The Leeuwin Current flows in autumn and winter along the west coast and into the Great Australian Bight, while the East Australian Current flows inshore in summer and further offshore in winter along the Queensland and New South Wales coasts. Those and other main current systems are shown in Figure 5.

The tropical and subtropical species *Sousa chinensis*, the various species of *Stenella*, and *Orcaella brevirostris* and *Mesoplodon densirostris* show a fairly well-defined pattern, broadly distinguished from the more temperate *Delphinus delphis* and several other *Mesoplodon* species. These distribution patterns can be linked to water temperature (see Table 2). Apparently anomalous records of *Stenella attenuata* from the south-west corner of Western Australia may well have resulted from transport in the Leeuwin Current; correspondingly, records of *Lagenodelphis hosei* in Victorian waters may have arisen from the effect of the east Australian current bringing warmer water species into Bass Strait. *Tursiops* is ubiquitous around the coast, but shows a well-defined size gradient inversely related to water temperature. The distributions of *Globicephala melas* and *G. macrorhynchus* seem to be directly related to different temperature preferences, the latter being found normally in tropical and warm temperate waters. The cold water species *Lagenorhynchus cruciger* and *Australophocoena dioptrica* are found mainly in the Antarctic and subantarctic, while *Lagenorhynchus obscurus* and *Lissodelphis peronii* are often associated with the Subantarctic Convergence.

Water depth is also an important feature in defining cetacean distribution. An extensive continental shelf is found in the Great Australian Bight, Bass Strait and the Great Barrier Reef, and from Cape York to North West Cape (Figure 6). Over half the coastline has a shelf more than 200 km wide, although in a few places it is less than 50 km wide—off southern Queensland, New South Wales, east and west Tasmania, Kangaroo Island, SA, southern Western Australia, and at North West Cape, WA. In several places—off western Tasmania, South Australia and southern Western Australia—extensive submarine canyons are found. They are potentially productive and afford special habitats for invertebrates such as squid, and fish. The outer shelf areas and continental slope are important for several species, e.g. *Stenella attenuata* and *S. longirostris* off northern Australia and the Great Barrier Reef, and the two *Kogia* species elsewhere. The continental slope, particularly where that is associated with canyon systems, is particularly important for *Physeter*. Concentrations of the latter in such an area within only 20 nautical miles of the coast off Albany, WA led to the establishment of the coastal sperm whaling industry there. Other species favouring such areas include several of the beaked whales, Risso's dolphin, and perhaps the pilot whales. Deeper sea habitats are also important for sperm whales, and for beaked whales including *Hyperoodon*, for false killer whales and for several pelagic dolphins, such as *Stenella* species, *Lagenodelphis*, *Peponocephala*, *Feresa* and *Steno*.

Fourteen coastal regions are recognised (Figure 6). They extend out to the edge of the continental shelf except in far northern Australia, where the shelf extends beyond the 200 nautical mile EEZ. They are directly important to continental shelf animals such as *Stenella* spp., *Kogia simus*, *Orcinus orca* and species restricted to the inshore area, e.g. *Sousa chinensis*,

Orcaella brevirostris, as well as to some populations of *Tursiops* and *Delphinus* (Table 2). The inner coastal zone is also directly important to species that benefit by their prey spending part of their life-cycles there. For example, mangroves and seagrass beds harbour larval and fry stages of many invertebrates and fish; mangrove communities dominate the northern coasts. Other cetacean species may use the inshore environment on a seasonal basis.

Food resources

For resident species, or those that use Australian waters seasonally for food resources, distributions within the broad areas described are not uniform, but related to broad productivity patterns, locally enhanced by upwelling or undersea features such as seamounts or canyons, which may form a focus for cetacean activity.

In the Australian region, surface nutrient levels are generally low (<1.0 µg/l) in the water off continental Australia but much higher (20–30 µg/l) south of the Antarctic Convergence (see Figure 7). Low nutrient levels in sea water are usually associated with low productivity, although in some areas, such as along sections of the Great Barrier Reef, productivity is high but most nutrients are not available because they are locked up in the plant and animal life. Pockets of higher nutrient-status water occur along the east coast of Tasmania, off the coasts of New South Wales and southern Queensland, and off Western Australia. Other pockets may exist but have not yet been reported. Phytoplankton blooms are prominent in the southern Tasman Sea and around Tasmania. Seasonal events also bring up nutrient-rich water from deeper waters. Summer upwelling off south-eastern South Australia is brought about by wind-formed surface currents. Eddies are formed north-east of Tasmania and along the south coast of New South Wales by the East Australian Current, while south-west of Western Australia, eddies are formed by the Leeuwin Current. Nutrient-rich tropical water moves on to the North-West Shelf in summer and early autumn.

Although very few studies have been carried out on cetacean feeding preferences in Australian waters, there is sufficient information from elsewhere to suggest that wherever particular cetacean species occur they mostly feed on the same kinds of food (see Table 2). Some generalisations about cetacean feeding preferences likely to apply here are therefore possible.

Cetacean diets include zooplankton, non-planktonic crustaceans, squid, fish, birds and mammals. The standing crop of zooplankton in surface and subsurface waters is high in the Antarctic and subantarctic, moderate in the temperate zone and low in the tropics. The number of species is low in high latitudes but individual species biomass is very high, particularly for euphausiids and copepods, the main prey of most balaenopterids and of southern right whales. Information on zooplankton distribution and abundance in waters off continental Australia is sparse, though high standing stocks are reported off south-eastern Tasmania, presumably associated with the higher nutrient levels referred to above.

Squid species are difficult to survey and there is little direct information on their abundance. Several species are fished commercially in Australian waters. Large stocks are believed to occur in tropical waters off northern Australia and in temperate waters off southern Australia. Concentrations are found around Eyre, Yorke and Fleurieu peninsulas in South Australia, in Port Phillip Bay and off Wilsons Promontory, Victoria, and off Albany, WA. Squid form an extremely important part of the diet of many cetaceans (see Table 2). Both species of pilot whales, for example, feed largely on schooling muscular squid species.

Schooling dolphins, such as *Delphinus*, will also feed on large, single-species schools of pelagic squid. Fishing such commercially important species is therefore likely to have an impact on their cetacean predators. Conversely there may be little threat to those outer shelf or upper continental slope cetacean species such as *Kogia* and *Grampus* that tend to feed in small schools on more dispersed prey of little commercial value, such as ammoniacal squid species.

Knowledge of the abundance of fishes important to cetaceans in Australian waters is likewise generally lacking. Indirect evidence of concentrations in abundance comes from records of commercially important species. Clupeids (sardines, herrings, pilchards, sprats) form large surface-dwelling schools, often near the coast, and are probably a main feature of the diet of many delphinids (Table 2). Fishing for pilchards has intensified in Australian waters since the 1970s, with the largest fishery off south-western Western Australia and smaller fisheries along the New South Wales coast and off central and eastern Victoria. Engraulids—anchovies—are primarily shallow water fishes, distributed in subtropical and temperate coastal waters. They can form vast schools, and must be important to at least one baleen whale, the non-migratory Bryde's whale, individuals of which have recently been observed feeding on such a school in winter close to the coast north of Carnarvon, WA. Myctophids—lantern fish—which live in deep water and may migrate vertically at night from 400–1000 m to the surface, are an important food resource for many delphinids. One species, *Lampanyctodes hectori*, may be abundant enough to be fished commercially. It is benthopelagic, at depths of 300–400 m, just off the edge of the shelf around the southern half of Australia. Further offshore, oceanic cetaceans such as *Pseudorca* may be affected by high catches of tuna and of the pelagic teleost fishes which form an important part of their prey.

This overview emphasises the paucity of data on cetacean taxonomy, distribution, habitat preferences and diet in Australian waters, and the need for more detailed information on nearly all aspects of them for the majority of the Australian cetacean fauna.

2.2 Threatening processes

None of the species of cetaceans listed as part of Australia's marine fauna are exclusively Australian. It is likely that most range far beyond our territorial boundaries and into the territorial waters of other nation states. Cetaceans are subject to a variety of threatening processes, most of which result from human activities on the land as well as at sea. Some threatening processes are localised and generally affect only those species which live in particular regions or which are seasonal visitors to coastal waters, while others are ocean-wide or even global in scale and have the potential to affect many species no matter where they occur. As cetaceans are predators operating mainly at mid- to high trophic levels in the food web, they are particularly vulnerable to any broad-scale changes or perturbations that have medium to long-term adverse effects on marine environments.

The Commonwealth Government can assist the states and the Northern Territory to identify and deal with local or regional problems affecting cetaceans within their respective territorial waters, but the challenge to remove or ameliorate some of the wider threats is beyond the capacity of any one country, and requires the cooperation of all nations, through international forums, agreements and conventions, such as the International Whaling

Commission, 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 (CMS; also known as the Bonn Convention) and the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR). Fortunately, awareness of the need for a cooperative international response to environmental issues is growing, aided by the educational and political activities of many concerned organisations active in the cause of conservation in general or on behalf of marine mammals in particular, such as the World Conservation Union, the World Wide Fund for Nature (WWF), Greenpeace Australia, the Australian Conservation Foundation (ACF), Project Jonah and the Australian Whale Conservation Society (AWCS). Australia is at the forefront in developing international policy and negotiating agreements to protect marine habitats on an appropriate scale and to conserve endangered cetacean species.

Processes threatening cetaceans may be viewed and categorised in a number of different ways. For convenience they are grouped here under the broad headings of *immediate, intermediate* and *long-term*, but these are not mutually exclusive categories and the sequence in which threats are discussed does not imply any particular ranking or priority within or between groups. Given the generally poor state of knowledge of the biology and status of most Australian cetaceans, an evaluation of the *degree* to which any or all of these threats actually impinge on a species or population is difficult to achieve and the result, in many instances, is speculative.

This situation is the result of the inaccessibility of most species for detailed observation and counting. It is further compounded by the difficulties of defining populations (with the exception of the two Australian populations of humpback whale) and the extended time-scales involved in detecting real trends in numbers, given the variable biases inherent in the visual techniques currently employed in censuses. In these circumstances a population could be subject to a serious covert threat and be trending downward, but this may not be detected as statistically significant until numbers have reached a vulnerable or even an endangered level.

When addressing threats to Australian species of cetaceans it is important therefore to look beyond locally available information for relevant parallels in other parts of the world, where well-documented experience and research is providing increasingly explicit information about the nature and extent of many processes adversely affecting cetaceans.

One important aspect of the degree to which adverse processes threaten cetaceans is their *vulnerability*. Populations of species most at risk are those which:

- occupy a restricted geographical range throughout the year, in areas used by humans in ways that could significantly affect cetaceans
- occupy a narrow ecological niche which is used by humans in ways that could significantly affect cetaceans
- seasonally occupy a restricted geographic range or habitat for a critical biological function, in areas heavily used by humans in ways that could significantly affect cetaceans
- are specialised feeders on a narrow range of organisms or organisms at high trophic levels within the food web.

Priority for management action will be determined by assessment and consideration of many contributing factors, including the perceived scale and immediacy of the problem,

whether illegal activities are occurring, requirements of international agreements and conventions, roles and responsibilities of the government and non-government organisations involved, the resources available, public opinion and the consequences of choices made at various stages in the decision-making process.

Immediate threats

Direct killing

Commercial whaling in Australia on humpbacks ceased at the end of 1963 but continued on sperm whales until 1978.
In Antarctic waters the larger species of balaenopterids were targeted first and as catches declined the smaller species became successively important in that fishery. Catches of right whales had been prohibited in 1935, of blue whales since 1964, fin whales in 1976 and sei whales in 1978. Illegal pelagic catching of some species, including blue, humpback and right, continued until the early 1970s. Minke whales, the smallest species, were taken in increasingly large numbers through the early 1970s and sustained the commercial fishery until the IWC agreed on a moratorium on commercial whaling which came into effect in 1985.

The killing of cetaceans is absolutely prohibited by law in all state and territory waters (to 3 nautical miles offshore) and within the Australian EEZ (to 200 nautical miles offshore). Nevertheless, instances of stranded cetaceans bearing gunshot and spear wounds and occasional reports of incidents (and successful prosecutions) indicate that some of the smaller species are still being deliberately killed, sometimes as an act of senseless vandalism, or by some fishers in the belief that they are a serious competitor for commercially valuable fish, while others are occasionally taken for rock lobster bait as a convenient alternative when normal sources of bait (fish heads and trash fish) are temporarily in short supply. There are no reliable estimates of the extent of these activities, which in general are condemned by the public. Inshore species such as bottlenose and common dolphins appear to be most at risk because of their propensity to approach boats and to bow-ride.

Entanglement/incidental take

Capture and drowning of cetaceans in fishing nets and on long-lines in international waters is a threat of continuing concern. Even widely dispersed pelagic whales and dolphins are at risk, as a result of the number and extraordinary lengths, often measured in tens of kilometres, of individual monofilament drift-nets set by hundreds of vessels year-round in international waters. Except for the Taiwanese gill-net fishery in the Arafura and Timor seas, the incidental take of cetaceans in Australian waters has been poorly documented. Recent international measures for reducing drift-net fishing in the world’s oceans have brought about some amelioration of the problem. Measures introduced in the purse-seine tuna fishery in the eastern tropical Pacific have been effective in reducing the incidental take of dolphins, at risk because they feed in association with the tuna. Although annual losses were as high as 160 000 during the 1960s, only a few thousand are now killed annually.

Over four years to December 1985 an estimated 14 000 dolphins were taken in drift-nets set by Taiwanese vessels operating under Australian licences in the Arafura and Timor seas. Action by Australia in response to this large incidental take resulted in the closure of the fishery. However, drift-netting by Taiwanese vessels is continuing under licence in

Indonesian waters and there is concern that incidental takes at similar rates are continuing on populations of dolphins that move between Australian and Indonesian waters.

In other parts of the world, large whales can also be at substantial risk. For example, studies have revealed that 57 per cent of North Atlantic right whales (*Eubalaena glacialis*) carried scars suggestive of entanglement and 12 per cent of deaths were attributed to this cause; and in the case of recovering sub-populations of humpback whales off Newfoundland and in the Gulf of Maine the estimated annual loss by entanglement was 5.4 per cent and 4.8 per cent respectively.

In Australia, humpback whales also risk entanglement in fishing nets while on their annual migration along the east coast, where several incidents in recent years indicate that there is significant potential for mortality. Similarly, mesh-nets set off popular recreational beaches in New South Wales and Queensland, to kill and thereby reduce local populations of potentially dangerous sharks, also entangle and kill significant numbers of dolphins, turtles and dugongs. Dolphins and small whales are lost by entanglement in set-net fisheries elsewhere in Australia, and buoy-lines on pots set for rock lobster, crab and octopus and long-lines set for tuna and other fish occasionally entangle large species such as southern right and sperm whales. However, few incidents are reported and the extent of mortality is unknown.

A particularly insidious and destructive hazard for cetaceans is the vast quantity of fish netting lost at sea (ghost nets), which if buoyant may remain actively 'fishing' for several years. A related problem is caused by smaller pieces of net, the result of the normal wear and tear on fishing gear, that are abandoned or consciously discarded at sea. A cetacean entangled in a small fragment of net or lines may not immediately die, but if the encumbrance cannot be shed it will impair locomotion, affecting the animal's ability to catch food and increasing the risk of predation, and is likely to cause physical injury by constant abrasion and individual strands cutting deeply into subdermal tissues.

Shipping strikes

The problem posed by shipping includes small recreational craft as well as large cargo ships, fishing boats and fast, highly manoeuvrable naval vessels. Larger vessels pose the greatest risk to large whales and small inshore dolphins are particularly vulnerable to fast, high-powered launches and jet skis. In some circumstances, and most particularly when a vessel is running at high speed, cetaceans may perceive its approach but are unable to manoeuvre in time to avoid being struck. In this regard, the advent of large, high-speed, wave-piercing or hydrofoil ferries to serve coastal population centres will pose a particular hazard to individual cetaceans that may loiter in their path (and to the vessel as well). Of particular concern, for example, would be proposals to operate large, fast passenger vessels of these types along the east coast during the humpback whale migration, with current risks of collision increasing as the population of this species recovers.

The outcome of a solid collision is likely to be fatal even for a large cetacean, either killing the animal outright or causing major debilitating injuries which can become septic and life-threatening. For example, in the North Atlantic population of northern right whales, *Eubalaena glacialis*, the low incidence (7 per cent) of propeller wounds relative to the high apparent incidence (20 per cent) of ship-killed stranded animals indicates how deadly ship / whale collisions are to that species. Shipping strikes on cetaceans in Australian waters

are not well documented, but are not rare. As the numbers of humpback and southern right whales wintering in Australian coastal waters continue to rise, incidents involving those two species are likely to become more frequent. The effects of ship strikes on cetacean populations will be exacerbated where shipping and recreational boating impinge heavily on habitats, such as calving and nursing sites, and along migration routes.

Intermediate threats

Competition from commercial fisheries

Modern technologically advanced fisheries have the potential to compete seriously for organisms important in the diet of cetaceans or which sustain their prey species. The effects of this competition are likely to amplify as stocks of the target species decline. Currently little or no allowance is made for the food requirements of cetaceans when particular fish stocks are assessed to determine the maximum quantities that can be harvested for human consumption. Similarly, little consideration is given to the consequences for organisms at other trophic levels and for inter-dependencies within the food web, of continuing large catches of prime target species or of significant by-catches of unwanted organisms. However, in the absence of good estimates of the status of all the major components upon which to develop multi-species ecosystem models, and with little progress towards the necessary multi-disciplinary biological research to provide good data, implementation of ecosystem management remains a desirable goal only.

Cetaceans that are restricted to narrow and specific habitats, such as inshore populations of dolphins, can be at particular risk, while on a larger scale pelagic commercial fisheries on fish, squid and euphausiids pose a threat to all the oceanic cetaceans which are entirely or substantially dependent, directly and indirectly, on these resources. The 200 nautical mile Exclusive Economic Zone surrounding continental Australia, its island territories and adjacent to the Australian Antarctic Territory is of critical importance in providing the means of regulating the impact of fisheries in those waters. The Convention on the Conservation of Antarctic Marine Living Resources is of direct relevance here, and is particularly important in respect of the convention’s holistic approach to conserving and managing the living resources of the Antarctic on an ecosystem basis.

Ecosystem management is widely acknowledged to be fundamental to long-term, sustained use of marine resources, but progress towards that goal is slow and is hampered by the lack of reliable data on population sizes, predator–prey dynamics and other relationships within ecosystems.

Aquaculture is a rapidly expanding means of controlled harvesting of marine organisms, which requires the exclusive occupation of unpolluted habitats in broad estuaries and other protected coastal waters normally accessible to cetaceans. By creating extensive structures for the growth of sessile organisms, e.g. oysters, and to contain fish, e.g. salmonids and tuna, it is likely that these industries will seek to exclude cetaceans from such areas because of the likelihood of entanglements and damage and consequent financial loss.

Oil spills

Crude oils are complex mixtures of organic compounds, mainly hydrocarbons, and vary in their chemical composition and physical properties. The lighter crudes contain higher proportions of volatile compounds such as benzene, benzpyrene, toluene and naphthalene,

which can have sublethal and lethal effects on a variety of organisms, including birds and mammals. Heavy crudes are generally less toxic, but also pose a mechanical threat to wildlife by coating body surfaces and blocking orifices. The smooth skin of cetaceans appears to be much less affected by heavy oils than the easily fouled plumage of sea birds and the pelage of pinnipeds.

Apart from contamination of the skin and mucous membranes, petroleum oils can affect cetaceans by blocking the digestive tract, can cause acute poisoning by inhaled and ingested toxic compounds, and can pose a risk of chronic poisoning via ingestion of components that have entered the food web (see *Contamination of marine environments by chemical pollutants*, below). Oil will adhere to the baleen of mysticete whales and may interfere with feeding, but it appears to wash off in a relatively short time. Cetaceans may also be indirectly affected by oil damaging their habitats and reducing populations of staple prey.

Large quantities of crude oil can enter cetacean habitats as a result of major loss of a bulk cargo following wreck or collision, failure of an undersea pipeline, or blow-out of a well, e.g. 17 280 tonnes from the breakup of the tanker *Kirki* off Western Australia in 1991. In addition to the amount and type of oil, the degree of threat depends on many factors, such as prevailing temperature, wind strength and direction, other physical aspects of the environment such as sea currents and proximity to sensitive habitats, and the success of human intervention to contain and clean up the slick. Lighter and more volatile fractions of spilled oil remain at the sea surface and either evaporate or dissolve in the water. The very high percentage of air exchange achieved by cetaceans during respiration, which occurs close to the sea/oil surface, would maximise absorption of these more toxic components into the bloodstream. While in some instances cetaceans seem to be able to detect and avoid an oil slick, in others the animals have been observed swimming through the oil or continuing to feed.

A large oil slick spreading alongshore could completely invest small bays and estuaries, trapping inshore-dwelling cetaceans in a situation where their exposure to toxic compounds could be prolonged. This appears to be the case with the massive *Exxon Valdez* spill of 70 000 tonnes of oil into the waters of Prince William Sound, Alaska, in 1989. While no direct causation was demonstrated, a coincident and unprecedented mortality of resident killer whales was noted after the spill. Similarly, 79 cetaceans of three species were found dead after the Gulf War oil spills in 1991. In contrast, the potential risk to wide-ranging pelagic species is small. Even though a group may pass through a slick offshore, they are less likely to suffer significant exposure and any lasting toxic effects.

Euphausiids, copepods and mysid zooplankton absorb dissolved hydrocarbons (from spilled oil) directly from the water and ingest oil droplets and contaminated food. Baleen whales which feed exclusively on these crustaceans could be exposed to this source of contamination, should a major spill of oil occur in their feeding grounds. Heavier, longer lasting fractions tend to fall to the sea floor, where they become incorporated into sediments and affect the benthic fauna. Consequently, cetaceans whose diet includes a significant component of benthic organisms are more likely to be exposed to continuing contamination or be affected by any consequent reduction in prey populations.

Containment of oil spills and amelioration of effects

The probability of a major spill (more than 1370 tonnes) occurring in Australian waters was estimated by the Bureau of Transport and Communications Economics (BTCE) in 1991 to be

as much as 49 per cent in the next five years (note the loss of the *Kirki* that year) and 84 per cent in the next 20 years. The bureau also found that the region between Brisbane and Adelaide is generally at high risk and that Bass Strait and the Great Barrier Reef are areas of particular concern. Ship accidents per unit shipping in the latter area are the highest in Australia.

Australia's National Plan to Combat Pollution of the Sea by Oil is designed to deal only with major events. It does not include detailed operational planning or guidelines for responses aimed at protecting populations of marine mammals or other vulnerable marine wildlife in the event of a large oil spill. Thus the responsibility for preparing and implementing specific operational guidelines to minimise the effects of major oil spills on wildlife and to rehabilitate affected animals and/or habitat currently lies with state and territory governments and must be accommodated in their plans, formulated with a view to local resources and assessments of risk. As with the national plan, consultative and cooperative arrangements with the oil industry are essential to the success of state and regional plans.

While large spills are dramatic events, most inputs of oil to marine environments are from small spills and routine discharges from industrial plants and shipping. The effects of infrequent small spillages on local biota may be transient, but as urban and industrial development and shipping and leisure activities increase in coastal regions, the frequency of small spillages and discharges of petroleum oils and fuels will also increase. The current cumulative impact of chronic petroleum pollution in heavily used areas is unknown, but is likely to be significant. Coordinated, proactive planning by federal and state governments is needed to anticipate and contain this less obvious source of environmental contamination.

Disturbance and harassment

Acoustic disturbance

Cetaceans employ an extremely acute acoustic sense to monitor their environment and are correspondingly sensitive to sounds below and, to a lesser extent, above the water surface. Any human activities which produce loud and persistent sounds under water are likely to interfere seriously with the acoustic perception and communication of any cetaceans in the vicinity, and have the potential to induce significant levels of stress. Dredging and harbour construction, concentration of shipping in commercial sea lanes, in harbours and approaches to port facilities, repeat-run high-speed passenger ferries, and private recreational and tourist vessels operating under power in bays and estuaries are examples of activity which produce much underwater sound and can be disturbing to cetaceans. In the short to medium term, incessant or repeated acoustic disturbance could cause abandonment of important habitats such as narrow migration paths and calving and nursery sites.

Underwater explosions, as are used in removing hazards to shipping or might be a consequence of military testing, and sonic detonations used in seismic exploration, create intense high-energy bursts of underwater sound. Disturbance by these activities is generally infrequent and localised, but any cetaceans in the near vicinity could be highly stressed, disorientated or even physically harmed.

Whale watching from commercial and private vessels and aircraft

Whale and dolphin watching is a rapidly expanding industry in Australia. Experience here and overseas has shown that unregulated competition between operators of whale watching vessels (including 'dolphin swims'), and the activities of private boat owners, film crews,

over-enthusiastic swimmers and board riders, lead to practices which cause significant disturbance to cetaceans, at least in the short term. Inappropriate practices include persistent intrusive approach, fast manoeuvring under power, and congestion of whale watching vessels when few animals are available, causing unrelieved crowding. These forms of disturbance pose a threat to localised populations, e.g. bottlenose dolphins in Port Phillip Bay, as well as to humpback whales and southern right whales during critical phases of their annual migratory cycle, e.g. calving and nursing. The tolerance levels of these and other cetaceans likely to be subjected to disturbance by whale watchers are unknown, but possible consequences include reduced nursing of young calves, leading to increased mortality. If cows react by abandoning preferred habitats for less secure locations for calving and nursing, they could be more exposed to collision with coastal shipping and to natural predators such as killer whales and large sharks.

Tourism centred on feeding wild dolphins

Attracting wild dolphins by acclimatising them to hand feeding with dead fish has been shown to significantly and detrimentally modify natural behaviour. Evidence is also accumulating that substituting a significant part of the normal diet of live prey with dead fish, which may not be of species normally selected by the dolphins, and may be of dubious quality, poses a risk to their health. Experience with harmful consequences of hand feeding led the United States Marine Mammal Commission to define this practice as 'harassment' under the Marine Mammal Protection Act. Since April 1994, hand feeding of wild dolphins has been prohibited in the United States. In Australia, hand feeding of wild dolphins is prohibited in Commonwealth waters, Victoria, Queensland and in Western Australia (except in relation to managed human–dolphin interactions at Bunbury and Monkey Mia).

A recent review of the practice at Monkey Mia, where 12 of 17 named calves born since 1975 to 'provisioned' females have died, provides compelling evidence of serious hazards to both females and offspring. These hazards include:

- prolonged exposure to polluted near-shore waters
- exposure to human pathogens
- distracting females and/or calves in situations of imminent danger, e.g. sharks
- increased numbers of sharks in the area, attracted by the concentration of food scraps and offal in the water
- compromised nutritional status resulting from replacement of a significant proportion of the daily food intake with nutritionally inadequate food items, i.e. frozen fish thawed before hand feeding
- accepting poor quality food items (or non-food items) from boats, causing illness.

Studies of the Monkey Mia dolphins have shown that provisioned females and their calves spend less time in contact compared with non-provisioned female/calf pairs, thereby significantly increasing vulnerability to shark attack, and that irreversible dependence behaviour such as begging also lessens the chances of long-term survival.

Degradation of cetacean habitat

Physical modification

Dredging is a common activity in bays near ports and at harbour entrances. Depending on area and extent, the removal and dumping of bottom materials can cause major and

permanent modification of environments which could reduce or eliminate elements of the benthic communities important to local populations of cetaceans, e.g. seagrass and mangrove communities. These communities are important fish spawning and nursery areas for young fish, as well as providing shelter for adult fish. Similarly, extensive dredge and bottom trawl fisheries have the potential to modify substantially entire fishing grounds in ways that might be detrimental to the benthic ecosystem on which local cetaceans might directly or indirectly depend.

Biological modification

The concept and practice of quarantine in Australia, which exists to protect the nation's unique terrestrial flora, fauna and established plant and animal industries, has yet to be satisfactorily applied to analagous problems affecting its marine biota. The recent accidental introduction and rapid spread of the Pacific seastar (*Asterias amurensis*) in south-eastern Australia illustrates the significant potential of foreign organisms to invade, modify and degrade habitats used by inshore cetaceans, by direct predation and competition with the natural benthic fauna. Other foreign organisms believed to have been brought to Australia in the ballast water of foreign ships include dinoflagellates. As some species of dinoflagellates have the capacity to produce biotoxins, there is potential for consequent harmful effects on indigenous fish and cetaceans which feed on them.

Continuation of the practice of allowing ships arriving at Australia ports from overseas to discharge ballast water, without any requirement to render it innocuous, will inevitably result in further introductions of a variety of potentially harmful marine organisms. Any hardy alien organism that is able to proliferate within the new environment is then likely, free of its natural controls, to spread aggressively to the detriment of the local biota.

Exposure to infectious human disease organisms

Inshore populations of dolphins are possibly at risk of acquiring human infections where untreated human wastes enter coastal environments or where there are prolonged and multiple physical contacts with tourists at sites where wild dolphins are induced to concentrate and interact, e.g. bottlenose dolphins at Monkey Mia in Western Australia. Although swimming with wild dolphins offshore poses less risk to the animals, some resident groups have become habituated and exposed to this form of contact with humans as a result of marketing this experience as an adjunct to whale watching cruises, e.g. bottlenose dolphins in Port Phillip Bay, Victoria.

Long-term threats

Long-term threats include natural processes which alter aspects of marine environments in ways or at rates to which cetaceans may not be able to adapt, e.g. long-term cycles of climate change and extensive changes in sea levels as a result of tectonic events. Such distant possibilities are not considered here. We are concerned with threats arising as a result of human activities in the past and others of more recent origin which are impinging gradually and incrementally through time (possibly to accelerate slow-acting natural processes) and the effects of which may be ameliorated or reversed by appropriate intervention.

Contamination of marine environments by chemical pollutants

A variety of biologically active synthetic compounds now occur widely in marine environments. Many of these compounds (some of which were developed specifically as

potent biocides) have been shown to have adverse physiological effects on a variety of vertebrates. The consequences of these effects—which include immuno-suppression, hepatoxicity, carcinogenesis, reproductive and developmental toxicity, dermal toxicity and neurotoxicity—can be impaired fertility, reduced fecundity and increased mortality.

Marine mammals are particularly vulnerable to the long-term toxic effects of chemical pollutants for a variety of reasons:

- oceanic water bodies act as a sink for the more persistent and damaging compounds, such as poly-chlorinated biphenyls (PCBs), the levels of which are unlikely to decline in the near future, cf DDT and DDE which are declining but will continue to circulate in biological systems
- circulation within and between these water bodies ensures wide dispersal from points of input
- marine mammals have a reduced capacity for degrading PCBs, due to the specific mode of their cytochrome P-450 enzyme systems
- contaminants such as PCBs and other organochlorines accumulate in body tissues through feeding. Levels of these contaminants increase in the blubber and organs of males throughout their lifetime, but levels in females decrease abruptly with the birth of the first calf, because they are passed to the offspring via lactation. Evidence from South African bottlenose dolphins indicates that the first calf can receive almost 80 per cent of the mother's accumulated burden of these contaminants within the first seven weeks of nursing, and significant mortality is suspected to occur as a result.

The main sources of contamination of marine ecosystems are industrial and human wastes and agricultural biocides and fertilisers. These materials and chemicals are released in various ways, in effluent gases from industrial plants, by legal discharge of waste liquids, by accidental spillage, by illegal dumping, and by overzealous use in agricultural practice. These contaminants may be deliberately released into aquatic environments via drains emptying into rivers or outfalls to the sea, or eventually reach the sea via irrigation and rainwater run-off and groundwater seepage into river systems. Where management policies, checks and regulatory processes are inadequate to prevent or ameliorate the problem, the more persistent contaminants will pose an increasing threat to cetaceans and other top order predators in marine ecosystems, as a result of their bio-accumulation within the food web. Similarly, fertilisers leached from agricultural land cause significant eutrophication of rivers, their estuaries and adjacent inshore waters, and stimulate blooms of toxic algae.

Species of cetaceans at greatest risk are those restricted to, or those which feed extensively in, areas close to major sources of chemical pollutants, such as industrial centres located adjacent to rivers, or on the coast. Ecosystems of the littoral zone tend to have much higher levels of pollutants than further offshore, but since airborne pollutants are transported over vast areas by climatic systems, and dissolved pollutants are widely dispersed biologically and by sea currents, pelagic cetaceans which normally inhabit oceanic waters far from land are also exposed to varying levels of contamination. Pelagic odontocetes which operate at high trophic levels within the food web, selecting larger (and longer lived) prey species, are exposed to higher intakes of bio-accumulated pollutants. Most baleen whales feed at much lower levels in the food web, are less exposed and consequently have lower concentrations of contaminants in their tissues. In general, concentrations of total DDT and PCBs are lower in baleen whales in the southern oceans than in the northern hemisphere, possibly because

the southern ecosystems are more extensive, further from sources of pollution and therefore less contaminated, and fish are less important in their diets. Levels of other contaminants such as dieldrin and HCB in the tissues of baleen whales appear to be generally very low and in some samples were not detected; levels of heavy metals are generally unremarkable.

Environmental contamination and mass mortalities

Two recently discovered aquatic morbilliviruses have been responsible for major epizootics affecting marine mammals. Dolphin morbillivirus (DMV) caused large-scale mortalities of bottlenose dolphins, *Tursiops truncatus*, on the Atlantic coast of USA during 1987–1988, and of striped dolphins, *Stenella coeruleoalba*, in the Mediterranean in 1990–1991. Phocine distemper virus (PDV) caused a similar mass mortality in harbour seals and grey seals in the North Atlantic in 1988. A third member of the group, porpoise morbillivirus (PMV), was recently found in harbour porpoises, *Phocaena phocaena*, but has not been implicated in significant mortality. All three morbilliviruses occur worldwide. It has been suggested that high levels of environmental contaminants may have played a contributory role in these epizootics, e.g. levels of PCBs higher than 1000 ppm were found in livers of sampled *S. coeruleoalba*, suggesting that toxic stress was a predisposing factor in the die-off, but such a connection has not been confirmed for any of these events.

Contamination of marine environments by plastic debris

Vast and increasing quantities of plastic objects and debris are entering the world's oceans each year. Many different synthetic materials are involved, including polyethylene, polypropylene, polystyrene, polyurethane and nylon, in raw pelleted forms and as manufactured objects such as sheeting, lines, cords and containers. Floating plastic debris tends to accumulate in particular areas, which relate to points of origin, coastal topography, transport by currents and the influence of oceanic gyres; but contamination of marine environments is now a problem worldwide. Animals that are prone to ingest plastic objects accidentally or in mistake for natural prey are directly threatened, and are also at risk of entanglement in loops or openings in larger objects and in fragments of buoyant debris. Once encumbered, animals may drown or be less able to catch food or to avoid predators, suffer trauma as a result of constant abrasion by the attached debris, and be prone to infection. Species attracted to and foraging in areas where plastic flotsam tends to concentrate are at higher risk.

Few data are available on the effects of ingested plastic objects on cetaceans, but pieces of plastic sheet and/or cord have been found in the stomachs and intestines of dead dolphins—including killer whales—and minke whales and sperm whales in sufficient quantities to have caused fatal blockages. Possible sublethal effects include physical damage and ulceration of the digestive tract and reduced feeding activity. While ingested plastic polymers, plasticisers and anti-oxidant additives are not particularly toxic, many incorporated pigments are, and there is evidence that plastics can adsorb organochlorine pollutants from sea water and thereby contribute to bio-accumulation of these substances when fragments or objects are ingested directly, or indirectly via the gut of their prey. Furthermore, small pieces of ingested plastic debris pass through the gut largely unaffected by digestive acids and enzymes and on return to the marine environment become available for successive cycles of adsorption and ingestion.

Objects made of synthetic materials do not readily degrade. Some forms of plastic occurring as debris accessible to marine vertebrates, including cetaceans, are broken down by micro-

organisms and ultraviolet (UV) radiation in sunlight and may degrade within a few years or decades. Others are highly resistant, e.g. oil-based plastics, and are predicted to remain a continuing threat for hundreds of years.

Reduced genetic variation in depleted populations

In the case of terrestrial mammal species whose numbers have been reduced to very low levels, e.g. of the order of 50 individuals, loss of genetic variation becomes a problem and can result in decreased resilience to disease, physiological stress and loss of capacity to adapt to environmental change. This is a possible consequence of drastic over-harvesting of cetacean species such as the 'true' or nominate form of the blue whale (*Balaenoptera musculus musculus*), the humpback whale and the southern right whale, all of which were reduced by whaling to very low numbers compared with their estimated pre-exploitation levels.

Reduced genetic variation is of greatest concern in the southern right whale and 'true' blue whale as both were grossly depleted and then were subject to a period of illegal whaling. Some of their subspecific identity has possibly been lost, e.g. from the Australian population of the former; and from subgroups of the latter if they exist. However, a high proportion of their subunit heterozygosity would be preserved by a few matings with other subgroups every few generations.

Neither of the Australian populations of humpback whales was apparently reduced to such low levels and consequently there is less likelihood of reduced heterozygosity. Interchange of breeding animals, as a result of the two populations mixing at the southern feeding grounds, would also have mitigated against significant genetic loss.

The extent of genetic variation and subunit identity of the two Australian sub-populations of humpback whales is currently being investigated; that of the Australian population of southern right whales and of the southern remnant of the 'true' blue whale is unknown.

Commercial whaling

Whaling on large cetaceans

Member countries of the IWC have accepted a Revised Management Procedure (RMP) developed by the IWC Scientific Committee, as part of the overall Revised Management Scheme under which any future commercial whaling would be regulated. The RMP establishes the scientific and methodological basis for assessing baleen whale management units and the levels at which animals could be harvested without posing a threat to the continued existence of a stock or sub-population. In relation to Southern Ocean species, setting sustainable catch limits under the RMP for the abundant 'dark-shoulder form' minke whale would result in a gradual reduction in the stocks/sub-populations to a target of 72 per cent of their estimated initial abundance. This is the level at which they would be managed in the long term and is slightly above the level at which they are estimated to produce the highest yields. In the case of the sei whale, for example, which was significantly depleted in the past, introduction of sustainable catch limits would result in a much slower recovery to the 72 per cent target level.

With the recent implementation of the Southern Ocean Sanctuary, catch limits for commercial operations by IWC member countries are zero and will remain so for a period of 10 years, after which the situation will be reviewed. Thus there is a distant possibility that commercial whaling could resume in the Southern Ocean under the accepted IWC protocols at some time after 2004. Nevertheless, in the meantime there is a possibility of whaling

outside IWC controls by IWC member countries (which still have the option to take whales for research) or pirate whaling by non-member countries. Of greatest concern are those species reduced to population levels at which even relatively small catches would pose a serious threat to their recovery, i.e. the 'true' blue whale, fin whale, sei whale, humpback whale and southern right whale. There is still a significant international demand for whale meat, and in the light of recent revelations of illegal killing of seriously depleted protected southern ocean species by the former USSR, an IWC member, until at least the 1970s, and of a recent attempt by Norwegian nationals to export minke whale flesh to Korea in contravention of CITES, there is justifiable concern about the adequacy of international agreements and IWC protocols to protect the depleted great whales. Any legal hunt would have to accept close regulation of all stages of the process, from killing to preparation, marketing and distribution of the products. No satisfactory solution to the problem of pirate whaling, which might re-emerge to satisfy current international demand by means of covert export/import, is apparent (see also next paragraph).

Whaling on small cetaceans

In various parts of the world a large number of direct and indirect takes of small cetaceans currently occur, but except for a few species this exploitation is not regulated by the IWC. Fisheries for small cetaceans are generally on a small scale and localised, but are a source of products that could enter international trade, given the inducements of high profits. Controls over international trade in such products relate only to species listed under CITES and are binding only on those countries which are signatories to that convention. In the absence of agreed international controls over the exploitation of all species of small cetaceans, major difficulties exist in ensuring that products from endangered and vulnerable species are not being traded, e.g. the identification of whale meats offered for sale would require sophisticated analysis to identify species-specific proteins or genetic markers.

Global climate change

Evidence is accumulating that long-term changes to ecosystems at oceanic scale are in train as a result of global warming. The driving influence is increasing levels of atmospheric CO_2 and other so-called greenhouse gases, which have the effect of retaining a greater proportion of incident solar radiation within the earth's atmosphere. A separate but related problem is the increasing exposure to UV radiation as a result of the depletion of stratospheric ozone (the so-called ozone layer), caused by rising concentrations of chlorofluorocarbons (CFCs), gases synthesised for industrial purposes in huge quantities. Loss of ozone is greatest over Antarctica and the Southern Ocean, and has led to the formation of a vast depleted zone (the so-called 'hole') which fluctuates in size seasonally and from year to year. Innocuous alternatives to CFCs are available and moves to secure international agreement on phasing out the use and manufacture of the latter, e.g. the Montreal Convention, should lead eventually to ozone levels rebuilding in the future.

The processes maintaining the Southern Ocean ecosystem are in dynamic thermal balance, involving complex interactions on huge scales between a number of factors, including the annual extension and contraction of sea ice (covering about 20 million square km at its winter maximum), the vertical circulation of the waters of the Southern Ocean and associated weather systems. Supercooled and hypersaline brine, released by the differential freezing of fresh water in the formation of sea ice adjacent to the Antarctic continent, is of a higher specific gravity than normal sea water and sinks to the bottom, causing

compensatory upwellings of nutrient-rich water further north. In the Australian spring and summer this nutrient-rich Antarctic surface water provides the basis of the high productivity of the Southern Ocean, stimulating massive blooms of phytoplankton which support the entire food web of the ecosystem. The photosynthetic activity of these phytoplankton blooms also functions as a major sink for atmospheric CO_2, representing a substantial proportion of the total uptake of all the world's oceans.

A relatively small sustained change in mean annual temperature has the potential to have a significant impact on this ecosystem. Mathematical models of global climate based on geological history and the relationship between atmospheric CO_2 and surface air temperatures indicate that resulting climate changes will be greater at higher latitudes, where ecological impacts would be further exacerbated by the disruption of various feedback mechanisms. For instance, current weakening of the ozone shield is likely to add further stresses, by increasing UV penetration into surface waters where it has the potential for lethal effects on micro-organisms and depression of photosynthesis, with consequent loss of productivity and reduced CO_2 uptake. Although stratospheric ozone levels are expected to increase when CFCs are no longer used, a lag phase of a decade or more has been predicted before a significant recovery is achieved. However, any improvement might be long delayed. Although countries party to the Montreal Convention are, within various time-scales, turning to innocuous alternatives, other countries are not. For instance, India and China are continuing to use CFCs (as the circulating coolant) in their rapidly expanding production of domestic refrigerators, leakages from which are one of the most serious sources of environmental pollution by these chemicals.

Any major perturbations within the Southern Ocean ecosystem are likely to have significant effects on the cetacean fauna and especially on the populations of the large baleen whales dependent on its resources. However, the nature and degree of the (presumed) adverse effects of global warming are highly speculative, especially in view of the major changes in sea level and sea temperature that have occurred during past geological periods and which the Southern Ocean cetaceans survived. Nevertheless, it is apparent that even a relatively short-term but significant climate change on a regional to global scale can have considerable potential to aggravate synergistically any stresses operating on populations of cetaceans that are already in low numbers and under threat. For instance, a persistent haze in the upper atmosphere of global extent was created by the June 1991 Mt Pinatubo eruption in the Philippines, and resulted in widespread cooling of the northern hemisphere. In conjunction with a pronounced effect on regional weather patterns by El Niño, this event is believed responsible for a major change in the zooplankton community in the Gulf of Maine. Right whales, which normally feed in the region, were not encountered during summer surveys in 1992 and presumably were forced to seek food elsewhere.

2.3 Legislation*

Item 2.2 has already referred to the need for international cooperation in relation to threats to which cetaceans are likely to be vulnerable because of their relatively high positions in the food web and generally widespread distribution. Australia has played a leading role in the major international forum regulating human impact on cetaceans—the International Whaling Commission—and is active in conservation initiatives on other relevant bodies, particularly CITES, CMS and CCAMLR, and in regional agreements such as the South Pacific Regional

Environment Program (SPREP) and the Torres Strait Treaty. Nationally, including within its territories, its legislative role in respect of cetaceans is discharged primarily through the *Whale Protection Act 1980*, with additional controls under aspects of the *Endangered Species Act 1992*. Under the *National Parks and Wildlife Conservation Act 1975*, there is a general basis for the establishment of marine protected areas, including those of particular conservation significance for cetaceans. The *Wildlife Protection (Regulation of Exports and Imports Act) 1982* controls import or export of cetaceans or parts and products; commercial international trade is prohibited but there are provisions for bona fide scientific and educational exchange.

The Commonwealth *Whale Protection Act 1980* came into effect in 1981. It followed government adoption of the recommendations of the 1978 Independent Inquiry into Whales and Whaling (the Frost Report), which included recommendations that whaling be banned in Australian waters and that the existing Whaling Act be replaced with legislation providing for the conservation and protection of cetaceans in areas under Australian control. The 1980 Act prohibits killing, injuring, taking, capturing or interfering with cetaceans, and applies to all persons, vessels and aircraft in Australian waters, including those of the External Territories. Under the Offshore Constitutional Settlement of 1979, Commonwealth jurisdiction includes all those waters seawards of the outer limit of the 3 nautical mile territorial sea out to the limit of the 200 nautical mile Australian Fishing Zone. From 1 August 1994, Australia has established an Exclusive Economic Zone around continental Australia and all its External Territories, including the Australian Antarctic Territory. Amending legislation now provides that the Whale Protection Act applies within that zone. Beyond the EEZ, the Act applies to Australian vessels and to all Australian citizens normally domiciled in Australia, an extra-territorial application of domestic legislation unusual at the time when the Act was passed but which had been a feature of the US Marine Mammal Act passed in 1972.

Australia was an initial signatory to the International Convention for the Regulation of Whaling 1946, which established the IWC. It has been active not only within the commission itself but also on its scientific committee, providing chairs and vice-chairs of both in recent years and convenors of subcommittees of the latter. Most recently, Australian scientists have been closely involved in the development of the Revised Management Procedure, which has been regarded as a major advance in the management of marine living resources subject to exploitation. Although since 1979 it has been Australian policy to seek an end to commercial whaling, it has been Australia's view that formal adoption of the procedure was important in ensuring that, were commercial whaling to be considered at some future time, the most conservative management measures achievable should be in place, but without necessarily linking that adoption to the reintroduction of commercial whaling. Most recently, Australia has been at the forefront in seeking the adoption of the Southern Ocean Sanctuary, within which all species subject to the convention's provisions are protected from commercial whaling indefinitely but with review after 10 years (see Item 5.4.6). For waters of direct concern to Australia and within the area covered by this report, the sanctuary provisions apply to waters south of 40°S, except as already covered by the Indian Ocean Sanctuary. The latter, declared by the IWC in 1979, protects cetaceans subject to its jurisdiction in the ocean area east to 130°E and south to 55°S. The boundaries of both sanctuaries are shown in Figure 8 (p. 216).

An unresolved difficulty within the IWC has been the question of its responsibility towards those 'small' cetaceans (generally dolphins and porpoises) not subject to commercial

whaling. There has been a lack of agreement on that matter within the commission, particularly in the context of the provisions of the United Nations Law of the Sea and the sovereign rights of nations to regulate exploitation of living resources within their exclusive economic zones; currently the IWC restricts itself to providing advice on those species' status to the governments concerned. Australia's position has been that the commission's charter is for the conservation of all cetaceans and not solely those that were regarded as of commercial importance when the IWC came into being in 1946. Its policy has been to ensure that however the discussions proceed, the IWC's existing role in the conservation of small cetaceans is not eroded.

The Whale Protection Act provides for some activities, that would otherwise be an offence, to occur if they do so in the course of licensed fishing activities, but reports are required to be submitted on any cetaceans taken or injured. Nevertheless, a potentially powerful provision is that fisheries may be prescribed—for example, by notice in the *Government Gazette*. Permits are then required for any cetaceans taken in the course of such a fishery. In conjunction with the requirements for reporting of cetacean by-catch or accidental capture, this provision makes it possible in principle to regulate catch levels in any fishery in which there may be a significant impact on cetacean populations. So far the only potential candidate for fisheries under Commonwealth control has been the Arafura Sea gill-net fishery, primarily Taiwanese, in which an estimated 14 000 small cetaceans were taken, as described in Item 2.2. Reports and direct observation were followed by a joint experimental program in which methods to reduce the by-catch rate were tested. Restrictions on net length, to 2.5 km, led to the closure of the fishery in 1986.

Capture or interference for scientific or educational purposes is also permitted. In the case of capture for display, the provision remains in the Act, but following the 1985 Senate Select Committee on Animal Welfare's review of cetaceans in captivity (the Georges Report) the government decided not to grant any further permits. None have in fact been issued under the Commonwealth Act, and permits to import live cetaceans for display under the Wildlife Protection (Regulation of Imports and Exports) Act have only been considered in exceptional circumstances.

In addition to surveillance and enforcement, the Commonwealth Act provides for research and monitoring related to cetacean conservation. Where research involves interference, which is otherwise prohibited, and is defined to include chasing, harassing, marking or tagging, a permit is required. Applications for permits, for example for photo-identification or biopsy sampling for genetic studies—both involving close approaches to animals at sea—require public notification in all states, with the opportunity for public comment within a 30-day period. By delegated powers from the minister, the Director of National Parks and Wildlife then considers the request in the light of the public comment and the applicant's response. Where there are concerns that some research may be intrusive (e.g. close approach for photo-identification) or invasive (e.g. biopsy sampling, attachment of telemetry devices) and therefore may conflict with animal welfare considerations, such research must receive the prior approval of an appropriate animal welfare ethics committee.

A general provision—section 30 of the Act—authorises the development of a range of research and other programs, including on stranded animals. Under the provision, long-term monitoring of humpback and southern right whales has been funded, a National Strandings Contingency Plan was developed, and whale watching guidelines were introduced. Expenditure levels have however been small, and not maintained overall, with a severe decline in real terms in such Commonwealth-funded research in recent years.

State and territory legislation relating to cetacean conservation and protection in general mirrors the major provisions of the Commonwealth Act, either under specific Acts (Victoria, Tasmania), under specific regulations within existing wildlife protection or fisheries legislation (New South Wales, Western Australia) or under revised general wildlife protection legislation that incorporates specific provisions on cetaceans (Queensland). The differences in machinery reflect differences in coverage between the states. In fact, at least 14 different Acts of Parliament, including Fisheries Acts, are involved. The major elements can be summarised as follows:*

- 'take' of cetaceans, without a permit, is prohibited in all state waters
- 'interfering / harassment' is not prohibited in some states (Queensland, South Australia, Western Australia, Northern Territory) although guidelines on whale watching are generally in place
- 'treatment' and possession of whale carcasses are not permitted in some states (Victoria, Queensland, South Australia, Western Australia, Tasmania), but are permitted in others
- export / import permits for whale products and parts are required by all states
- incidental capture is not an offence, but some states (Victoria, South Australia, Western Australia) require that such captures are reported.

Some of the above is covered elsewhere in this report (for whale watching, for example, see Item 5.3.2; for incidental take, see Item 5.4.2). Clearly there is a need for greater complementarity in provisions across the states. That and other aspects are covered by specific recommendations in Item 5.5.

2.4 Community involvement

(see also Appendix 3)

During the past 20 years or so, society in general has become more aware of cetaceans and of issues affecting their welfare. Concerns and interests of one kind or another have led many individuals, groups and organisations, including private enterprise, to become actively involved in many aspects of the study, care, protection and use of cetaceans. There are important challenges in all of these areas, and room for a wide diversity of contributions and views, as outlined (with some examples) below. These headings are only a matter of convenience and the examples are not meant to establish or emphasise roles and boundaries. On the contrary, it is important to underscore the interactive nature of the participants in all of these areas—individuals, communities and community groups, tertiary institutions, private enterprise and government, and to stress that the role of the public cannot be considered in isolation from that of government.

Study

The study of cetacean biology and ecology; of the impacts of threatening processes; of current uses and of past impacts on whale and dolphin populations (i.e. the history of exploitation by Europeans and by Aborigines); of cultural relationships and attitudes (Aboriginal and European); of political developments nationally and internationally in the management and conservation of cetaceans.

Care

Primarily a matter of animal welfare, which may involve some members of the public in practical aspects of the rehabilitation of stranded animals, and others in disseminating

information and in political activity promoting their views and concerns about such matters as consumptive uses of cetaceans and cruelty. This is an important and challenging aspect of the role of the public and is an essential contribution to the development of philosophical concepts and ethical viewpoints on animal welfare.

Protection

Political and policy developments at state, national and international levels in relation to consumptive and non-consumptive uses of cetaceans, and local and global threats; legislation and regulation to govern human activities which have an impact on cetaceans; reservation of key cetacean habitats as marine parks and other marine conservation areas, and development of ocean sanctuaries.

Use

Enjoyment and education via commercial and private whale watching and dolphin feeding activities, well-interpreted exhibits and displays in oceanaria, museums and tourist centres focusing on cetaceans and related themes, e.g. cultural relationships, whaling; and creativity and education in the form of films, videos, art and literature.

Even from this brief summary, it is clear that there is a multiplicity of roles and opportunities for personal and community achievement in all aspects of concern for cetaceans, in the quest for knowledge and understanding, and in the uses to which cetaceans can be put. In the area of wildlife conservation, achievement can be a slow and uncertain process because it is essentially long-term, the issues are complex and conflicts inevitably arise. Resources are limited and time is short for effective remedial management of endangered species. Fundamental to progress in all of these endeavours is sound information, open communication and rational debate, but lasting solutions to problems will require pragmatism, goodwill and cooperation. Thus of equal importance are the roles of scientists and educators in gathering, analysing and disseminating information, and of government and the community in providing the resources and deciding the outcomes.

Key areas of concern in cetacean conservation, where the public plays an important role

Knowledge base

As demonstrated elsewhere in this report, relatively little is known about the biology and ecology of most cetaceans, the status of their populations, or of the impacts of threatening processes in the short and long term. The public can be influential in increasing the effort and securing support for cetacean research done by government agencies and tertiary institutions, by raising the political profile of issues that require investigation and by making representations to government. The public can also be directly involved by conducting private research or by sponsoring research. Some recent and current examples are:

- Oceanic Research Foundation, a non-profit research group
- ORRCA, a non-profit community group which operates in close liaison with the NSW NPWS, and which is committed for the long term to investigate marine mammal strandings in New South Wales

- the Dolphin Research Project Port Phillip Bay Inc., which is supported by the wider community and by private sector sponsorship in conducting population studies on bottlenose dolphins in Port Phillip Bay, Victoria
- BHP Petroleum Pty Ltd, which has directly and substantially funded extensive population surveys and behaviour studies of the southern right whale in south-eastern Australia and at the head of the Great Australian Bight
- John West, which has provided funding for dolphin studies by the University of Sydney in Moreton Bay and adjacent waters
- the Princess Melikoff Trust, a private trust based in Tasmania, which funds research on marine mammals
- the Scott Foundation, a private trust based in New South Wales.

These organisations and initiatives hopefully indicate a continuing trend of community involvement.

Welfare issues

As an expression of the interest and concern for the plight of whales and dolphins that has developed within the community over the past 20 years or so, many citizens are members of or actively support animal welfare groups and conservation organisations. Some of these groups and organisations were formed specifically to promote the protection and welfare of cetaceans. Others have much wider concerns, but have added their voice to the public debate on specific issues of cetacean conservation or welfare, e.g. whaling, captive display. The following list is by no means exhaustive.

Australian Conservation Foundation

Australian and New Zealand Federation of Animal Societies Inc.

Australian Whale Conservation Society

Australian Wildlife Protection Council

Dolphin Freedom Campaign

Dolphin Research Group Port Phillip Bay Inc.

Greenpeace Australia

Organisation for Rescue and Research on Cetaceans in Australia Inc.

Project Jonah New South Wales

Project Jonah Tasmania

Project Jonah Victoria

Royal Society for the Prevention of Cruelty to Animals

World Society for the Protection of Animals

The collective influence of these organisations is substantial (see next item), but many are not directly involved in the scientific study of cetaceans and for technical information they must prospect a vast literature in which the most recent original data can be hard to locate, and in which many of the more accessible secondary sources, e.g. generalised accounts in books, may be out of date or oversimplified. No one library in Australia would have a comprehensive and up-to-date reference collection on cetacean research and management. Finding particular papers and reports requires access to and meeting the costs of technical library services, including inter-library loans, photocopying or computerised data access.

These difficulties also confront under-resourced private cetacean researchers and students at various levels of education.

Public roles in political, legal, administrative and management issues

The public is able in a number of ways to influence government and hence to affect the management of cetaceans; for instance:

- members of the community have the right to make representations at any time to government on matters of personal or public concern, by contacting their parliamentary representative (federal and state), ministers holding the relevant portfolio or an appropriate government agency
- community views are also sought by government on contentious matters in a number of ways, for example:
  - permit applications to undertake invasive research on cetaceans in Commonwealth waters must, under the *Whale Protection Act 1980,* be submitted to public scrutiny and comment. The same or similar requirements apply under some state legislation to research activities in state waters
  - evidence and views are sought from the community and non-government organisations by formal committees of inquiry set up by government from time to time, e.g. the federal Inquiry into Whales and Whaling (1978) and the Senate Select Committee on Animal Welfare Inquiry into Dolphins and Whales in Captivity (1985)
  - the inclusion of appropriately qualified individuals from the community and representatives of non-government organisations on statutory advisory bodies or on advisory committees that ministers of government or departmental heads may establish from time to time; the inclusion of representatives of relevant non-government organisations and of the wider community (a statutory requirement) on animal welfare ethics committees, some of which may be required from time to time to adjudicate on applications for research on cetaceans.

Consumptive and non-consumptive use of cetaceans

The only recent consumptive use of cetaceans in Australia has been captive for display, mainly involving bottlenose dolphins (New South Wales and Queensland) and a few false killer whales (Queensland). Public debate and the findings of the Senate Select Committee on Animal Welfare in their report *Dolphins and Whales in Captivity* (1985) had salutary effects on the standards of husbandry in some of the then existing oceanaria, with major upgrading required of some establishments by the relevant state governments.

Non-consumptive uses are many. Where living animals are involved, i.e. in whale watching and interactions with wild dolphins, public opinion has been effective in encouraging the development of codes, guidelines and formal regulations governing the activities and behaviour of commercial operators and private individuals. However, there is a need for regular review of practices and standards in the light of experience, to improve the protection of target species as required.

Roles of Aboriginal and Torres Strait Islander communities

Aboriginal and Torres Strait Islander peoples are concerned about the persistently held Eurocentric view of them being concerned only with cetaceans (and other marine mammals) as a source of food. On the contrary, in many parts of Australia Aboriginal people associate

cetaceans with sacred sites, Dreaming tracks, customary marine states, language names and clan names, and celebrate them in traditional and contemporary songs, stories, dance and art. In these and in other ways, whales and dolphins are deeply significant to the culture of many Aboriginal and Torres Strait Islander communities. The great age of this significance is evident in the representations of dolphins found in rock paintings in northern Australia and rock carvings in various places along the east coast. For example, in the Sydney area alone there are more than 60 sites featuring dolphins and whales.

Aboriginal people did not actively hunt cetaceans, but they used stranded whales for food. These bounties from the sea were highly prized and were occasions for great feasting. Some groups, such as the Booandik people near Mount Gambier, believed their 'strong men' were able to induce strandings by singing a whale song. Only in northern Australia were Aborigines and Torres Strait Islanders equipped to actively hunt free-swimming marine animals, and took dugong and turtle. As a result of this long association and keen observation, Aboriginal and Torres Strait Islander peoples have knowledge of cetacean movement patterns, behaviour, breeding areas and calving grounds. One example of this knowledge and its practical use is the part dolphins played in helping Aboriginal people in south-east Queensland to hunt and gather fish. Certain groups, for instance on Moreton Island and Fraser Island, knew all the local dolphins and had names for them. As described by early European observers, Aboriginal communities took advantage of seasonal runs of schooling fish such as mullet, *Mugil* sp., and tailor, *Pomatomus saltator*, by 'calling' dolphins in to assist in the hunt by herding schools of fish into the shallows where they were readily netted or speared. A portion of the catch was shared with the dolphins as their reward.

It is clearly of benefit to explore the historical and contemporary knowledge that Aboriginal and Torres Strait Islander peoples have of cetaceans, and to cooperatively use this experience to more effectively manage human impacts on these animals and their habitats. The recently enacted *Native Title Act 1993* is likely to initiate and to hasten this process, and at the same time encourage governments to recognise the need to involve Aborigines and Torres Strait Islanders in developing management plans for marine parks and reserves in areas not necessarily subject to Native Title.

The *Native Title Act 1993* makes provision for sea claims and once a claim is successful the management of sea areas will change. How management changes will depend on the area in question and the attitudes of the Aboriginal or Torres Strait Islander group holding title. Native fauna in these areas may be used for cultural purposes and for food, as provided for under section 211 of the Act, and as is recognised by the Convention on Biological Diversity, to which Australia is a signatory. Whether or not the smaller and more accessible inshore species of cetaceans will be actively hunted is not known. However, it must be acknowledged that traditional Aboriginal use of sea resources in the past has not had the impact of European exploitation on Australia's marine fauna and habitats, and Aboriginal and Torres Strait Islander peoples maintain that they are well aware of the importance of conserving endangered, vulnerable and threatened species.

Successful claims in areas such as the Great Barrier Reef Marine Park will require the striking of cooperative agreements, and will effectively legitimise Aboriginal and Torres Strait Islander aspirations to be involved in research and management of culturally significant marine areas and their resources, in addition to the narrower aspects of subsistence and cultural hunting, fishing and gathering. In relation to the latter, a working

agreement already exists in the form of the current permit system which allows hunting of dugong by Aboriginal communities within the Great Barrier Reef Marine Park.

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3. Conservation Status

3.1 Categories

The World Conservation Union (IUCN) has been foremost in developing definitions of categories of threat, to assess and rank the conservation status of vertebrate species in its Red Data Books. The union's three basic categories of highest concern—extinct, endangered and vulnerable—have been adopted by the Commonwealth Government and applied to the official listing of endangered and threatened vertebrate species in the Australia and New Zealand (ANZECC) list of Endangered Vertebrate Fauna (1991). In that list, only three cetaceans are included: blue whales, humpback whales, and southern right whales.

Recent refinements of the IUCN categories (Mace and Lande 1991, Mace et al. 1993) seek to apply a more quantitative approach to assessing factors recognised as contributing to the extinction of species. Consequently, modifications to the criteria used to define categories of threat have concentrated on measures or estimates of geographic range, as well as on aspects of population size, structure and dynamics, with particular reference to population declines, and include statistical analyses of the probability of extinction in the wild.

Mace et al. 1993 proposed seven categories: extinct; critical; endangered; vulnerable; susceptible; safe / low risk; insufficiently known. Details are given in Appendix 2.

Recognising that the more objective criteria adopted offer a more reliable basis for setting priorities and allocating resources, we attempted to apply them (with some scaling up of range areas by factors of $x10^2$, $x10^3$ or more), to an assessment of the conservation status of Australian cetaceans. These approaches seem to work reasonably well for some of the higher terrestrial vertebrates (for which they were designed), which generally are more accessible and occur within more easily measured habitats than do most cetaceans. However, the pelagic cetaceans in particular present a number of formidable problems related to their elusive nature, the vast size of oceanic habitats, the difficulty of establishing meaningful boundaries to the distribution of many species, and the range of populations or sub-populations, as well as to the poor state of knowledge of their habitat requirements. Information of the kinds and quality needed to apply the criteria is for most species fragmentary, or of doubtful relevance because it is derived from studies on 'populations' elsewhere, or does not exist.

Lacking the required information base, we concluded that neither the Mace and Lande (1991) nor the Mace et al. (1993) classifications can be applied successfully to a systematic evaluation of the conservation status of the Australian cetacean fauna.

The same or similar problems were experienced by Cogger et al. (1993), in attempting to apply the Mace and Lande classification to an assessment of Australian reptile species for the Reptile Action Plan. Instead, Cogger et al. used a modified version of an approach developed by Millsap et al. (1990), for assessing priorities for the conservation of fish and wildlife in Florida. The Millsap et al. methodology recognises three distinct, but often

related, data sets, each of which consists of a suite of scored criteria: biological variables; action variables; supplemental variables.

Only the biological variables data set is used to identify the taxon's conservation status. Details are given in Appendix 2.

As with Mace et al. 1993, the application of the Millsap system of classification to the Australian cetacean fauna requires good measures or estimates of numbers and of distribution and range size, together with detailed knowledge of those reproductive parameters that are crucial to calculations of population dynamics (e.g. age at sexual maturity, calving interval and reproductive life/longevity), and of dietary specialisations/food sources. Even with the many modifications necessary to align the variables more realistically to the basic patterns of cetacean biology, we found that the lack of adequate data frustrated any meaningful and comparative assessment or ranking of species.

At this point we returned to the status categories used in the preparation of the IUCN Red Data Book *Dolphins, Porpoises and Whales of the World* (Klinowska 1991), and which were the starting point for Mace and Lande's (1990) development of objective criteria. Those categories, as defined by IUCN, are as follows.

Extinct

Not definitely located in the wild during the past 50 years.

Endangered

Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating. Included are taxa whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction. Also included are taxa that are possibly already extinct but have been definitely seen in the wild in the past 50 years.

Vulnerable

Taxa believed likely to move into the endangered category in the near future if the causal factors continue operating. Included are taxa of which most or all of the populations are decreasing because of over-exploitation, extensive destruction of habitat or other environmental disturbance; taxa with populations that have been seriously depleted and whose ultimate security has not yet been assured and taxa with populations that are still abundant but are under threat from severe adverse factors throughout their range.

Rare

Taxa with small world populations that are not at present endangered or vulnerable but are at risk. These taxa are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range.

Indeterminate

Taxa *known* to be endangered, vulnerable or rare, but where there is not enough information to say which of the three categories is appropriate.

Insufficiently known

Taxa that are *suspected* but not definitely known to belong to any of the above categories, because of lack of information.

Out of danger

Taxa formerly included in one of the above categories, but which are now considered relatively secure because effective conservation measures have been taken or the previous threat to their survival has been removed.

Despite the subjective nature of these categories, they provide a reasoned framework for evaluating threat based on trends in populations through time. We have therefore used them as the basis of our evaluations, but with some modifications.

Consequently, we have:

- adopted four of the IUCN categories as defined above
- formulated two more, one with three subcategories.

We have then applied them to the species or subspecies of cetaceans found within the area covered by this report.

The categories used by us are thus:

Extinct

As defined by IUCN.

Endangered

As defined by IUCN.

Vulnerable

As defined by IUCN.

Insufficiently known

As defined by IUCN, and involving a *suspicion* that the species or subspecies may belong to any of the above.

No category assigned, (a) because of insufficient information

Where there is no firm basis on which to infer a significant threat, past or present. It thus differs from the IUCN category insufficiently known.

No category assigned, (b) but possibly secure

Where there is no firm basis on which to infer a significant threat, past or present but there are general indications of wide distribution and abundance.

No category assigned, (c) but probably secure

Where there is no firm basis on which to infer a significant threat, past or present, but reasonably objective assessment exists of numbers in the wild.

Secure

Where current population numbers are such that the species or subspecies is in no danger, except perhaps if uncontrolled commercial whaling resumes.

To summarise, a comparison of our approach with those others reviewed above is given in Table 3.

3.2 Conclusions on threat categorisations

Our conclusions using the classifications we adopted in Item 3.1 are listed individually for each taxon in the species synopses (Item 4). They are summarised in Table 4. Explanations for particular categorisations are indicated in the relevant species synopsis, but are summarised below.

As explained in Item 3.1, our categories have been applied to the species or subspecies recognised by us as occurring within the area covered by this report. Given the poor state of knowledge of populations or subdivisions in Australian waters, we have not attempted to categorise any subdivisions except for those already recognised, i.e. the pygmy blue whale and the diminutive form of the minke whale.

We do not consider that any of the Australian cetaceans can reasonably be considered extinct. Longman's beaked whale, *Mesoplodon pacificus*, is the only possible candidate, but the common supposition that few strandings equates with rarity in the wild can be notoriously misleading. Other tropical oceanic species previously recorded on very few occasions are now known to be abundant, but only distant from land, e.g. Fraser's dolphin *Lagenodelphis hosei.*

On the basis of recent estimates of numbers as low as 1000 or less and the lack of evidence for any recent increase, we conclude that the 'true' (nominate form) blue whale, *Balaenoptera musculus musculus* is **endangered**. This is in line with the IUCN application of the category to species with an estimated population size of less than 2000 (see Cooke, in Klinowska 1991). We assign southern right whale *Eubalaena australis,* humpback whale *Megaptera novaeangliae,* sei whale *Balaenoptera borealis,* and fin whale *Balaenoptera physalus,* to **vulnerable** on the basis of their known or likely current status. While the two Australian populations of the humpback whale, and southern right whales off the south-west coast, have shown encouraging recent increases, none have yet recovered sufficiently—i.e. to around 60 per cent of their estimated or likely pre-exploitation level—to warrant designation as **secure**; both fin and sei whales were severely depleted by commercial whaling and there is no firm evidence yet of any recovery. Our conclusions on humpbacks and southern right whales accord with IUCN's view that, in practice, this category may temporarily include taxa whose populations are beginning to recover but not yet sufficiently to justify transfer to another category. The Indo-Pacific humpbacked dolphin *Sousa chinensis,* Irrawaddy dolphin *Orcaella brevirostris,* and spinner dolphin *Stenella longirostris,* are categorised as **insufficiently known** on the basis that all are subject to incidental take of an unknown level and could well be vulnerable. In the case of the spinner dolphin, we are concerned that large incidental catches north of Australian waters are likely to be from the same population as occurs within Australian waters. The sperm whale, *Physeter macrocephalus,* is included in that category because of selective take and consequent depletion of males in the population off south-

western Australia by 1978 and the subsequent lack of information on possible recovery since then.

We have considered concerns expressed over the status of the bottlenose dolphin *Tursiops truncatus,* which may be subject to the same threat of incidental take in northern waters as the spinner dolphin, and occurs close to population centres elsewhere. Given its wide coastal distribution around Australia, we have not included it in the same category 'insufficiently known' as the spinner dolphin but have placed it in **no category assigned (a) because of insufficient information**.

The vast majority of Australian taxa (35 species or 78 per cent) has been listed under **no category assigned (NCA)**. We recognise that our subdivision of this group rests largely on intuitive assessments, which form a ranking of increasing confidence in their conservation status, with 22 taxa in **NCA (a) because of insufficient information**, 12 taxa in **NCA (b) but possibly secure**, and one in **NCA (c) but probably secure**. The single taxon assigned to the last category, the killer whale, *Orcinus orca,* occurs there because of an estimate of numbers (70 000+) in the Antarctic.

We have included in the category **secure** the dark-shouldered form of the minke whale *Balaenoptera acutorostrata bonaerensis,* on the basis of recent Antarctic population estimates of approximately 300 000 combined in the two Antarctic Areas (IV and V) relevant to Australia.

Selected references

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Millsap, B A, Gore, J A, Runde, D E and Cerulean, S I (1990). Setting priorities for the conservation of fish and wildlife species in Florida. *Wildl Monogr* **111**: 1–57.

UNEP (1992). Convention on Biodiversity, June 1992. United Nations Environment Program, Nairobi.

Table 4: Conservation status of species

Endangered (EN)	
Blue whale ('true' or nominate form)	*Balaenoptera musculus musculus*
Vulnerable (V)	
Southern right whale	*Eubalaena australis*
Humpback whale	*Megaptera novaeangliae*
Sei whale	*Balaenoptera borealis*
Fin whale	*Balaenoptera physalus*
Insufficiently known (K)	

Indo-Pacific humpbacked dolphin	*Sousa chinensis*
Irrawaddy dolphin	*Orcaella brevirostris*
Spinner dolphin	*Stenella longirostris*
Sperm whale	*Physeter macrocephalus*

No category assigned:
(a) because of insufficient information (NCA (a))

Spectacled porpoise	*Australophocoena dioptrica*
Rough-toothed dolphin	*Steno bredanensis*
Dusky dolphin	*Lagenorhynchus obscurus*
Risso's dolphin	*Grampus griseus*
Bottlenose dolphin	*Tursiops truncatus*
Pan-tropical spotted dolphin	*Stenella attenuata*
Striped dolphin	*Stenella coeruleoalba*
Fraser's dolphin	*Lagenodelphis hosei*
Pygmy killer whale	*Feresa attenuata*
False killer whale	*Pseudorca crassidens*
Shepherd's beaked whale	*Tasmacetus shepherdi*
Longman's beaked whale	*Mesoplodon pacificus*
Dense-beaked whale	*Mesoplodon densirostris*
Hector's beaked whale	*Mesoplodon hectori*
Andrew's beaked whale	*Mesoplodon bowdoini*
True's beaked whale	*Mesoplodon mirus*
Ginkgo-toothed beaked whale	*Mesoplodon ginkgodens*
Pygmy sperm whale	*Kogia breviceps*
Dwarf sperm whale	*Kogia simus*
Minke whale (diminutive form)	*Balaenoptera acutorostrata* (undescribed subsp.)
Bryde's whale	*Balaenoptera edeni*
Pygmy blue whale	*Balaenoptera musculus brevicauda*

(b) but possibly secure (NCA (b))

Hourglass dolphin	*Lagenorhynchus cruciger*
Common dolphin	*Delphinus delphis*
Southern right whale dolphin	*Lissodelphis peronii*
Melon-headed whale	*Peponocephala electra*
Long-finned pilot whale	*Globicephala melas*
Short-finned pilot whale	*Globicephala macrorhynchus*
Arnoux's beaked whale	*Berardius arnuxii*
Strap-toothed whale	*Mesoplodon layardii*
Gray's beaked whale	*Mesoplodon grayi*
Cuvier's beaked whale	*Ziphius cavirostris*
Southern bottlenose whale	*Hyperoodon planifrons*
Pygmy right whale	*Caperea marginata*

(c) but probably secure (NCA (c))

Killer whale	*Orcinus orca*

Secure (S)

Minke whale (dark-shoulder form)	*Balaenoptera acutorostrata bonaerensis*

4. Species Synopses

The Introduction has outlined the process in the consultancy that led to the preparation of species synopses for all Australian cetaceans rather than recovery outlines for solely those taxa considered to be under threat.

In this section, therefore, we summarise information under 18 headings for all 43 species we regard as belonging to the Australian cetacean fauna. The format was originally developed from the recovery outline headings adopted for the Action Plan for Australian Freshwater Fishes (Wager and Jackson 1993), and modified slightly as a result of discussion at the Canberra workshop. A deliberate attempt has been made to adopt a summary style, without losing accuracy. We are grateful to all those who have in many ways assisted in the preparation of the synopses, by providing detailed information, responding to specific queries, or reviewing particular synopses. Four were prepared by scientists other than the consultants (those for *Tursiops, Sousa* and *Orcaella* by P J Corkeron, that for *Australophocoena* by M W Cawthorn) and special assistance was provided for that on *Eubalaena* by S Burnell.

Within headings 11, 13 and 16, research projects are in order of priority. No costings have been included here in heading 16. They have, however, been provided for those species recommended for priority action; see Item 5.1.

Page numbers for the species synopses are included in Table 1 (pp. 38–39), as well as in the Table of Contents.

Spectacled porpoise*

1. Family — Phocoenidae

2. Scientific name — *Australophocoena dioptrica*

3. English name(s) — Spectacled porpoise

4. Taxonomic status, including species and subgroups

Described by Lahille in 1912 as *Phocoena dioptrica.* No subgroups known.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, because of insufficient information (NCA (a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration

Southern hemisphere only. Apparently circumpolar in subantarctic latitudes. Off Atlantic coast of South America north to ca 34°S; at Falkland Islands and South Georgia. Recorded in Pacific Ocean south of New Zealand, at Auckland Islands, Macquarie Island and to

west in open ocean ca 56°S,175°W; in Indian Ocean at Heard and Kerguelen Islands. Apparent concentration of records near subantarctic islands possibly due to observer bias. Insufficient evidence to assess possible seasonal north–south movements (off South America) or east–west movements at higher latitudes. No records from continental Australian seas.

7. Habitat

7.1 General
Apparently prefers subantarctic region (ca 1–8°C) and continental seas in cold temperate region influenced by cold currents, e.g. Falkland Current off Argentina.

7.2 Key localities
None known in Australian waters.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (data mainly from Argentina)

9.1 Growth and age

Birth, weight/length:	? kg/0.484 m (near term foetus), probably ca 0.70–0.80 m
Weaning, age/length:	not known
Physical maturity, age/length	? years/ca 2.0 m (male)
Weight, maximum:	ca 80 kg
Age, maximum:	not known
Length, maximum:	2.24 m (male), 2.04 m (female)

9.2 Reproduction

Sexual maturity, age/length	? years/ca 1.85 m (female)
Calving interval:	not known
Mating season:	not known
Gestation:	not known
Calving season:	possibly late winter summer
Calving areas:	not known for Australian waters

9.3 Diet
Fish and squid.

9.4 Behaviour
Little known. Unobtrusive, seen singly and in groups of 2–3, latter comprising male, female and calf; apparently does not school in larger numbers.

9.5 Mortality and pathology
Strands and taken incidentally in nets. Possibly vulnerable to predation by killer whales.

9.6 Population abundance and rates of change

No absolute measures, but apparently common in inshore waters of Tierra del Fuego; elsewhere not known.

10. Threats

10.1 Past

- Incidental capture in tangle-nets set for crabs and fishes in Tierra del Fuego, but not now used.

10.2 Current

- Incidental capture in gill-nets set by artisanal fishermen on Argentine coast, extent unknown but fishery expanding since 1988.
- Possible entanglement in drift-nets and other nets set, lost or discarded in international waters at higher latitudes.

10.3 Potential

- Incidental captures in expanding fisheries in Southern Ocean, especially in areas adjacent to subantarctic islands.
- Disturbance and pollution resulting from coastal and offshore oil and mineral exploration (Argentina).
- Pollution of preferred habitats, leading to accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research

- Establish basic biological parameters, including seasonal variation (with reference to Argentinian and New Zealand data).
- Investigate genetic relationships including possibility of discrete populations.
- Assess degree of biological threat posed by pollutants.
- Improve definition of range in relation to oceanographic parameters and seasonal occurrence.

11.2 Management

- Increase international efforts to ameliorate and/or remove current and potential threats.

12. Conservation actions already initiated

12.1 Research

- Opportunistic examination of stranded and incidentally-caught specimens in Argentina by Goodall and colleagues.

12.2 Management

- Protection under federal and state laws.
- Development of international objectives and agreements (CITES, CMS, IWC) to protect cetaceans and marine environments.

13. Conservation actions required

13.1 Research

- Maximise basic biological information gained from strandings and incidental captures.
- Conduct follow-up investigations of taxonomic and genetic material, organ systems and stomach contents, health status including parasites, and pollutants in body tissues.
- Obtain information on distribution via platforms of opportunity, e.g. observers on oceanographic research vessels and Antarctic Division resupply vessels, and obtain

estimates of abundance by dedicated field survey, e.g. by expansion of IWC whale sighting cruises.
- Further investigate status of population and possible sub-populations, by opportunistic biopsy sampling for genetic analysis.

13.2 Management
- Encourage compliance by IWC member states with commission recommendation to report all incidental captures.
- Ensure specimens are made available to appropriate scientific museums.
- Monitor development of fisheries in the Southern Ocean directed at pelagic squid and fish, possibly important in the diet of *A. dioptrica*.

14. Organisations responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: Tasmania PWS/DELM, in state waters (= 3 n miles) around Macquarie Island

15. Other organisations and individuals involved
No current projects targeting this species.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No, requires:
- Cooperative and coordinated actions by relevant nations, to achieve objectives set out in 11.1, via actions listed in 13.1.

16.2 Management
Yes, but limited, requires:
- See 13.2.

17. Remarks
One of the smallest and least known cetaceans of the Southern Ocean.

Selected references

Baker, A (1990). *Whales and Dolphins of Australia and New Zealand: An Identification Guide.* Victoria University Press, Wellington, New Zealand.

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Fordyce, R E, Mattlin, R H and Dixon, J M (1984). Second record of spectacled porpoise from subantarctic south-west Pacific. *Sci Rep Whales Res Inst Toyko* **35**: 159–164.

Goodall, R N P and Cameron, I S (1980). Exploitation of small cetaceans off southern South America. *Rep Int Whal Commn* **30**: 445–450.

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Leatherwood, S and Reeves, R R (1983). *The Sierra Club Handbook of Whales and Dolphins.* Sierra Club Books, San Francisco.

Rough-toothed dolphin

1. Family	Delphinidae
2. Scientific name	*Steno bredanensis*
3. English name(s)	Rough-toothed dolphin

4. Taxonomic status, including species and subgroups
Described by Lesson in 1828 as *Delphinus bredanensis*. No subspecies recognised. Inconclusive evidence that Indo-Pacific animals differ from Atlantic. No information on taxonomic status of the few Australian specimens.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, because of insufficient information (NCA(a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration
Occurs in low latitudes of Atlantic, Indian and Pacific Ocean. Strandings in mid-latitudes outside these regions could be vagrants. In Australia, recorded from Barrow Island, WA, Northern Territory, Queensland and New South Wales. Not known to be migratory.

7. Habitat

7.1 General
Pelagic and possibly neritic. Also oceanic. Tropical and subtropical waters. Possible vagrants in temperate region. Habitat requirements unknown.

7.2 Key localities
None known in Australian waters.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (based on non-Australian information)

9.1 Growth and age

Birth, weight/length:	?/ca 1.0 m
Weaning, age/length:	not known
Physical maturity, age/length	ca 16 years/? m
Weight, maximum:	155 kg
Age, maximum:	32 years
Length, maximum:	2.65 m (male), 2.55 m (female)

9.2 Reproduction

Sexual maturity, age/length:	14 years/2.25 m (male), 10 years/2.20 m (female)
Calving interval:	not known
Mating season:	not known
Gestation:	not known
Calving season:	not known
Calving area(s):	none known in Australian waters

9.3 Diet

Very limited data. Pelagic octopus, squid and reef fish. Larger fish may be taken in deep water.

9.4 Behaviour

Can occur in groups of up to several hundred individuals but usual group size is 10–20. Seen with pilot whales, bottlenose dolphins, and spotted and spinner dolphins. Rides bow waves but not as commonly as some other dolphin species. 'Skimming' swimming behaviour reported. Stays submerged for longer periods (up to 15 mins) than other dolphins. Possibly feeds in groups.

9.5 Mortality and pathology

Group strandings on several occasions outside Australia. Three animals stranded together on Barrow Island, WA in 1971. Japanese specimens had a high incidence of skeletal malformations. Very little known about parasitology.

9.6 Population abundance and rates of change

No population estimates known. Believed to be uncommon throughout its range but difficulties in identification could mean abundance is underestimated.

10. Threats

10.1 Past

- No information available.

10.2 Current

- Possible direct catches in areas adjacent to Indonesia so illegal catches within Australian EEZ are likely.
- No information on indirect catches in Australian waters.
- Direct fisheries captures in Solomon Islands and Papua New Guinea, in small numbers.
- Known incidental catches are pelagic drift-net and gill-net fisheries off Sri Lanka.
- Rarely taken in purse-seine netting operations outside Australia.

10.3 Potential

- Entanglement in drift-nets set outside Australian Territorial Waters and in lost or discarded netting.
- Pollution (including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea) leading to bio-accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research

- Determine distribution and monitor abundance in Australian waters to assess possible impact of threats, particularly effect of direct and indirect fishing activities.

- Obtain information on diet to determine trophic level and assess possible impact of fishing industry on food resources.
- Determine taxonomic relationships within and outside Indo-Pacific region to assess likely impact of threats on possible individual populations.

11.2 Management
- Minimise possible detrimental effects on population(s) from fishing activities.

12. Conservation actions already initiated

12.1 Research
- Study of incidental catch in Arafura and Timor Sea, 1981–1985, commissioned by Australian National Parks and Wildlife Service; no *Steno* recorded.

12.2 Management
- Requirement to report incidental catch within Australian EEZ

13. Conservation actions required

13.1 Research
- Carry out sighting program to monitor numbers in northern waters.
- Obtain basic biological information (including diet and pollutant levels) from incidentally-caught and stranded specimens, especially from Arafura and Timor seas.
- Make taxonomic comparisons (when sufficient material is available) between Australian specimens and those from the Indo-Pacific and Indian oceans.

13.2 Management
- Ensure adequate protection of species and resources in Australian and nearby waters.
- Require reporting and salvage of specimens incidentally caught or stranded.
- Ensure specimens available for appropriate scientific museums.

14. Organisation(s) responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
No-one actively studying *S. bredanensis* in Australian region.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No, requires:
- Minimum requirement for a sighting program operated from existing cruises: two observers on two appropriate vessels (e.g. government) for one year; may be possible to combine observer with incidental catch biologist (see next dot point).
- Minimum requirement to obtain basic biological information from incidentally-caught animals from fishing vessels: one biologist on fishing vessels for one year.

16.2 Management
No, requires:
- Appropriate guidelines/legislation, where not provided.
- Funding required to assist in salvage, lodgement and curation of specimens obtained.

17. Remarks
Species may not be as rare in Australian waters as believed.

Selected references

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Indo-Pacific humpbacked dolphin*

1. Family	Delphinidae
2. Scientific name	*Sousa chinensis*
3. English name(s)	Indo-Pacific humpbacked dolphin

4. Taxonomic status, including species and subgroups
Osbeck (1765) described *Sousa chinensis* from the coast of China, but the holotype has been destroyed. The genus is in need of review and may comprise several species. *S. chinensis* inhabits the western parts of the genus' range. Included in *S. chinensis* is *S. borneensis*, found south and east of Indonesia (including Australia).

5. Species survival status

5.1 Australian Action Plan status
Insufficiently known (K)

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix I

6. Distribution, including migration
Occurs in southern China through the Indo–Malay Archipelago to northern Australia. Recorded in Western Australia (north of 24°S), Northern Territory and Queensland, with occasional strandings reported in New South Wales (mostly north of 29°S). Not known to be migratory.

7. Habitat

7.1 General

Coastal, estuarine, occasionally riverine. Tropical and subtropical. Occurs close to the coast, in less than 20 m depth. Aerial surveys in the Great Barrier Reef region may have located *Sousa* in waters between the outer reef and the mainland, further from shore than has been reported in the literature.

7.2 Key localities

Moreton Bay, Queensland and adjacent offshore waters, because resident population known there. Tin Can Inlet, Great Sandy Strait, Queensland because regularly seen there.

8. Marine protected areas managed for or relevant to the species

All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (mainly South African data and possibly not the same species)

9.1 Growth and age

Birth, weight / length:	ca 14 kg / 0.97–1.08 m**
Weaning, age / length:	not known
Physical maturity, age / length:	13–14 years / 2.58–2.74 m**
Weight, maximum:	260 kg** (male), 170 kg** (female)
Age, maximum:	>40 years**
Length, maximum:	2.74 m**

9.2 Reproduction

Sexual maturity, age / length:	10–13 years** / not known
Calving interval:	not known
Mating season:	not known
Gestation:	not known
Calving season:	summer
Calving area(s):	none known in Australian waters

9.3 Diet

Teleosts, some cephalopods and crustaceans. Littoral, estuarine and demersal reef species eaten. Feeds in association with prawn trawlers in Moreton Bay, presumably elsewhere throughout its range in Australia.

9.4 Behaviour

Sound—clicks, burst-pulses and whistles recorded. Whistles are pure tones ranging in frequency from 1.2 kHz to at least 20 kHz. Frequency range of whistles may be greater, but bandwidth limitations of most recording equipment prevent accurate determination of upper frequency limit. Capacity for echolocation not tested experimentally.

Social structure—occurs in groups of up to 25. Mean group size in Moreton Bay, 2.4. No data on sex differences in group formation, or on social behaviour. Appears subordinate to bottlenose dolphin when feeding near trawlers.

Behaviour—wide range observed. More spectacular aerial behaviour includes surfing, breaching, jumps (leaps to >2 m above the water surface), somersault jumps, fluke slaps, head slaps. Surfacing pattern very different from bottlenose dolphin. Tends to remain under water, surfacing only to breathe: bottlenose dolphin more likely to remain at the surface. *S. chinensis* surfaces in a rolling motion, poking rostrum out of the water, then arching its back as it dives.

9.5 Mortality and pathology

No good data on mortality rates. In Moreton Bay, 36% of dolphins show evidence of shark attack, suggesting mortality from sharks is significant. Very high levels of organochlorines, probably sufficiently high to kill a female's first calf, occur in South African animals. Possible that similar high pollutant loads occur in *S. chinensis* in Moreton Bay, but no data available at present.

9.6 Population abundance and rates of change

No data on absolute abundance. Fifty individuals have been photo-identified in Moreton Bay. Data from dugong aerial surveys along Queensland coast provide minimum estimates of humpbacked dolphins. Counts uncorrected for submerged animals. Continuation of surveys should allow monitoring of relative abundance for much of Queensland coast.

10. Threats

10.1 Past

- None that are not current.

10.2 Current

- Presumed habitat destruction and degradation, including noise pollution, harassment—particularly close to major cities (e.g. in Moreton Bay).
- Incidental capture in shark nets, trawl-nets, drift-nets
- Illegal killing, particularly by people killing for sport, e.g. spearing or shooting.
- Live capture in Queensland (permits granted for up to 12 per year at present) and northern New South Wales.
- Overfishing of prey species.

10.3 Potential

- Pollution, particularly form organochlorines, because inshore cetaceans very vulnerable, especially in agricultural regions.
- Epizootics. Marine mammals very susceptible to pathogen-induced mass mortalities.

11. Conservation objectives

11.1 Research

- Monitor abundance, especially in key areas, to determine possible impact of threats, e.g. pollutants, habitat degradation.
- Determine levels of pollutants in individuals and in prey fish species to assess possible impact in different areas.
- Study habitat requirements to assess impacts of degradation.
- Derive a relationship between aerial survey estimates and absolute abundance to allow absolute abundance to be estimated and monitored.
- Compare genetics and morphology between Australian and other regions to assess taxonomic status of Australian animals.

- Establish life history parameters for Australian animals to allow better interpretation of population trends and effects of threats.

11.2 Management

- Ensure regular monitoring of the population throughout Australia to detect possible decreases in numbers.
- Minimise possible detrimental effects, e.g. water quality.
- Help ensure adequate stocks of dolphins' prey by contributing to fisheries management discussions.

12. Conservation actions already initiated

12.1 Research

- Aerial surveys of Northern Territory coastline (W Freeland et al., Conservation Commission of Northern Territory).
- Aerial surveys in Great Barrier Reef Region and northern waters of Western Australia—adjunct to dugong aerial surveys (H Marsh et al., James Cook University).
- Carcass salvage from shark nets in Queensland.
- Photo-identification studies in Moreton Bay and adjacent offshore waters (P Corkeron et al., University of Sydney).

12.2 Management

- Enforce legal protection under the *Whale Protection Act 1980* in the Australian EEZ and state and Northern Territory waters.
- Funding for aerial surveys—Great Barrier Reef Marine Park Authority, Queensland Fish Management Authority and Northern Territory Conservation Commission.

13. Conservation actions required

13.1 Research

- Using aerial survey, establish baseline estimate for minimum population in Australia, identify areas of highest density along the Australian coastline and monitor trends.
- In selected key areas, establish sizes and trends of populations using photo-identification sight/resight techniques.
- Coordinate aerial survey and photo-identification in selected key areas to derive relationship between aerial survey minimum estimate and estimate of absolute abundance.
- Determine levels of pollutants occurring in populations in key areas, using biopsy of free-ranging animals.
- Determine level of genetic interchange between local and other Indo-Pacific populations; study existing museum specimens from different regions.
- Determine habitat requirements.
- Determine causes of death of stranded animals, relate pollutant levels to those in key areas.
- Improve reporting of catches and carcass salvage of dolphins in shark nets (especially off Queensland), including at least identifying animals to species.
- Establish basic life history parameters for animals in Australian waters from carcass salvage, long-term observations of naturally marked individuals and satellite telemetry studies.

13.2 Management

- Monitor watershed management, including effects on habitat and prey species.
- Fisheries management should allow for the requirements of upper predators (i.e. sharks, dolphins).
- Require reporting and specimen collection from incidental capture.

- Ensure specimens available for appropriate scientific museums.

14. Organisation(s) responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
G Ross, Australian Nature Conservation Agency
Australian Whale Conservation Society
ORRCA
Project Jonah, NSW
Sea World, Surfers Paradise

16. Can research and management be carried out with existing resources? If no, what is required?
Planning for the conservation of *S. chinensis* in Australian waters is required. Much of its range in Queensland is covered by marine parks—the Moreton Bay Marine Park, Hervey Bay Marine Park and the Great Barrier Reef Marine Park. Declaration of the Great Sandy Straits Marine Park will extend this coverage. The possibilities for management in Queensland waters are therefore good. Most management will relate to water quality and maintenance of fish stocks. Strategic planning for research required, listed above, is also required. For example, monitoring will require a commitment to fund aerial surveys over several decades.

16.1 Research
- For coordinating and collating data from surveys dedicated to other marine species: one research assistant, one year minimum.
- For maintaining a long-term photo-identification project: one biologist working in one area, 10 year minimum.
- For developing and implementing computerised cataloguing system for photo-identification project: one research assistant (half-time), one year minimum.
- For telemetry program using satellite time-depth recorders to determine the movements and activity patterns of dolphins in key areas: one biologist working in two areas,* one year minimum.
- For program investigating time budgets of animals in different areas, to assess relative importance of feeding/foraging in different areas: one biologist working in two areas,* one year minimum.
- For program investigating pollutant loads in free-ranging animals: one biologist working in one area,* one year minimum.
- For program investigating genetic segregation between populations: one biologist working in one area,* one year minimum.
- Carcass salvage.

16.2 Management
- Federal/state working group should be formed to oversee environmental management of inshore habitats in northern Australia and monitor abundance of *Orcaella* and *Sousa.*

17. Remarks

Very little is known about the species' biology. It is vulnerable because it lives so close to the coast. Given projections for human population expansion in south-east Asia, *S. chinensis* will probably be the first *Sousa* to be threatened. Australia is one of the few 'first world' countries in this species' range. As industrial, mining, fishing, farming, urban development and tourism activity in northern Australia increases, so too will the impact on these animals. It is vital that Australia takes a leading role in this species' conservation.

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Dusky dolphin

1. Family	Delphinidae
2. Scientific name	*Lagenorhynchus obscurus*
3. English name(s)	Dusky dolphin

4. Taxonomic status, including species and subgroups

Described as *Delphinus obscurus* by Gray, 1828. Some doubt about placement in *Lagenorhynchus* but no subgroups recognised.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, because of insufficient information (NCA(a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration

Occurs only in the southern hemisphere, from about 55° to 26°S but with extensions well north of this in association with cold currents. Unconfirmed sightings south of continental Australia but confirmed sightings near Kangaroo Island, SA and off Tasmania, and a recent stranding in the latter state. Erroneous record for Tasmania, re-identified as *Lissodelphis peronii*. Skull from Kerguelen Island. Not known to be migratory, although there may be small seasonal movements.

7. Habitat

7.1 General

Mostly occurs in temperate and subantarctic zones. Primarily inshore but also pelagic at times. Resident inshore for much of year and may seek out colder water (<18°C) as inshore temperatures rise in summer. Around New Zealand, distribution believed to be related to the Subtropical Convergence, with numbers declining north and south of this.

7.2 Key localities

None known in Australian waters.

8. Marine protected areas managed for or relevant to the species

All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (based on non-Australian information)

9.1 Growth and age

Birth, weight/length:	? kg/0.92 m
Weaning, age/length:	? years, estimated 18 months/? m
Physical maturity, age/length:	not known
Weight, maximum:	not known
Age, maximum:	>21 years
Length, maximum:	2.11 m (male), 1.93 m (female)

9.2 Reproduction

Sexual maturity, age/length:	7 years*/? m (male), 18 years*/ >1.65 m (female)
Calving interval:	not known
Mating season:	infer summer
Gestation:	estimated 11 months
Calving season:	mainly summer
Calving area(s):	none known in Australian waters

9.3 Diet

Fish and squid. Schooling fish, especially southern anchovy.

9.4 Behaviour

Occurs in groups of hundreds in summer and less than 20 in winter. Rests in shallow water. Most aerial behaviour associated with surface feeding; acrobatic displays associated with social behaviour. Known to dive to at least 150 m. Surface feeder, in aggregations with sea birds. Has been seen with southern right whales.

9.5 Mortality and pathology
Suspected predator is killer whale. Mass stranding of six animals reported. No strandings reported from Australia.

9.6 Population abundance and rates of change
Considered abundant within its range including New Zealand, but no estimates of population size. No information for Australia.

10. Threats

10.1 Past
- None known.

10.2 Current
- Pelagic drift-net fishery in Tasman Sea may involve dusky dolphins; no information on whether incidental catch south of continental Australia.
- Taken as part of an uncontrolled gill-net fishery off Peru and fished illegally off Chile.

10.3 Potential
- Entanglement in drift-nets set outside Australian EEZ and in lost or discarded netting.
- Pollution (including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea) leading to bio-accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research
- Determine distribution and abundance in Australian waters to assess possible impact of threats, particularly effect of direct and indirect fishing activities.
- Obtain information on diet to determine trophic level and assess possible impact of fishing industry on food resources.
- Determine taxonomic relationships within and outside Australasian region to assess likely impact of threats on possible individual populations.

11.2 Management
- Minimise possible detrimental effects on population(s) e.g. from fishing activities.

12. Conservation actions already initiated

12.1 Research
- DE Gaskin related sightings around New Zealand to water temperature.

12.2 Management
- Requirement to report incidental catch within Australian EEZ.

13. Conservation actions required

13.1 Research
- Carry out sightings program in southern waters, especially around the Subtropical Convergence.
- Obtain basic biological information (including diet and pollutants) from incidentally-caught and stranded specimens.

13.2 Management

- Ensure adequate protection of species and resources in Australian and nearby waters.
- Require reporting and salvage of specimens incidentally caught or stranded.
- Ensure specimens available for appropriate scientific museums.

14. Organisation(s) responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
R Brownell, NMFS, La Jolla, USA

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No, requires:
- Program to train personnel, on already existing cruises (including government and non-government vessels), to identify and report sightings—species is very distinctive, and therefore easy for observers to identify.
- Obtain basic biological information from incidentally-caught specimens from fishing vessels: one biologist on vessels for one year.

16.2 Management
No, requires:
- Appropriate guidelines/legislation, where not provided.
- Funding required to assist in salvage, lodgement and curation of specimens obtained.

17. Remarks
Confirmed sightings off Kangaroo Island and Tasmania were made by W Dawbin (pers. comm.).

Selected references

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Würsig, B and Bastida, R (1986). Long-range movement and individual associations of two dusky dolphins *(Lagenorhynchus obscurus)* off Argentina. *J Mammal* **67**: 773–774.

Hourglass dolphin

1. Family	Delphinidae
2. Scientific name	*Lagenorhynchus cruciger*
3. English name(s)	Hourglass dolphin

4. Taxonomic status, including species and subgroups
Described by Quoy and Gaimard (1824) as *Delphinus cruciger*. No known taxonomic confusion.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, but possibly secure (NCA(b))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration
Southern hemisphere, in waters generally south of 45°S. Seen to the south-east of New Zealand and from outside territorial waters south of Australia. Confirmed record (skull) from Heard Island and unconfirmed sightings from there. Sighted in the vicinity of Macquarie Island.

7. Habitat

7.1 General
Pelagic and oceanic. Cold waters of polar and subantarctic zones in waters of about 0–12°C. Most sightings occurring at temperatures of <7.0°C. Rarely seen near land. In Antarctic, usually seen away from pack ice. May be found in cool currents associated with West Wind Drift.

7.2 Key localities
None known in Australian waters.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (based on non-Australian information)

9.1 Growth and age

Birth, weight/length:	not known
Weaning, age/length:	not known
Physical maturity, age/length:	not known
Weight, maximum:	>94 kg
Age, maximum:	not known
Length, maximum:	>1.74 m (male), >1.83 m (female)

9.2 Reproduction

Sexual maturity, age/length:	not known
Calving interval:	not known
Mating season:	not known
Gestation:	not known
Calving season:	not known
Calving area(s):	none known

9.3 Diet

Very limited data (two specimens): fish and squid.

9.4 Behaviour

School size 1–100, with most being up to eight individuals. Acrobatic, rides bow waves. Has been seen in company with several other cetacean species including pilot whales, southern bottlenose, Arnoux's beaked whales, killer whales, southern right whale dolphins, sei whales and fin whales. Sounds are clicks and whistles.

9.5 Mortality and pathology

Few strandings are known.

9.6 Population abundance and rates of change

No population estimates available but presumably abundant judging by frequency of sightings. Apparent concentrations in Areas VI and I. Apparently commonly sighted around Heard Island.

10. Threats

10.1 Past

- None known.

10.2 Current

- None known.

10.3 Potential

- Incidental catch, impact of present and future fisheries on prey species.
- Global and ocean warming, and depletion and holing of the ozone layer, possibly leading to altered distribution and abundance of prey.

11. Conservation objectives

11.1 Research

- Determine distribution and monitor abundance in Australian waters to assess possible impact of incidental catch and climatic changes.
- Determine diet in order to assess impact of present and future fisheries in southern waters.

11.2 Management

- Minimise possible detrimental effects on population(s).

12. Conservation actions already initiated

12.1 Research

- IDCR/IWC sightings cruises in Antarctic from 1978–79 to present.

12.2 Management

- Requirement to report incidental catch within Australian Territorial Waters.

13. Conservation actions required

13.1 Research
- Carry out sightings program in conjunction with existing voyages to southern latitudes.
- Obtain basic biological information (including diet) from incidentally-caught and stranded animals.

13.2 Management
- Ensure adequate protection of species and resources in Australian and nearby waters.
- Require reporting and salvage of specimens incidentally caught or stranded.
- Ensure specimens available for appropriate scientific museums.

14. Organisation(s) responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
R Brownell, NMFS, La Jolla, USA

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No, requires:
- Minimum requirement to obtain basic biological information from incidentally-caught specimens; two trained biologists on government vessels for six months.
- Minimum requirement for a monitoring program operated from existing voyages; three trained observers on government vessels, three months each over two years.

16.2 Management
No, requires:
- Appropriate guidelines/legislation, where not provided.
- Funding required to assist in salvage, lodgement and curation of specimens obtained.

17. Remarks
The hourglass dolphin can be confused at sea with the dusky dolphin. Trained observers are necessary to record sightings from government vessels.

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Risso's dolphin

1. Family	Delphinidae
2. Scientific name	*Grampus griseus*
3. English name(s)	Risso’s dolphin, grampus

4. Taxonomic status, including species and subgroups

Described as *Delphinus griseus* by Cuvier, 1812. Morphological differences between regions suggest several races worldwide. Australian specimens (few available) have not been compared with other regions.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, because of insufficient information (NCA(a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration

All oceans, from equator north and south but not very high latitudes (to about 50–55°). In Australia, recorded from south-western Western Australia, South Australia, Victoria, New South Wales and Queensland. Stranding records range from ca 23° to 39°S. Seasonal migration has been suggested, including in search of prey off Japan.

7. Habitat

7.1 General
Tropical, subtropical, temperate and subantarctic waters. Has been sighted both inshore and well offshore, although generally considered pelagic and oceanic. Southern African records appear to be associated with the 1000 m isobath. Sea temperatures 15°–30°C. Frequently seen over continental slope.

7.2 Key localities
Fraser Island has the only known 'resident' population in Australia.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (based on non-Australian and limited information)

9.1 Growth and age

Birth, weight/length:	ca 59 kg/ca 1.1–1.5 m
Weaning, age/length:	? years /<2.12 m
Physical maturity, age/length:	not known
Weight, maximum:	>230 kg
Age, maximum:	>17 years
Length, maximum:	4.1 m

9.2 Reproduction

Sexual maturity, age/length:	? years/2.6–3.0 m
Calving interval:	not known
Mating season:	not known
Gestation:	ca 1 year
Calving season:	possibly summer, but Victorian neonate in June
Calving areas	none known

9.3 Diet
Feeds in pelagic waters primarily on squid, some octopus and possibly fish. Squid species both pelagic and neritic.

9.4 Behaviour
Usually gregarious, living in groups of 25 to several hundred but may also be solitary. Sometimes swims in 'echelon formation', lined up abreast at evenly spaced intervals—possibly a useful prey hunting tactic. Dives long and deep. Displays most of the usual behaviour patterns but not a regular bow-rider. Well-documented case of a *G. griseus* 'leading' ships into harbour in Pelorus Sound, New Zealand for many years. Has been seen in company with striped dolphins, pilot whales, common dolphins and other pelagic cetaceans.

9.5 Mortality and pathology
Has stranded on very few occasions in Australia, all single animals. Mass strandings are known elsewhere.

9.6 Population abundance and rates of change
No estimates of abundance available but believed to be reasonably abundant throughout the main part of its range.

10. Threats

10.1 Past

- None known apart from some that are still current.

10.2 Current
- Possible illegal and incidental catches in northern Australian waters.
- Cause for concern in Sri Lanka because of high proportion (25%) in incidental gill-net fishery catch.
- Captured in small numbers in directed fisheries in several parts of the world, including Indonesia and Solomon Islands.

10.3 Potential
- Entanglement in drift-nets set outside Australian Territorial Waters and in lost or discarded netting.
- Pollution (including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea) leading to bio-accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research
- Determine distribution and monitor abundance in Australian waters to assess possible impact of threats, particularly effect of direct and indirect fishing activities.
- Obtain information on diet to determine trophic level and assess possible impact of fishing industry on food resources.
- Establish behavioural and ecological parameters to assess biology of offshore delphinids.
- Determine taxonomic relationships with Indo-Pacific and Indian Ocean specimens to assess likely impact of threats on possible individual populations.

11.2 Management
- Minimise possible detrimental effects on population(s) e.g. from fishing activities.

12. Conservation actions already initiated

12.1 Research
- Study of incidental catch in Arafura and Timor seas, 1981–1985, by Australian National Parks and Wildlife Service.
- Surveys of Queensland coast by H Marsh, James Cook University, and P Corkeron and M Bryden, University of Sydney.

12.2 Management
- Requirement to report incidental catch within Australian EEZ.

13. Conservation actions required

13.1 Research
- Carry out sighting program to monitor abundance, especially along continental shelf.
- Obtain basic biological information (including diet and pollutants) from incidentally-caught and stranded specimens, especially from Indian Ocean and Queensland coast.
- Undertake behavioural and photo-identification study of Fraser Island animals.
- Make taxonomic comparisons (when sufficient material is available) between Australian specimens and those from the Indo-Pacific and Indian Ocean.

13.2 Management
- Ensure adequate protection of species and resources in Australian and nearby waters.
- Require reporting and salvage of specimens incidentally caught or stranded.
- Ensure specimens available for appropriate scientific museums.

14. Organisation(s) responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
No-one actively studying Risso's dolphin in the Australasian region.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No, requires:
- Minimum requirement to obtain basic biological information from incidentally-caught animals from fishing vessels: one biologist on fishing vessels for one year.
- Minimum requirement for a sighting program operated from existing cruises: two observers on two appropriate vessels (e.g. government) for one year. May be possible to link observation with incidental catch biologist as outlined above.

16.2 Management
No, requires:
- Appropriate guidelines/legislation, where not provided.
- Funding required to assist in salvage, lodgement and curation of specimens obtained.

17. Remarks
Very few specimens are available for taxonomic study of the relationships of Australian specimens to those elsewhere.

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Bottlenose dolphin*

1. Family	Delphinidae
2. Scientific name	*Tursiops truncatus*
3. English name(s)	Bottlenose dolphin

4. Taxonomic status, including species and subgroups

Described by Montague in 1821. Taxonomy of the genus *Tursiops* is confused, with many nominal species. Currently one species, *T. truncatus,* is accepted, with several subspecies. Two subspecies (*T. t. truncatus, T. t. aduncus*) are known to occur in Australia. *T. t. aduncus* is generally considered a warm water, inshore ecotype with *T. t. truncatus* usually in colder and deeper waters. However, taxonomy remains unresolved and current genetic and morphological work may lead to reassessment.

5. Species survival status

5.1 Australian Action Plan status
No category assigned because of insufficient information (NCA(a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration

Cosmopolitan, but not in polar seas, i.e. to approximately 65°N and 55°S. Found in all states and the Northern Territory, also Norfolk Island. *T. t. aduncus* occurs in New South Wales north of Port Macquarie, through Queensland and Northern Territory into Western Australia, south to Perth. *T. t. truncatus* occurs in southern Queensland, north to at least Hervey Bay, through New South Wales, Victoria, Tasmania, South Australia, and in Western Australia at least to Albany. In Spencer Gulf, S A, a smaller *Tursiops* occurs with affinities to both *aduncus* and *truncatus*. Can be migratory in temperate waters.

7. Habitat

7.1 General
Coastal, estuarine, pelagic and oceanic. Tropical to temperate, occasionally subantarctic. Where sympatric with *Sousa chinensis, T. t. aduncus* occurs slightly further offshore but often in water of <10 m depth, and may range to approximately 10 km offshore in oceanic waters. In southern Australia, *T. t. truncatus* can occur close to shore (e.g. within a few hundred metres of the coastline) as well as in waters beyond the continental slope.

7.2 Key localities
Has been studied and is common in several localities (e.g. Shark Bay, Cockburn Sound (WA), Moreton Bay and adjacent offshore waters (Queensland), Jervis Bay (NSW), Port Phillip Bay (Victoria), Adelaide (SA)) but the relative importance of these 'populations' to the total is not known.

8. Marine protected areas managed for or relevant to the species

Great Barrier Reef Marine Park, Hervey Bay Marine Park, Moreton Bay Marine Park (Queensland), Marmion Marine Park, Shoalwater Bay Marine Park, Shark Bay Marine Park (WA).

All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (data mostly from Australia and South Africa; includes both subspp.)

9.1 Growth and age

Birth, weight / length:	13.8 kg / 1.03 m	
Weaning, age / length:	18 months / 1.8 m	
Physical maturity, age / length:	14.5 years / ? m (male), 9–11 years / ? m	(female)
Weight, maximum:	204 kg (male), 182 kg (female)	
Age, maximum:	42 years (male), 43 years (female)	
Length, maximum:	3.12 m (male), 2.92 m (female)	

9.2 Reproduction

Sexual maturity, age / length:	14.5 years / 2.4 m (male), 9–11 years / 2.27–2.38 m (female)	
Calving interval:	3–6 years	
Mating season:	diffuse, summer	
Gestation:	12.3 months	
Calving season:	diffuse, summer	
Calving area(s):	none known, no specific areas	probably

9.3 Diet

Catholic feeder: teleosts, cephalopods, elasmobranches and crustaceans. Demersal, benthic and reef-associated species taken. May feed in association with human activities, e.g. prawn trawling, fish farming. Most data available are for inshore ecotype.

9.4 Behaviour

Sound—clicks, whistles, burst-pulses and low frequency narrowband sounds have been recorded. Whistles are pure tones ranging in frequency from 800 Hz to at least 20 kHz. Frequency range of whistles may be greater, but bandwidth limitations of most recording equipment prevents certain determination of the upper frequency limit. Clicks are broadband, and short duration (10 to 100 µs). Good descriptions of the structure of burst-pulses and low frequency narrowband sounds are lacking. Ability to echolocate has been demonstrated experimentally.

Social structure—occurs in groups of up to >1000.
Mean group size from studies in Australia:

- Moreton Bay—10.4 (identified individuals, generally non-calves)
- Shark Bay—4.8 (non-calves, identified individuals). Societies are fluid, possibly with migration between groups. Probably matrilineal—females form networks of associations. Males form alliances, stable groups of 2–5 individuals, and compete

between alliances for access to females. Males may herd cycling females to maintain association with them.

Behaviour—a wide range of patterns observed. More spectacular aerial behaviour includes surfing, breaching, jumps (leaps to >2 m above the water surface), fluke slaps, head slaps. Chases during social behaviour can be spectacular.

9.5 Mortality and pathology

Estimates of annual survivorship for a coastal population in the USA are: young of the year—0.803 (0.7327–0.8733); animals > 1 year–0.961 (0.9531–0.9689). The value for young of the year is probably an overestimate, due to the difficulty of recording all births in a population. In Moreton Bay, 36% of dolphins showed evidence of shark attack, suggesting that mortality from sharks is significant. However, dolphins in adjacent offshore waters show relatively low rates of such scarring, so local variations in impact of shark mortality may be important.

Very high levels of organochlorines have been reported elsewhere. PCB levels, probably high enough to kill a female's first calf, occur in South African dolphins. Similar high pollutant loads may occur in Australian dolphins in resident populations close to major urban, industrial and agricultural centres. Highest levels reported in Australia to date (few available) are an order of magnitude less than those recorded in South Africa.

Occasional deaths in trawl-nets—possibly mostly young animals (four to five years old). Human influence was implicated in 46% (13 of 28) of deaths reported by CALM, WA between 1985 and 1993, where cause could be determined. Net entanglements accounted for 28%, intentional killing (e.g. shooting, spearing) 18%. In South Australia, 64% (nine of 14 cases) where cause could be established were due to human actions, including four shootings. Human influenced deaths more likely to be discovered by people than natural deaths, but figures are cause for concern; many cases go unreported.

9.6 Population abundance and rates of change

Accurate population estimates, with confidence intervals, not available for any bottlenose dolphin community in Australia. Several studies have photo-identified individual animals, providing minimum estimates for local populations, including: Moreton Bay (Queensland)—334; inshore oceanic waters off North Stradbroke Island (Queensland)—321; south-eastern Shark Bay (WA)—over 300, Cockburn Sound (WA)—at least 150; Adelaide (SA)—at least 140. No estimates for rates of change. Data collected during dugong aerial surveys along the Queensland coast provided minimum estimates of numbers but are uncorrected for submerged animals.

10. Threats

10.1 Past

- Incidental capture in Taiwanese gill-netting in the Australian EEZ of the Arafura and Timor seas. *T. truncatus* was most frequently recorded species in by-catch.
- Live capture for oceanaria in New South Wales, South Australia, Western Australia.

10.2 Current

- Presumed habitat destruction and degradation, including noise pollution, harassment—particularly close to major cities (e.g. Moreton Bay).
- Incidental capture in aquaculture nets (high rates in South Australia), shark nets, trawl-nets and drift-nets, especially in Taiwanese shark gill-netting just outside northern Australian EEZ.
- Illegal killing, particularly by people killing for sport, e.g. spearing or shooting dolphins, for bait or because of perceived predation on commercial fish stocks.
- Live capture in Queensland (permits granted for up to 12 per year at present).

- Overfishing of prey species.

10.3 Potential

- Pollution (organochlorines, particularly PCBs) is a serious potential threat because of the species' inshore nature.
- Epizootics—inshore bottlenose dolphins from the east coast of the USA and striped dolphins in the Mediterranean have been subject to massive die-offs in the past decade. Marine mammals may have a genetic susceptibility to pathogen-induced mass mortalities, as they have limited polymorphism in genes of the major histocompatibility complex (MHC). Epizootic-induced mortality may play a major role in the demographic structure of cetacean populations.
- Tourism—further development of dolphin watching, dolphin feeding, dolphin swims.

11. Conservation objectives

11.1 Research

- Monitor abundance, especially in key areas, to determine possible impact of threats, e.g. pollutants, habitat degradation, incidental capture.
- Determine levels of pollutants in bottlenose dolphins and prey fish species to assess possible impact in different areas.
- Study habitat requirements to assess impacts of degradation.
- Derive relationship between aerial survey estimates and absolute abundance to allow latter to be estimated and monitored.
- Compare genetics and morphology within and outside Australian region to establish stock identity and assess taxonomic status of Australian animals.
- Establish life history parameters for both ecotypes to allow better interpretation of population trends and effects of threats.
- Determine effects of ecotourism operations (e.g. feeding stations) on animals.

11.2 Management

- Ensure regular monitoring of the population throughout Australia to detect possible decreases in numbers.
- Minimise possible detrimental effects, e.g. water quality.
- Help ensure adequate prey stocks by contributing to fisheries management discussions.
- Provide appropriate legislation / guidelines to contain the effects of ecotourism.
- Encourage more centralisation of data and processing carcasses.

12. Conservation actions already initiated

12.1 Research

- Aerial surveys off Northern Territory coastline—adjunct to dugong aerial surveys (W Freeland et al., Conservation Commission of Northern Territory).
- Aerial surveys through Great Barrier Reef region and northern waters of Western Australia—adjunct to dugong aerial surveys (H Marsh et al., James Cook University, and CALM, WA).
- Aerial surveys of Shark Bay and Ningaloo Reef Marine Park—(CALM, WA).
- Ecology and photo-identification of individuals in Moreton Bay and adjacent oceanic waters (M Bryden et al., University of Sydney); south-eastern Shark Bay, including mortality data (R Connor et al. University of Michigan, J Mann, Georgetown University); Jervis Bay (F Mandelc, Macquarie University); Port Phillip Bay (J Weir, Port Phillip Bay Dolphin Research Group); off Bunbury (Bunbury Dolphin Trust); off Adelaide (M Bossley, University of SA); off Perth (K Waples, Texas A & M University, Galveston; B Donaldson, Murdoch University).

- Behavioural studies investigating the impact of a feeding program on the behaviour of dolphins in eastern Moreton Bay (Brieze et al., University of Queensland).
- Sightings records of dolphins in Tasmania (M Hindell et al., University of Tasmania).
- Molecular genetics to determine relationships of *Tursiops* in Australia (P Hale et al., University of Queensland).

12.2 Management

- Legal protection under the *Whale Protection Act 1980* in the Australian EEZ and state and Northern Territory waters.
- Funding for aerial surveys—Great Barrier Reef Marine Park Authority, Queensland Fish Management Authority, CALM, WA.
- Permits required in Queensland waters for dolphin feeding programs.

13. Conservation actions required

13.1 Research

- Using aerial survey, establish baseline estimate for minimum population in Australia, identify areas of highest density along the Australian coastline and monitor trends.
- In selected key areas, establish sizes and trends of populations using photo-identification sight/resight techniques.
- Determine levels of pollutants occurring in populations in key areas, using biopsy of free-ranging animals.
- Determine level of genetic interchange between local populations, both within and between ecotypes.
- Determine effects of ecotourism operations (e.g. feeding stations) on dolphins.
- Determine causes of death of stranded animals, relate pollutant levels to those in key areas.
- Improve reporting and salvage of incidental catches and carcass salvage.
- Standardise cataloguing of photo-identified animals, encourage more interaction between research groups doing similar work in Australia.
- Determine habitat requirements, including hunting and diet.

13.2 Management

- Monitor watershed management, including effects on habitat and prey species important for *Tursiops truncatus.*
- Fisheries management should allow for the requirements of upper predators (i.e. sharks, dolphins).
- Encourage greater cooperation between cetacean and fisheries biologists.
- Require reporting and collection of incidentally-caught animals.
- Ensure specimens available for appropriate scientific museums.

14. Organisation(s) responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved

Sea World (Surfers Paradise), Coffs Harbour Pet Porpoise Pool, Underwater World (Perth) all keep and study *Tursiops* in captivity. AWCS monitors *Tursiops* in Gold Coast region, Queensland. Dolphin Research Project, Port Phillip Bay, Victoria, carries out regular surveys.

16. Can research and management be carried out with existing resources? If no, what is required?

No, because they are apparently quite common, and probably live in discrete local populations, management to protect inshore populations of *Tursiops* needs direction. Research on offshore populations should be directed to establishing some baseline data on their biology and status. Coordinating research effort among study sites to allow better comparative studies should be encouraged. One of the major studies in Australia is carried out by visiting researchers from universities in the USA; they are keen to see Australian involvement in their program, and it should be encouraged.

16.1 Research

Requires:

- Coordinating and collating data from surveys dedicated to other marine species: one research assistant, one year minimum.
- Sighting program (inshore) using dedicated aerial surveys: two biologists, two year minimum.
- Sighting program (offshore) operated from existing cruises: two biologists on appropriate vessels, five year minimum.
- Program investigating pollutant loads in free-ranging and salvaged animals: one biologist working in one area,* one year minimum.
- Accurate incidental catch information from South Australia aquaculture: minimum one biologist for two years.
- Program investigating genetic segregation between populations: one biologist working in one area,* two year minimum.
- Carcass salvage.
- Program investigating impact of feeding stations on the behaviour of dolphins: one biologist working in one area,* one year minimum.
- Program investigating time budgets of animals in different areas, to assess relative importance of feeding/foraging in different areas: one biologist working in two areas,* one year minimum.
- Developing and implementing computerised cataloguing system for photo-identification: one research assistant, one year minimum.
- Maintaining a long-term photo-identification project: one biologist working in one area, 10 year minimum.
- Taxonomic studies involving genetics and morphology.

16.2 Management

Requires:

- Federal/state working groups to be formed to monitor status of inshore *Tursiops* and quality of inshore habitat, including incidental capture, disturbance, harassment and ecotourism.

17. Remarks

One of the best studied behaviourally of the delphinids. Taxonomy needs resolution. If the two ecotypes in Australian waters are subspecies found only in the Indian and south-west Pacific oceans, their survival through much of their range in the next century is precarious. Coastal habitats make them very susceptible to impacts from human activities. As they are relatively common and coastal, they are noticed more by people than other species. Localised populations can be depleted; there is a need to know at what point such depletion may impinge on the species in Australia.

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Pantropical spotted dolphin

1. Family	Delphinidae
2. Scientific name	*Stenella attenuata*
3. English name(s)	Pantropical spotted dolphin, spotted dolphin

4. Taxonomic status, including species and subgroups

Taxonomy of spotted dolphins confused until recent revision. Now two species, *Stenella frontalis* (Atlantic spotted dolphin) and *S. attenuata* (pantropical spotted dolphin), described by Gray, 1846—the species occurring off Australia. *S. attenuata* is highly variable (with age and geography) in size, colour pattern and skeletal characteristics. Relationship with animals in other regions unknown.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, because of insufficient information (NCA(a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration
Northern and southern hemisphere, in Pacific, Atlantic and Indian oceans. In Australia recorded off Northern Territory, Western Australia (south to Augusta), Queensland and New South Wales. Erroneous record for Victoria. Seasonal movements north/south are known off Japan and inshore/offshore in the eastern tropical Pacific.

7. Habitat

7.1 General
Pelagic and oceanic but also found on shelf and along continental slope. Possibly neritic. Multispecies aggregations in eastern tropical Pacific correlated with a shallow, mixed layer and a thick, oxygen-minimum layer, creating a well-defined, shallow, 100 m deep pelagic habitat. Tropical and subtropical waters, 22°C or greater. Occasionally in temperate waters.

7.2 Key localities
None known in Australian waters.

8. Marine protected areas managed for or relevant to the species
Great Barrier Reef Marine Park.
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone
(= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (based on non-Australian information)

9.1 Growth and age

Birth, weight/length:	? kg/0.8–0.9 m
Weaning, age/length:	1–3 years/? m
Physical maturity, age/length:	>15 years
Weight, maximum:	119 kg
Age, maximum:	50 years
Length, maximum:	2.57 m (male), 3.4 m (female)

9.2 Reproduction

Sexual maturity, age/length:	12–15 years/ 1.9–2.0 m (male), 10–12 years/ 1.8–2.0 m (female)
Calving interval:	2–4 years
Mating season:	diffuse, peaks in

	spring and autumn
Gestation:	11.2–11.5 months
Calving season:	diffuse, peaks in spring and autumn
Calving area(s):	none known in Australian waters

9.3 Diet

Mainly small epipelagic and mesopelagic fish, squid. Some other foods such as nemertean worms and crab larvae. Diet varies with region and reproductive state. Lactating females eat a greater proportion of fishes than squids, presumably because the former is higher in calorific value. Diet overlaps greatly with yellowfin tuna and a close association has been noted between these species and sea birds in the eastern tropical Pacific.

9.4 Behaviour

Gregarious. Group size is a few individuals to over 1000, average <100. Offshore pods usually larger than coastal ones. Often seen with other species of dolphin (including spinner dolphin), tuna and sea birds, probably in feeding aggregations. Home range is several hundred km or more, daily movements of 30–50 km are made. Very acrobatic and leaps high in the air. Also rides bow waves. Feeds near the surface.

9.5 Mortality and pathology

Group strandings at Augusta, WA, but usually strands singly. Predators include humans, sharks and several other cetaceans (killer whale, false killer whale, pygmy killer whale). Sharks known to take dolphins in association with purse-seining operations.

9.6 Population abundance and rates of change

No population estimates for Australian waters. Incidental catch in past offshore gill-net fishery of waters off northern Australia suggests fewer pantropical spotted dolphins than bottlenose and spinner dolphins. Considerable work done on estimating numbers and rates of change in the eastern tropical Pacific. Has declined there, probably as a result of by-catch in purse-seine netting operations.

10. Threats

10.1 Past

- Some pantropical spotted dolphins were taken incidentally during the 1970s and early 1980s in a gill-net fishery operating in Australian EEZ in the Arafura and Timor seas. Some captures in 1970s for New South Wales oceanarium.

10.2 Current

- Taiwanese gill-net shark fishery still operates just outside the EEZ and involves by-catch of same populations as live in Australian waters. The incidental catch is very high and shows no sign of easing.
- Directed fisheries and incidental catch in large numbers in the Philippines, where used for human consumption.
- Caught in inshore shark nets in low numbers in Queensland and New South Wales.
- Believed to interfere with hook-and-line fisheries and therefore seen as a competitor to the fishing industry.
- Drive fishery operates in the Solomon Islands. Pantropical dolphins are preferred catch.

10.3 Potential

- Entanglement in drift-nets set outside Australian territorial boundaries and in lost or discarded netting.
- Pollution leading to accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research

- Determine distribution and monitor abundance, especially in Australian waters, to assess possible impact of threats, particularly direct and indirect effect of fishing activities.
- Determine taxonomic relationships within and outside Indo-Pacific region to assess likely impact of threats on possible individual populations.
- Obtain information on diet to determine trophic level and assess possible impact of fishing industry on food resources.

11.2 Management

- Minimise possible detrimental effects on population(s) e.g. from fishing activities.

12. Conservation actions already initiated

12.1 Research

- Distribution in region documented by J Gilpatrick et al., NMFS, La Jolla, USA.
- Taxonomic relationships being studied by W Perrin, NMFS, La Jolla, USA.
- Abundance and impacts of fisheries being studied by MLL Dolar, Silliman University, Philippines in cooperation with Department of Natural Resources.
- Biology and hunting regime studied in Solomon Islands by W Dawbin, c/- The Australian Museum.

12.2 Management

- Requirement to report incidental catch within Australian EEZ.

13. Conservation actions required

13.1 Research

- Carry out sightings program and monitor density in northern waters.
- Obtain basic biological information (including diet and pollutants) from incidentally-caught and stranded specimens, especially from Arafura and Timor seas.
- Continue taxonomic comparisons between Australian specimens and those from the Indo-Pacific and Indian Ocean.

13.2 Management

- Ensure adequate protection of species and resources in Australian and nearby waters.
- Require reporting and salvage of specimens incidentally caught or stranded.
- Ensure specimens available to appropriate scientific museums.

14. Organisation(s) responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
W Dawbin, c/- The Australian Museum
W Perrin, NMFS, La Jolla, USA

16. Can research and management be carried out with existing resources?
If no, what is required?

16.1 Research

No, requires:

- Minimum requirement to obtain basic biological information from incidentally-caught animals from fishing vessels: one biologist on fishing vessels for one year.
- Minimum requirement for a sighting program operated from existing cruises: two observers on two appropriate vessels (e.g. government) for one year. May be possible to combine observer with incidental catch biologist.

16.2 Management

No, requires:

- Appropriate guidelines / legislation, where not provided.
- Funding required to assist in salvage, lodgement and curation of specimens obtained.

17. Remarks

The species has been well studied in the eastern tropical Pacific, but little is known of its biology in Australian waters. Increased observer and collecting effort in northern waters would both rectify that and help assess the impact of threats on the population.

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Spinner dolphin

1. Family	Delphinidae
2. Scientific name	*Stenella longirostris*
3. English name(s)	Spinner dolphin

4. Taxonomic status, including species and subgroups

Described by Gray in 1828. Extensive variation in colour pattern and size between regions. Three named subspecies of which *S. longirostris* occurs in Australian region. There is a possibility of further subdivisions. An unnamed dwarf form has been described from Gulf of Thailand and animals from Arafura and Timor seas and possibly the Great Barrier Reef may be similar to this.

5. Species survival status

5.1 Australian Action Plan status
Insufficiently known (K)

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration

Northern and southern hemisphere. Indian, Pacific and Atlantic oceans. In Australia, recorded from Western Australia (furthest south record Bunbury, 33°19'S), Northern Territory, Queensland and New South Wales. Not known to be migratory.

7. Habitat

7.1 General
Primarily pelagic but can be neritic in some regions. Tropical, subtropical and occasionally temperate waters. Associates with tuna, pantropical spotted dolphin and sea birds, under certain oceanographic conditions, i.e. well-defined, shallow, 100 m deep pelagic habitats in restricted areas. Along west coast of Australia its presence in southern localities may be associated with the Leeuwin Current.

7.2 Key localities
None known in Australian waters.

8. Marine protected areas managed for or relevant to the species

All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (based on non-Australian information)

9.1 Growth and age

Birth, weight/length:	? kg/0.7–0.8 m
Weaning, age/length:	1–3 years/? m
Physical maturity, age/length:	>10 years/? m
Weight, maximum:	75 kg

Age, maximum:	22 years
Length, maximum:	2.35 m (male), 2.04 m (female) (smaller in northern Australia)

9.2 Reproduction

Sexual maturity, age / length:	6–9 years / 1.6–1.9 m (male), 4–10 years / 1.5–1.9 m (female)
Calving interval:	2–3 years (more frequent in depleted populations)
Mating season:	not known
Gestation:	9–11 months
Calving season:	not known
Calving area(s):	none known in Australian waters

9.3 Diet

Mesopelagic fish, mostly myctophids, squids and shrimps at depths greater than 250 m. Stomachs of animals from northern Australia contained reef-living and benthic organisms. Dwarf form from Gulf of Thailand also could be bottom-feeder and their small size may be associated with such a habit.

9.4 Behaviour

Associates with pantropical spotted dolphin as well as tuna and sea birds, probably in some sort of feeding association. Known to congregate in groups of over 1000 animals but generally group size is less than 250. There is some segregation by age and sex. Associates with small to medium-sized whales as well as dolphins. Very acrobatic and playful and gets its name from the ability to leap and spin in the air. Often rides bow waves.

9.5 Mortality and pathology

Very few strandings recorded in Australia. Predators are sharks and possibly killer whales, false killer whales, pygmy killer whales and pilot whales. High levels of mercury (natural contamination) and DDT, Dieldrin and PCBs have been recorded for *S. longirostris* from outside Australian waters. Parasitism is believed to be a major factor in the natural mortality of this dolphin.

9.6 Population abundance and rates of change

In eastern tropical Pacific numbers declined to about 58–72% (whitebelly spinners) and 44% (eastern spinners) of their former numbers of millions of animals as a result of incidental catch in purse-seine nets. No population estimates for other parts of range but generally considered common.

10. Threats

10.1 Past

- Comprised 35% of the by-catch in gill-net fishing industry in the Arafura and Timor seas during 1981–1985.

10.2 Current

- Taiwanese gill-net shark fishery operates just outside Australian waters and is a serious problem for incidental catches of small cetaceans. The same populations as found in Australia would be affected by this threat.
- Illegal catches within Australian EEZ are likely.
- Occasionally reported as incidental captures in shark nets in Queensland.
- In the Philippines it is the most frequently caught species in the gill-net fishery.
- In the Solomon Islands a small cetacean fishery takes some spinner dolphins.
- In Thailand they are taken incidentally in shrimp trawls. The effect on numbers in both areas is unknown.
- Purse-seine netting in the eastern tropical Pacific. Population size still well below original levels despite measures to curtail incidental take.

10.3 Potential
- Entanglement in drift-nets set outside the Australian EEZ and in lost or discarded netting.
- Pollution (including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea) leading to bio-accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research
- Determine distribution and monitor abundance in Australian waters to assess possible impact of threats, particularly effect of direct and indirect fishing activities.
- Obtain information on diet to determine trophic level and assess possible impact of fishing industry on food resources.
- Determine taxonomic relationships within Indo-Pacific region to assess likely impact of threats on possible individual populations.

11.2 Management
- Minimise possible detrimental effects on population(s) e.g. from fishing activities.
- Ensure funding provided for monitoring threatened populations in northern Australia.

12. Conservation actions already initiated

12.1 Research
- W Perrin (NMFS, La Jolla, USA) and colleagues are making a taxonomic comparison of *S. longirostris* from northern Australia with other Pacific regions.
- Abundance and impacts of fisheries on populations in the Philippines being studied by MLL Dolar (Silliman University) with support of Department of Environment and Natural Resources.

12.2 Management
- Requirement to report incidental catch within Australian EEZ.

13. Conservation actions required

13.1 Research
- Carry out sighting and monitoring program in northern waters.
- Obtain basic biological information (including diet and pollutants) from incidentally-caught and stranded specimens, especially from Arafura and Timor seas.
- Continue taxonomic comparisons (morphologic and genetic) between Australian specimens and those from the Indo-Pacific and Indian oceans.

13.2 Management
- Ensure adequate protection of species and resources in Australian and nearby waters.

- Require reporting and salvage of specimens incidentally caught or stranded.
- Ensure specimens available for appropriate scientific museums.
- Initiate education programs on concerns associated with incidental capture.

14. Organisation(s) responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
W Dawbin, c/- The Australian Museum
W Perrin, NMFS, La Jolla, USA

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No, requires:
- Minimum requirement for a sighting program operated from existing cruises: two observers on two appropriate vessels (e.g. government) for one year. May be possible to combine observer with incidental catch biologist.
- Minimum requirement to obtain basic biological information from incidentally-caught animals from fishing vessels: one biologist on fishing vessels for one year.
- Dedicated sightings program to monitor abundance in Arafura and Timor seas. Minimum three years.

16.2 Management
No, requires:
- Appropriate guidelines/legislation, where not provided.
- Funding required to assist in salvage, lodgement and curation of specimens obtained.

17. Remarks
The true status of *S. longirostris* in Australian waters will not be known until dedicated surveys are carried out to monitor population density. The possibility of incidental and direct catches in the region is cause for serious concern.

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Striped dolphin

1. Family	Delphinidae
2. Scientific name	*Stenella coeruleoalba*
3. English name(s)	Striped dolphin, euphrosyne dolphin

4. Taxonomic status, including species and subgroups

Described by Meyen in 1833. Synonyms described on differences in colour pattern, a feature variable even within a single population. No subspecies formally recognised. Affinities of Australian specimens not known.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, because of insufficient information (NCA(a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration

Northern and southern hemisphere. All oceans at low to medium latitudes. Recorded from Western Australia (south to Augusta), Queensland and New South Wales. Stranding records from south coast of Western Australia are probably related to the southward flowing, warm Leeuwin Current. Migratory in north Pacific where it moves north and south in relation to a warm current: same may be true off the coast of Southern Africa.

7. Habitat

7.1 General
Pelagic. Deep water and outer edge of continental slope. Tropical, subtropical and warm temperate waters. Possible vagrants recorded in colder waters.

7.2 Key localities
None known in Australian waters.

8. Marine protected areas managed for or relevant to the species

All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (based on non-Australian information)

9.1 Growth and age

Birth, weight / length:	? kg / 0.8-1.0 m
Weaning, age / length:	15–36 months / 1.7 m
Physical maturity, age / length:	not known
Weight, maximum:	156 kg
Age, maximum:	58 years
Length, maximum:	2.6 m (male), 2.5 m (female)

9.2 Reproduction

Sexual maturity, age / length:	15 years / 2.0–2.5 m (male), 7–10 years / 1.9–2.4 m (female)
Calving interval:	1.5–4 years
Mating season:	not known
Gestation:	ca 12 months
Calving season:	prolonged
Calving area(s):	none known in Australian waters

9.3 Diet

Prey small (<300 mm length), including mesopelagic fish, shrimp and squid. Southern African study suggested animals were feeding in oceanic waters over the continental slope, with some prey taken nearer to shore before stranding.

9.4 Behaviour

Gregarious. Can occur in groups of up to several thousand individuals but generally a few hundred. Schools made up of subadults, adults or mixed ages. Subadults may move closer to the coast than adult or mixed schools. Animals are active and conspicuous. Ride bow waves. May feed at depths of about 200 m or may take prey species that normally live at such depths when they come to surface at night.

9.5 Mortality and pathology

Strand as individuals or in groups. Mass stranding of 24 at Augusta, WA, in January 1989. Predators not known, though sharks and killer whales, false killer whales, pygmy killer whales and pilot whales are likely. Parasitism may be a major factor in natural mortality. Lungworms noted in several Southern African specimens, with associated necrotic tissue and enlarged lymph nodes. Morbillovirus, possibly linked with toxic contaminant tissue levels, has resulted in large number of deaths in Mediterranean.

9.6 Population abundance and rates of change

No population estimates for Australia. Only ones available are for Japan—(1985) 176 000–252 000 and eastern tropical Pacific—1.9 million. Relatively frequent strandings in Western Australia suggests *S. coeruleoalba* is not uncommon there.

10. Threats

10.1 Past
- No information available.

10.2 Current
- No quantitative information on incidental catch in Australian waters but possibly taken in nets off Western Australia. One recorded in study of gill-net incidental catch in Timor and Arafura seas.
- Level of direct and indirect catch in Sri Lanka is high and taken in small numbers in the Solomon Islands fishery.
- Taken in large numbers by the Japanese drive fishery, with some concern being expressed by IWC as to the extent of the catch.

10.3 Potential
- Entanglement in drift-nets set outside Australian EEZ and in lost or discarded netting.
- Pollution (including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea) leading to bio-accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research
- Determine distribution and monitor abundance in Australian waters to assess possible impact of threats, particularly effect of direct and indirect fishing activities.
- Obtain information on diet to determine trophic level and assess possible impact of fishing industry on food resources.
- Determine taxonomic relationships within and outside Indo-Pacific region to assess likely impact of threats on possible individual populations.

11.2 Management
- Minimise possible detrimental effects on population(s) e.g. from fishing activities.

12. Conservation actions already initiated

12.1 Research
- Dept of CALM, WA gathered information from mass stranding at Augusta
- Incidental catch in Arafura and Timor seas, 1981–1985, investigated by ANPWS.

12.2 Management
- Requirement to report incidental catch within Australian EEZ.

13. Conservation actions required

13.1 Research
- Obtain basic biological information (including diet and pollutants) from stranded and incidentally-caught specimens especially off Western Australia and Queensland.
- Make taxonomic comparisons between specimens from Australia and nearby areas where incidental and directed catches still occur e.g. Solomon Islands, Sri Lanka.
- Publish information on mass stranding at Augusta, WA, in 1989.

13.2 Management
- Ensure adequate protection of species and resources in Australian and nearby waters.
- Require reporting and salvage of specimens incidentally caught or stranded.

- Ensure specimens available to appropriate scientific museums.

14. Organisation(s) responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
Dept of CALM, WA
WF Perrin, NMFS, La Jolla, USA

16. Can research and management be carried out with existing resources?
If no, what is required?

16.1 Research
No, requires:
- Dedicated sighting program in northern and western Australian waters, minimum two years.
- Minimum requirement for a sighting program operated from existing cruises: two observers on two appropriate vessels (e.g. government) for one year. May be possible to link observation with incidental catch biologist as outlined above.
- Minimum requirement to obtain basic biological information from incidentally-caught animals from fishing vessels: one biologist on fishing vessels for one year.

16.2 Management
No, requires:
- Appropriate guidelines/legislation, where not provided.
- Funding required to assist in salvage, lodgement and curation of specimens obtained.

17. Remarks
Striped dolphins strand relatively frequently along the Western Australian coast between Geraldton and Augusta. It is important to know whether these strandings represent vagrant animals, a seasonal influx or a resident population. Tour operators of the local whale-watching industry could be trained to collect sightings records. The striped dolphin was not collected during the study of gill-netting in northern Australian waters.

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Common dolphin

1. Family	Delphinidae
2. Scientific name	*Delphinus delphis*
3. English name(s)	Common dolphin

4. Taxonomic status, including species and subgroups

Described by Linnaeus in 1758. Until recently, considered one species but studies in the northern Pacific have described two, differing in colour pattern and morphometrics: a short-beaked form, *Delphinus delphis* and a long-beaked form, *D. capensis. D. delphis* occurs in Australia and there is unconfirmed evidence that long-beaked animals are also present.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, but possibly secure (NCA(b))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration

Northern and southern hemisphere, all oceans. Not found in higher latitudes; furthest south records are about the Subtropical Convergence. In Australia, recorded in all states and the Northern Territory. Short-beaked form recorded from at least Tasmania. Two forms exist in Queensland and South Australia but it is not known whether these represent the short- or long-beaked types. Not recorded from territories in the Antarctic or Heard and Macquarie Islands. Not known to be migratory but seasonal movements are recorded off southern California.

7. Habitat

7.1 General
Neritic, pelagic and oceanic. Temperate to tropical. Long-beaked species (*D. capensis*) seems to have a nearshore distribution whereas short-beaked (*D. delphis)* is both nearshore and offshore. Preferred water temperatures in the eastern tropical Pacific 10–28°C. Very few records from tropical regions around Australia may not truly reflect distribution, considering its common occurrence in tropical habitats elsewhere. May be associated with high topographical relief of the ocean floor, escarpments and areas of upwelling.

7.2 Key localities
None known in Australian region.

8. Marine protected areas managed for or relevant to the species

All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (based on mostly non-Australian information, except for maximum length)

9.1 Growth and age

Birth, weight/length:	? kg/ca 0.8 m
Weaning, age/length:	5–19 months/ ca 1.5 m
Physical maturity, age/length:	not known
Weight, maximum:	163 kg
Age, maximum:	22 years (male), 20 years (female)
Length, maximum:	2.32 m (male), 2.18 m (female)

9.2 Reproduction

Sexual maturity, age/length:	very variable 3–12 years/ 1.7–2.0 m (male), 2–7 years/ 1.5–1.9 m (female)
Calving interval:	variable, 1.3–2.6 years
Mating season:	not known
Gestation:	10–11 months
Calving season:	all year, peaks in spring and autumn
Calving area(s):	none known in Australian waters

9.3 Diet

Shoaling and mesopelagic fish, and cephalopods. Opportunistic. Varies with stock and season. May follow prey stocks. Prey items tend to be small.

9.4 Behaviour

Very gregarious. Some aggregations observed in Australian waters number thousands, or even 100 000 individuals; the latter may be smaller groups combined into one unit temporarily. Acrobatic, ride bow waves of boats and large whales. Seen with other species of dolphin, including bottlenose, as well as larger cetaceans (fin, humpback, blue, southern right whales). Highly mobile and may move long distances. Feed at surface and at depth (at least 280 m). May take advantage of human fishing operations to get prey. Some evidence of competitive interactions with spotted and spinner dolphins. May move inshore/offshore following food. Known to aggregate with tuna possibly in a feeding association. Produce the entire acoustic repertoire of most delphinids.

9.5 Mortality and pathology

Strandings common along Australian coast, usually single but one mass stranding (34 animals) reported for Victoria and several (up to 109 individuals *en masse*) for Tasmania. Cause of mortality rarely established but include incidental catches, intentional killing, presumed stillbirths, severe lungworm infection, haemolytic *Pasturella* in lungs, pneumonia, *Nasitrema* infection, congested lungs, bone lesions associated with hepatitis.

Predators include killer whale. Stranded animal in Western Australia had stingray barb embedded in body.

9.6 Population abundance and rates of change

Population estimates for areas in northern hemisphere indicate declines in some, particularly eastern tropical Pacific where purse-seine netting results in incidental deaths. No population estimates for Australian waters. Considered common based on number of strandings and sightings.

10. Threats

10.1 Past

- Used as bait for craypots by some Australian fishers. Captured for oceanarium in northern New South Wales during the 1970s.

10.2 Current

- Intentional killing (usually by shooting) occurs in most states. In South Australia, one conviction for killing common dolphins for use as cray bait. True extent of intentional and unintentional deaths is unknown because many cases go unreported.
- Incidental catches of concern in eastern tropical Pacific and possibly other regions. In Australia, death in nets has been recorded in South Australia and Tasmania, more commonly in Western Australia. Other forms of unintentional deaths and injuries reported.
- Bio-accumulation evident in moderate levels of organochlorines and some heavy metals in some common dolphins from Australian waters.
- Taken in small directed fisheries in several parts of its world range.

10.3 Potential

- Entanglement in drift-nets set outside Australian Territorial Waters and in lost or discarded netting.
- Pollution (including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea) leading to bio-accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research

- Determine taxonomic relationships within Australian region to determine possible subgroups and / or presence of other *Delphinus* species.
- Determine levels and effects of toxic contaminants, especially near centres of populations and industrialisation / agriculture, to assess risk from this threat.
- Determine relative abundance and distribution in Australian waters to assess possible impact of threats, particularly effect of direct and indirect fishing activities and intentional killing.
- Obtain information on diet to determine trophic level and assess possible impact of fishing industry on food resources.
- Determine level of incidental and intentional take.

11.2 Management

- Minimise possible detrimental effects from fishing activities, intentional killing and pollution, by mounting education programs and reducing figures for illegal killing.

12. Conservation actions already initiated

12.1 Research

- WF Perrin, NMFS, La Jolla, USA, studying common dolphin morphological variability between Australia and elsewhere.
- C Kemper et al., SA Museum, have reviewed levels of toxic contaminants in Australian marine mammals, some common dolphins included.
- P Corkeron, University of Sydney, studied photo-identification of Fraser Island animals.
- K Schultz, University of Sydney, has recordings of sounds produced by *D. delphis*.

12.2 Management
- Requirement to report incidental catch within Australian EEZ.

13. Conservation actions required

13.1 Research
- Determine existence of long- and short-beaked species in Australian waters, analyse and publish existing stranding and sighting data.
- Conduct dedicated surveys where neritic form may be resident (e.g. semi-enclosed areas such as the South Australian gulfs).
- Obtain basic biological information (including diet and pollutants) from incidentally-caught and stranded specimens.
- Study ecology and behaviour of selected populations by photo-identification and telemetry.

13.2 Management
- Require reporting and salvage of specimens incidentally caught or stranded, analyse level of take/stranding Australia-wide.
- Ensure specimens available to appropriate scientific museums.
- Ensure adequate protection of species and resources in Australian and nearby waters.

14. Organisation(s) responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
Dolphin Research Project, Port Phillip Bay, Victoria is undertaking regular surveys.

16. Can research and management be carried out with existing resources?
If no, what is required?

16.1 Research
No, requires:
- Funding assistance for taxonomic research; one genetics research assistant for six months, one morphology research assistant for one year.
- Sighting program operated from existing cruises: minimum requirement two observers on two appropriate vessels (e.g. government) for one year. May be possible to link observation with incidental catch biologist as outlined above.
- Dedicated surveys in two inshore areas (e.g. South Australian gulfs and one other).
- Basic biological information from incidentally-caught animals from fishing vessels: minimum requirement two biologists on fishing vessels for one year.
- Accurate incidental catch information from South Australia aquaculture: minimum requirement one biologist for one year.

- Study of ecology / behaviour: minimum requirement one biologist for three years.

16.2 Management
No, requires:
- Appropriate guidelines / legislation, where not provided.
- Funding required to assist in salvage, lodgement and curation of specimens obtained.
- Public education program to reduce intentional killing.

17. Remarks
Sufficient material is now available to make a preliminary assessment of taxonomic status and distribution in Australian waters.

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Fraser's dolphin

1. Family	Delphinidae
2. Scientific name	*Lagenodelphis hosei*
3. English name(s)	Fraser's dolphin, Sarawak dolphin

4. Taxonomic status, including species and subgroups
***Lagenodelphis hosei* described relatively recently by Fraser in 1956 from a specimen collected on Borneo. No subgroups recognised.**

5. Species survival status

5.1 Australian Action Plan status

No category assigned, because of insufficient information (NCA(a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration
Found in low latitudes of all three major ocean basins. Distribution in south-west Indian Ocean may be localised. Most records from between 30°N and 30°S. Records outside low latitudes may represent vagrants. Records from Southern Africa suggest the species may move to the higher latitudes in warmer months. In Australia, strandings recorded in Western Australia, Queensland, northern New South Wales and Victoria (Corio Bay 38°S).

7. Habitat

7.1 General
Pelagic and oceanic. In Philippines, seen nearshore, along outer continental shelf or slope and in deep oceanic waters. Subtropical and tropical waters, occasionally temperate. All sightings in Southern Africa in water >1000 m and associated with the warm Agulhas Current. Found in waters characterised by a stable, shallow mixed layer and thermocline ridging, also upwelling areas. Victorian stranding at Corio Bay was in January and possibly associated with the southward flowing warm Eastern Australian Current. In captivity, Fraser's dolphin very distressed in shallow water, possibly because it is unaccustomed to this environment.

7.2 Key localities
None known in Australian waters.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone
(= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (based on limited and non-Australian information)

9.1 Growth and age

Birth, weight/length:	? kg/ca 1 m
Weaning, age/length:	not known
Physical maturity, age/length:	>16 years/>2.52 m (female)
Weight, maximum:	209 kg
Age, maximum:	>16 years
Length, maximum:	2.70 m

9.2 Reproduction

Sexual maturity, age/length:	>7 years/>2.06 m
Calving interval:	not known
Mating season:	not known
Gestation:	not known, but infer

	10–12 months
Calving season:	no strong seasonality?
Calving area(s):	none known in Australian waters

9.3 Diet

Includes mesopelagic fish, squid and crustaceans. Some recorded prey are deep-sea or benthic, suggesting that Fraser's dolphin either feeds at depth (250–500 m) or when prey surface at night. Possibly a selective feeder on larger prey.

9.4 Behaviour

Seen in schools of less than 10, to about 1000. Considered highly gregarious, the school bond apparently tight. Observed with striped and spotted dolphins, false killer whales and sperm whales and especially melon-headed whales. Swimming behaviour is like other pelagic dolphins, although less acrobatic. In some parts of the world considered shy.

9.5 Mortality and pathology

Usually strands as a single animal but in Australia one group of three stranded at Corio Bay, Victoria. Mass stranding of 11 animals in France and 30 in Florida. If as pelagic and highly social as believed, mass strandings to be expected. Lung lesions caused by nematodes. Severe bronchopneumonia associated with lungworm. Trematode ova in blowhole. Cookie-cutter shark (*Isistius*) wounds.

9.6 Population abundance and rates of change

No longer considered rare. Estimate for the eastern tropical Pacific is a maximum of 289 000. No estimates for elsewhere in its range. Only four strandings in Australia.

10. Threats

10.1 Past

- Attempts have been made to establish captive animals in the past.

10.2 Current

- Incidental capture in gill-net fishery in Philippines is of concern. Second most frequently caught species there.
- Harpoon fisheries in Indonesia, Sri Lanka, Taiwan and Japan.
- Incidental catches in Sri Lanka and purse-seine deaths in the eastern tropical Pacific.

10.3 Potential

- Incidental and illegal captures within Australian waters of northern Australia.
- Entanglement in drift-nets set outside Australian Territorial Waters and in lost or discarded netting.
- Pollution (including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea) leading to bio-accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research

- Determine distribution and abundance in Australian waters to assess possible impact of threats, particularly effect of direct and indirect fishing activities.
- Obtain information on diet to determine trophic level and assess possible impact of fishing industry on food resources.
- Determine taxonomic relationships within and outside Indo-Pacific region to assess likely impact of threats on possible individual populations.

11.2 Management
- Minimise possible detrimental effects on population(s) e.g. from fishing activities.

12. Conservation actions already initiated

12.1 Research
- Study of incidental catch in Arafura and Timor seas, 1981–1985, commissioned by Australian National Parks and Wildlife Service, no Fraser's dolphins recorded.

12.2 Management
- Requirement to report incidental catch within Australian EEZ.

13. Conservation actions required

13.1 Research
- Carry out sighting program in northern waters.
- Obtain basic biological information (including diet and pollutants) from incidentally-caught and stranded specimens, especially from Arafura and Timor seas and east coast of Australia.
- Make taxonomic comparisons (when sufficient material is available) between Australian specimens and those from the Indo-Pacific and Indian oceans.

13.2 Management
- Ensure adequate protection of species and resources in Australian and nearby waters.
- Require reporting and salvage of specimens incidentally caught or stranded.
- Ensure specimens available to appropriate scientific museums.

14. Organisation(s) responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
No-one actively studying Fraser's dolphin in Australian region.
WF Perrin, NMFS, La Jolla, USA, studying incidentally-caught specimens in Philippines.

16. Can research and management be carried out with existing resources?
If no, what is required?

16.1 Research
No, requires:
- Minimum requirement to obtain basic biological information from incidentally-caught animals from fishing vessels: one biologist on fishing vessels for one year.
- Minimum requirement for a sighting program operated from existing cruises: two observers on two appropriate vessels (e.g. government) for one year. May be possible to link observation with incidental catch biologist as outlined above.

16.2 Management
No, requires:
- Appropriate guidelines/legislation, where not provided.
- Funding required to assist in salvage, lodgement and curation of specimens obtained.

17. Remarks

Fraser's dolphin has not yet been positively identified off the Northern Territory but may be present.

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Southern right whale dolphin

1. Family	Delphinidae
2. Scientific name	*Lissodelphis peronii*
3. English name(s)	Southern right whale dolphin

4. Taxonomic status, including species and subgroups

Described by Lacépède in 1804 as *Delphinus peronii,* possibly based on a specimen collected south of Tasmania. Closely related northern species *Lissodelphis borealis* may be conspecific with *L. peronii.*

5. Species survival status

5.1 Australian Action Plan status
No category assigned, because of insufficient information (NCA(a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration

Southern hemisphere, circumpolar generally between about 30° and 65°S (low latitudes (to 12°S) off western South Africa and South America related to the cold currents). Off

southern continental Australia; stranded in Tasmania, several sightings south and south-west of Tasmania, off south-western Australia and in the Great Australian Bight. Not recorded from Heard or Macquarie Island. Northward migration in winter and spring has been suggested off other continents.

7. Habitat

7.1 General

Pelagic, usually well offshore but if inshore, in deep water. On outer edge of continental shelf. In northern parts of distribution, associated with cold currents and upwelling conditions. Water temperatures range from about 2°–20°C. Possibly associated with West Wind Drift and generally seen between the Subtropical and Subantarctic Convergence.

7.2 Key localities

None known in Australian waters.

8. Marine protected areas managed for or relevant to the species

All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (based on non-Australian information)

9.1 Growth and age

Birth, weight/length:	ca 5 kg/ca 0.86 m
Weaning, age/length:	not known
Physical maturity, age/length:	not known
Weight, maximum:	116 kg
Age, maximum:	not known
Length, maximum:	2.97 m (male), 2.3 m (female)

9.2 Reproduction

Sexual maturity, age/length:	? years/ >2.5 m (male), ? years/ >2.18 m (female)
Calving interval:	not known
Mating season:	not known
Gestation:	not known
Calving season:	at least November and April
Calving area(s):	none known

9.3 Diet

Very few stomachs examined. Myctophid and other mesopelagic fish, squid, crustaceans. Euphausiids also possible food. Unknown whether surface or deep-layer feeder.

9.4 Behaviour

Capable of very fast swimming speed with sustained speeds of up to 12 knots. When swimming rapidly, leaps high and dives shallowly. Bow-rider. Other behaviours cause

water disturbance. Group size reported as 1–1000 individuals (mean ca 200) usually in tight group. Does not display consistent reaction to ships. Commonly reported swimming with many other species, e.g. pilot whales, common dolphins, hourglass dolphins, dusky dolphins and large whales.

9.5 Mortality and pathology

Only known predator, apart from humans, is Patagonian toothfish, but sharks and killer whales are likely. Many strandings have been recorded outside Australia. Mass strandings (up to 77 individuals) are known. Only three strandings in Australia, all in Tasmania. Reported pathologies are heart scars, lung abscesses, lung inflammation, pulmonary oedema, ulceration and brain lesions. Parasite *Nasitrema* found in air sinuses.

9.6 Population abundance and rates of change

No estimates of population size anywhere in southern hemisphere. Considered abundant off western South America, observed at sea many times to south-east of New Zealand. Sightings to south of Australia are rarely reported and may occur more regularly than believed.

10. Threats

10.1 Past

- Taken sporadically by whalers (for meat) in the nineteenth century but never a directed fishery.

10.2 Current

- Possibly caught in drift-nets in international waters.
- Commonly captured in gill-nets off Chile.
- Also reported hooked by line fishing but no information for Australian waters.

10.3 Potential

- Prone to entanglement in gill-nets and therefore potential problem if gill-netting occurs within their distribution in Australian region.
- Pollution leading to accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research

- Determine extent of incidental catch in netting and hook-and-line operations south of continental Australia.
- Investigate stranded and incidentally-caught specimens to establish basic biological parameters.
- Determine distribution and abundance south of continental Australia to assess impact of possible threats.

11.2 Management

- Increase international efforts to ameliorate and/or remove possible current and potential threats e.g. drift-netting, gill-netting.

12. Conservation actions already initiated

12.1 Research

- A Baker, Department of Conservation, NZ, summarised records for Australasian region.

12.2 Management

- Requirement to report all incidental catches during operations in Australian Territorial Waters.

13. Conservation actions required

13.1 Research

- Monitor incidental catch.
- Obtain sightings data from vessels and aircraft near and off the continental shelf of Australia, especially in West Wind Drift.
- Obtain information on diet and levels of toxic pollutants from stranded or incidentally-caught specimens.

13.2 Management

- Require accurate reporting and salvage of specimens incidentally caught or stranded.
- Ensure specimens available to appropriate scientific museums.

14. Organisation(s) responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved

No-one studying southern right whale dolphins in Australia.

16. Can research and management be carried out with existing resources?
If no, what is required?

16.1 Research

No, requires:

- Program to train personnel, on already existing cruises (including government and non-government vessels), to identify and report sightings. The species is very distinctively coloured and shaped and would therefore be easy for relatively untrained observers to identify (see also Item 5.4.3.1).
- Obtain basic biological information from incidentally-caught specimens from fishing vessels. One biologist on vessels for one year (see also Item 5.4.2.).

16.2 Management

No, requires:

- Appropriate guidelines / legislation, where not provided.
- Funding required to assist in salvage, lodgement and curation of specimens obtained (see also Item 5.4.1.).

17. Remarks

Investigations should concentrate on the Tasman Sea, around Tasmania and New Zealand, where several strandings and sightings have been reported. Cooperative research with New Zealand would maximise results.

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Melon-headed whale

1. Family	Delphinidae
2. Scientific name	*Peponocephala electra*
3. English name(s)	Melon-headed whale

4. Taxonomic status, including species and subgroups

Originally described as *Lagenorhynchus electra* by Gray in 1846. Recently placed in monospecific genus *Peponocephala*. No apparent taxonomic confusion and no subspecies recognised. Australian material enabled redescription of the species.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, because of insufficient information (NCA(a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration

Northern and southern hemisphere. Indian, Pacific and Atlantic oceans between about 35°N and 35°S. In Australian waters, recorded from Western Australia, Queensland and New South Wales. A stranding at Mundrabilla, WA, in the Great Australian Bight may be related to the warm Leeuwin Current. Not known to be migratory.

7. Habitat

7.1 General
Pelagic and oceanic. Primarily tropical and subtropical but can be found in temperate waters. Inhabits warm waters (usually >25°C), mainly equatorial. Generally in upwelling areas.

7.2 Key localities
None known in Australian waters.

8. Marine protected areas managed for or relevant to the species

All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (information from Australia and other regions)

9.1 Growth and age

Birth, weight/length:	? kg/ca 1.0 m
Weaning, age/length:	not known
Physical maturity, age/length:	? years/ca 2.7 m
Weight, maximum:	>100 kg
Age, maximum:	>20 years
Length, maximum:	2.75 m

9.2 Reproduction

Sexual maturity, age/length:	13 years/ 2.12–2.64 m (male), 6 years/ 2.29–2.57 m (female)
Calving interval:	not known
Mating season:	infer August to December (Australia)
Gestation:	estimate 12 months
Calving season:	August to December (Australia)
Calving area(s):	none known in Australian waters

9.3 Diet

Known diet squid and a variety of small fish.

9.4 Behaviour

Occurs in large herds of 150–1500 animals or groups of less than 40. Reported as a fast swimmer, breaking the water at a shallow angle. Can also jump clear of the water. Has been observed spy-hopping and swimming with Fraser's dolphin, spotted and spinner dolphins. Reported as herding other melon-headed whales and possibly attacking other dolphins.

9.5 Mortality and pathology

Three known Australian mass strandings: 150–250 animals at Crowdy Head, NSW, August 1958; 53 animals at Moreton Island, Queensland, August 1976; 7 animals at Point Plomer, NSW, November 1995. Single strandings have occurred. Nematodes reported from head air sinuses.

9.6 Population abundance and rates of change

Estimated 45 000 in eastern tropical Pacific. Apparently common in the Philippines. May be more common in Australian waters than records suggest.

10. Threats

10.1 Past

- None known.

10.2 Current

- Possible illegal and incidental catches in northern Australian waters.
- Incidental catches in gill-nets in Sri Lanka and small numbers taken in the purse-seine nets of the eastern tropical Pacific.
- Captured in low numbers in small cetacean fisheries in several places, including Japan, Indonesia and Sri Lanka.

10.3 Potential

- Entanglement in drift-nets set outside Australian EEZ and in lost or discarded netting.

- Pollution (including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea) leading to bio-accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research

- Determine extent of incidental take and fisheries in northern Australian and nearby waters.
- Determine distribution and monitor abundance in Australian waters to assess possible impact of threats, particularly effect of direct and indirect fishing activities.
- Obtain information on diet to determine trophic level and assess possible impact of fishing industry on food resources.
- Determine taxonomic relationships within and outside Indo-Pacific region to assess likely impact of threats on possible individual populations.

11.2 Management

- Minimise possible detrimental effects on population(s) e.g. from fishing activities.

12. Conservation actions already initiated

12.1 Research

- M Bryden, University of Sydney—general and reproductive biology, and summary of strandings.
  W Dawbin, c/- The Australian Museum—osteology and growth of skull.
- Study of incidental catch in Arafura and Timor seas, 1981–1985, by ANPWS (no *P. electra* caught).

12.2 Management

- Requirement to report incidental catch within Australian EEZ.

13. Conservation actions required

13.1 Research

- Carry out sighting program in northern waters.
- Obtain basic biological information (including diet and pollutants) from incidentally-caught and stranded specimens, especially from waters off northern Australia.
- Make taxonomic comparisons (when sufficient material is available) between Australian specimens and those from the Indo-Pacific and Indian oceans.

13.2 Management

- Ensure adequate protection of species in Australian and nearby waters.
- Require reporting and salvage of specimens incidentally caught or stranded.
- Ensure specimens available for appropriate scientific museums.

14. Organisation(s) responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
None.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research

No, requires:

- Minimum requirement to obtain basic biological information from incidentally-caught animals from fishing vessels: one biologist on fishing vessels for one year (see Item 5.4.2).
- Minimum requirement for a sighting program operated from existing cruises: two observers on two appropriate vessels (e.g. government) for one year (see Item 5.4.3.1). May be possible to link observation with incidental catch biologist as outlined above.

16.2 Management

No, requires:

- Appropriate guidelines/legislation, where not provided.
- Funding required to assist in salvage, lodgement and curation of specimens obtained (see also Item 5.4.1).
- Contingency funds to obtain scientific information from mass strandings.

17. Remarks

Melon-headed whales may be difficult to distinguish from false killer whales and pygmy killer whales. It is essential that trained observers be employed to record sightings and strandings.

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Pygmy killer whale

1. Family	Delphinidae
2. Scientific name	*Feresa attenuata*
3. English name(s)	Pygmy killer whale

4. Taxonomic status, including species and subgroups

Described as *Feresa attenuata* by Gray, 1874. The two skulls known until the 1950s were assigned to different species but subsequent specimens obtained have shown one species with a wide distribution. No information comparing Australian specimens with other regions.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, because of insufficient information (NCA(a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration

Found at low latitudes in the Pacific, Indian and Atlantic oceans to about 35°N and 35°S. In Australia, known from strandings in New South Wales and Western Australia. Sighting records are reported for the area north-east of Australia. Limited evidence suggests not migratory.

7. Habitat

7.1 General
Tropical and subtropical waters, generally 18°C or greater. Unknown whether pelagic or neritic, possibly the former.

7.2 Key localities
None known in Australian waters.

8. Marine protected areas managed for or relevant to the species

All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (based on non-Australian and limited information)

9.1 Growth and age

Birth, weight/length:	? kg/ca 0.8 m
Weaning, age/length:	not known
Physical maturity, age/length:	? years/2.31 m (average)
Weight, maximum:	155 kg
Age, maximum:	>14 years
Length, maximum:	2.07 m (male)

9.2 Reproduction

Sexual maturity, age / length:	? years / <2.16 m	(male),
	? years / <2.21 m	(female)
Calving interval:	not known	
Mating season:	not known	
Gestation:	not known	
Calving season:	infer summer	
Calving area(s):	none known	

9.3 Diet

Very limited information, from only three stomachs containing squid beaks and fish otoliths. Behavioural observations suggest it is a predator on other cetaceans including *Stenella* spp. and *Delphinus delphis.* Sardines eaten by a captive animal.

9.4 Behaviour

Observed in groups of up to 120 individuals, although generally less than 50. Has been seen with Fraser's dolphin and pygmy right whale, although the latter seems unusual because of the more temperate water preferences of that species. Has been reported to herd and attack other small cetaceans. Distinct fright reactions have been shown by other species when in captivity with it. Described as aggressive—snapping jaws, beating flippers and flukes on the water's surface and growling.

9.5 Mortality and pathology

Known to strand but not in groups. Heavy infestations of stomach nematodes, stomach ulcers. Respiratory infections. Stalked barnacles attach to flukes, flippers and dorsal fin.

9.6 Population abundance and rates of change

Unknown. Believed to be uncommon or rare throughout its range, although not uncommon in gill-net fishery off Sri Lanka.

10. Threats

10.1 Past

- None that are not current.

10.2 Current

- Illegal and incidental catches in northern Australian waters are likely.
- Taken in small numbers in directed fisheries in several places, including Indonesia.
- Incidental catches reported in gill-nets off Sri Lanka (ca 2%) and purse-seine nets in eastern tropical Pacific.
- Taken for bait in Sri Lanka.

10.3 Potential

- Entanglement in drift-nets set outside Australian Territorial Waters and in lost or discarded netting.
- Pollution (including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea) leading to bio-accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research

- Determine distribution and abundance in Australian waters to assess possible impact of threats, particularly effect of direct and indirect fishing activities.

- Obtain information on diet to determine trophic level and assess possible impact of fishing industry on food resources.
- Determine taxonomic relationships to assess likely impact of threats on possible individual populations.

11.2 Management
- Minimise possible detrimental effects on population(s) e.g. from fishing activities.

12. Conservation actions already initiated

12.1 Research
- Study of incidental catch in Arafura and Timor seas, 1981–1985, commissioned by ANPWS (now ANCA) (no pygmy killer whales reported).
- M Bryden, University of Sydney—description of stranding, skeleton.

12.2 Management
- Requirement to report incidental catch within Australian EEZ.

13. Conservation actions required

13.1 Research
- Carry out sighting program in northern waters.
- Obtain basic biological information (including diet and pollutants) from incidentally-caught and stranded specimens.
- Make taxonomic comparisons (when sufficient material is available) between Australian specimens and those from elsewhere.

13.2 Management
- Ensure adequate protection of species in Australian and nearby waters.
- Require reporting and salvage of specimens incidentally caught or stranded.
- Ensure specimens available for appropriate scientific museums.

14. Organisation(s) responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
None.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No, requires:
- Minimum requirement to obtain basic biological information from incidentally-caught animals from fishing vessels: one biologist on fishing vessels for one year (see also Item 5.4.2).
- Minimum requirement for a sighting program operated from existing cruises: two observers on two appropriate vessels (e.g. government) for one year (see also Item 5.4.3.1). May be possible to combine observer with incidental catch biologist as outlined above.

16.2 Management
No, requires:

- Appropriate guidelines/legislation, where not provided.
- Funding required to assist in salvage, lodgement and curation of specimens obtained.

17. Remarks

Pygmy killer whales may be confused with false killer whales and melon-headed whales, especially at sea. Trained personnel are required to make observations.

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False killer whale

1. Family	Delphinidae
2. Scientific name	*Pseudorca crassidens*
3. English name(s)	False killer whale

4. Taxonomic status, including species and subgroups

Described by Owen in 1846. No subgroups recognised.

5. Species survival status

5.1 Australian Action Plan status

No category assigned, but possibly secure (NCA (b))

5.2 IUCN status

Insufficiently known

5.3 CITES status

Appendix II

6. Distribution, including migration

Circumglobal, from equator to ca 45°S and 45°N. North–south and inshore seasonal movements appear to occur in the north-eastern Pacific and in some other areas, apparently associated with warm currents and seasonal availability of prey. Widely recorded by strandings and some sightings in waters of all Australian states and Northern Territory. Strandings occur in all months, but the majority of herd strandings occur from May to September on the south and south-eastern coasts, indicating a seasonal movement inshore or along the continental shelf.

7. Habitat

Prefers tropical (ca 22–32°C) to temperate (ca 10–20°C) oceanic waters, approaching close to land only where the continental shelf is narrow, possibly attracted to zones of enhanced prey abundance along the continental slope.

8. Marine protected areas managed for or relevant to the species

All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (data mainly from northern hemisphere; some Australian)

9.1 Growth and age

Birth weight/length:	? kg/1.2 m (Tasmania)–1.8 m
Weaning, age/length:	ca 18–24 months (Japan)/? m
Physical maturity age/length:	not known
Weight, maximum:	ca 1.5 tonnes (male), ca 1 tonne (female)
Length, maximum:	5.96 m (male), 5.06 m (female)
Age, maximum:	not known

9.2 Reproduction

Sexual maturity, age/length:	varies between populations: generally 8–14 years both sexes/ca 4.0–4.5 m (male), ca 3.5 (Tasmania)–4.0 m (female)
Calving interval:	average 6.9 years (Japan); increases with age
Mating season:	year-round
Calving season:	year-round, no seasonal pattern
Gestation:	15.1–15.6 months

(Japan)
Calving areas: none known for Australian waters

9.3 Diet
Staples are squid and large pelagic fish. In parts of the species range, individuals have been observed to prey on cod (*Gadus*), mahimahi (*Coryphaena*), yellowtail tuna (*Pseudosciena*) and salmon (*Onchorhynchus*), and will attack stressed dolphins escaping tuna purse-seine nets. Cephalopod remains in stomachs include *Todarodes*, *Oregoniateuthis*, *Phasmatopsis*, *Gonatopsis* and *Berryteuthis*.

9.4 Behaviour
Highly gregarious, occurring in socially cohesive herds of ca 20 to 50 in which both sexes are equally represented. Large aggregations of ca 100 to 800+ occur, which appear to be temporary associations of several smaller herds, congregating to exploit locally abundant prey. Often seen with other cetaceans, e.g. bottlenose dolphins. A very fast and athletic species; will approach vessels and bow-ride, and is capable of high leaps, well clear of the water. A mass stranding in Tasmania, ca 1868 included long-finned pilot whales and killer whales, but the circumstances are unclear.

9.5 Mortality and pathology
Prone to mass stranding, which can result in the death of whole herds, but without information on population size cannot be certain of its significance in population dynamics. Mass strandings on Australian coasts occur relatively frequently, on average one per 2.5 years since 1970, and have involved from ca 20 to ca 250 individuals, average ca 100. Scars and wounds on some strandlings (Victoria) indicate attacks by cookie-cutter sharks (*Isistius* sp.). False killer whales have occasionally been taken incidentally by gill-net and tuna purse-seine fisheries and may be vulnerable to predation by killer whales.

9.6 Population abundance and rates of change
Although widely distributed, apparently nowhere abundant. No population assessments available for southern hemisphere populations.

10. Threats

10.1 Past
- Incidental captures in Taiwanese pelagic gill-net fisheries in Australian Territorial Waters off northern Australia. Some captured for oceanaria in southern Queensland.

10.2 Current
- Culling to protect finfish fishery off western Japan, also incidentally captured in tuna purse-seine and in other net and long-line fisheries elsewhere in Pacific Ocean.
- Possible entanglement in drift-nets lost or discarded in international waters.

10.3 Potential
- Competition from expanding commercial fisheries.
- Pollution leading to accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research
- Establish basic biological parameters.
- Establish seasonal variation in distribution in relation to reproductive parameters.
- Assess degree of biological threat posed by pollutants.
- Improve definition of range in relation to oceanographic parameters and season.
- Establish indices of abundance.

11.2 Management

- Increase international efforts to ameliorate and/or remove current and potential threats.

12. Conservation actions already initiated

12.1 Research

- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which outline scientific objectives and appropriate biological/veterinary research activities.
- Development of state and national strandings and sightings databases (some state museums; some state wildlife agencies; ANCA) to preserve and consolidate data for analysis.
- Biological studies of mass strandings, sighting surveys using observer network: D Thiele, M Hindell (University of Tasmania).
- Biological studies of mass strandings: D Mell (CALM), D Kitchener (WA Museum), L Llewellyn (NSW NPWS), P Gibbs (Dept Fisheries, NSW).
- Veterinary studies on stranded specimens: T McManus, D Obendorf (Tasmanian Department of Agriculture).
- Investigation of stranding phenomena, salvage of material: J Wapstra (Tasmanian DELM), D Thiele, M Hindell (University of Tasmania).

12.2 Management

- Protection under federal and state laws.
- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which define management objectives and outline appropriate logistical responses by participating organisations and individuals.
- Development of international objectives and agreements (CITES, CMS, IWC) to protect cetaceans and marine environments.

13. Conservation actions required

13.1 Research

- Maximise basic biological information gained from strandings and incidental captures by improving the speed and efficiency of reporting, scientific response, salvage and lodgement of taxonomic materials in relevant museums.
- Mark re-floated animals to provide means of later identification, should opportunities arise.
- Conduct follow-up investigations of taxonomic and genetic material, organ systems and stomach contents, health status including parasites, and pollutants in body tissues.
- Obtain information on distribution via platforms of opportunity, e.g. observers on oceanographic research vessels, and by developing a wide network of voluntary observers, possibly involving merchant vessels, fishing vessels, spotter aircraft and ocean-going yachts.
- Obtain estimates of abundance by dedicated field survey.

13.2 Management

- Prompt and efficient responses to live single and mass strandings, and entanglements, as directed by the importance of opportunistic biological studies and welfare considerations.
- Ensure dead specimens are made available to appropriate scientific museums.
- Encourage compliance by IWC member states with commission recommendation to report all by-catches.

- Monitor development of pelagic fisheries directed at species possibly important in the diet of *P. crassidens*.

14. Organisations responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
Investigation of stranding phenomena, salvage of material: D Thiele, M Hindell (University of Tasmania).

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No, requires:
- A national program for the investigation of cetacean strandings and incidental captures, possibly based on the ANCA National Strandings and Sightings Database.
- A Stranding Investigation Fund for each state and the Northern Territory, possibly with joint contributions by the Federal Government and each state / Northern Territory government. (Alternatively, a central contingency fund, from which an average core cost of investigating each stranding event could be reimbursed to the agency, organisation and / or individual involved, on submission of a full stranding report to ANCA).
- A national program of cetacean survey which, although directed at species of concern, should include ziphiids and all other little known species. Would require preparation of a first-class field identification guide covering all Australasian species.

16.2 Management
Yes, but limited, requires:
- See 13.2.

17. Remarks
Widely recorded in Australia by strandings—Western Australia (17 events), South Australia (3), Victoria (2), Tasmania (15), New South Wales (11), Queensland (5), Northern Territory (nil). Absence of stranding records from the Northern Territory may reflect a lack of observers.

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Killer whale

1. Family	Delphinidae
2. Scientific name	*Orcinus orca*
3. English name(s)	Killer whale, orca

4. Taxonomic status, including species and subgroups

Described as *Delphinus orca* by Linnaeus in 1758. Large number of synonyms (22) because of individual and geographic variation in colour pattern and size. No widely accepted subspecies. Two synonyms have been described from Australasian waters.

5. Species survival status

5.1 Australian Action Plan status
No category assigned but probably secure (NCA(c))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration

Cosmopolitan, from polar regions to equator in all oceans. Recorded from all states but not Northern Territory. Concentrations believed to occur around Tasmania; sightings frequent in South Australia and Victoria. Frequently seen in the Antarctic south of 60°. Recorded from Heard and Macquarie Islands. Not known to be migratory but seasonal movements may be made, possibly related to food supply.

7. Habitat

7.1 General
Oceanic, pelagic and neritic, in warm and cold waters. May be more common in cold, deep waters. Off Australia, often seen along continental slope and on shelf. Often seen near seal colonies.

7.2 Key localities
Macquarie Island, because regularly sighted there.

8. Marine protected areas managed for or relevant to the species

All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone

(= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (based on non-Australian information)

9.1 Growth and age

Birth, weight / length:	ca 180 kg / ca 2.30–2.50 m
Weaning, age / length:	12–15 months / 4.3 m
Physical maturity, age / length:	not known
Weight, maximum:	>4000 kg (male), >3100 kg (female)
Age, maximum:	40 years
Length, maximum:	9.8 m (male), 8.5 m (female)

9.2 Reproduction

Sexual maturity, age / length:	ca 16 years / 5.2–6.2 m (male), ca 10 years / 4.6–5.4 m (female)
Calving interval:	3–8 years
Mating season:	all year
Gestation:	12–17 months
Calving season:	spans several months, season variable
Calving area(s):	none known in Australian waters

9.3 Diet

Top-level carnivore. Diet differs seasonally and regionally. In north-eastern Pacific, two kinds of animals, resident (eating mostly fish) and transient (eating birds and mammals). Specific diet of Australian killer whale not known but there are reports of attacking ‘dolphins’, young humpbacks, blue whales, sperm whales, dugongs and Australian sea lions. Also a well-documented case of herding bottlenose and common dolphins. In a large sample (362) of stomachs from Antarctic, 60% contained fish, 31% minke whale, 9% pinnipeds and 9% squid.

9.4 Behaviour

Grouping—has been observed in groups of up to several hundred. Usually less than 30; several studies outside Australian waters have reported mean pod sizes less than 10. Off southern Australia, group size up to 52 with most sightings less than 10. Long-term studies in the north-west Pacific have shown that pod composition appears to remain consistent with time—about 20% adult males, 40–50% adult females and 30–40% immatures and juveniles. Social hierarchy within the pod.

Feeding—often hunts in packs, especially when attacking schools of fish and large whales. In South Australia confirmed report of about 13 killer whales attacking a pod of sperm whales grouped in the protective ‘daisy’ formation. Has also been reported herding dolphins.

Home range—transients off British Columbia have very large ranges when compared with residents. No information for Australian animals.

Human interaction—reported cases of killer whales forming a symbiotic relationship with whalers at Eden, NSW, whereby killer whales received tongues of other whales caught by humans in return for help with procuring the whales.

Surface activity—exhibits usual cetacean behaviour patterns of breaching, spy-hopping, lob-tailing and flipper-slapping.

Communication—visual, tactile and acoustic.

9.5 Mortality and pathology

No known predators except humans. Natural mortality rate about 5% per year. Levels of pollutants can be high but effect not known. Neonate stranded in Victoria had moderate levels (28.4 ppm) of total DDT. Most common disease reported from wild animals is jaw infection as a result of tooth wear and opening up of the tooth pulp cavity. Atherosclerosis reported. Strandings not common in Australia: include one mass stranding (nine animals), Tasmania.

9.6 Population abundance and rates of change

No population estimates for continental Australian waters. In Antarctic south of 60°S, a preliminary population estimate of at least 70 000. Reported ‘concentrations’ of animals off Tasmania and Macquarie Island.

10. Threats

10.1 Past

- Hunted in the Antarctic by the USSR whose catches between 1969 and 1980 numbered up to about 1000 per season. Seen as a competitor to fishing and sealing industries and may have been killed by fishers for that reason.

10.2 Current

- Illegal killing, of concern in some areas (e.g. Tasmania): reliable reports of fishers shooting killer whales plundering catch.
- Incidental deaths have not been reported in Australian waters.

10.3 Potential

- Is long-lived and a top predator, making it highly susceptible to accumulating high levels of heavy metals and organochlorines.
- Reduction of food resources by overfishing of prey species.
- Entanglement in drift-nets set outside Australian EEZ and in lost or discarded netting.

11. Conservation objectives

11.1 Research

- Determine distribution and abundance in Australian waters to assess possible impact of threats, particularly effect of direct and indirect fishing activities.
- Determine levels of toxic contaminants to assess possible threat from pollution.
- Obtain information on diet to determine trophic level and assess possible impact of fishing industry on food resources.

11.2 Management

- Minimise possible detrimental effects on population(s) e.g. from fishing activities, possible future whaling and toxic contaminants.

12. Conservation actions already initiated

12.1 Research

- JK Ling, SA Museum, distribution records for South Australia.
- IWC/IDCR minke whale assessment cruises.
- G Copson, Tasmanian Parks and Wildlife Service, records of killer whales from Macquarie Island.
- DAA Parker, Antarctic Division, sightings on ANARE voyages to the Antarctic.

12.2 Management
- Requirement to report incidental catch within Australian EEZ.

13. Conservation actions required

13.1 Research
- Pool existing sightings and strandings data to locate possible concentration areas.
- Obtain basic biological information (including diet and pollutants) from incidentally-caught and stranded animals.
- Establish catalogue of identified individuals to determine scope of movements and pod home ranges.

13.2 Management
- Continuing assessment of tuna and seal stocks.
- Ensure adequate protection of species and resources in Australian and nearby waters.
- Ensure specimens available to appropriate scientific museums.

14. Organisation(s) responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
None in addition to those mentioned above.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No, requires:
- Minimum requirement for sighting program operated from existing cruises: three trained biologists on government vessels for three months each.
- Minimum requirement for establishing catalogue: one biologist for six months.

16.2 Management
No, requires:
- Appropriate guidelines/legislation, where not provided.
- Funding to assist in salvage, lodgement and curation of specimens obtained.
- Observer program on long-line fishing vessels to obtain information of extent of interactions between killer whales and fishery: two biologists for six months.

17. Remarks
Killer whales are highly visible and often photographed. Many organisations and individuals hold photographs; they could be used to establish a catalogue and make a preliminary investigation of possible movements.

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Long-finned pilot whale

1. Family	Delphinidae
2. Scientific name	*Globicephala melas*
3. English name(s)	Long-finned pilot whale

4. Taxonomic status, including species and subgroups

Described by Traill in 1809 as *Delphinus melas*. The specific name *melaena* used in combination with *Globicephala* until recently, when *melas* reinstated. Southern hemisphere form recognised as a subspecies, *G. m. edwardi.*

5. Species survival status

5.1 Australian Action Plan status
No category assigned, but possibly secure (NCA (b))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration

Northern and southern hemisphere. Southern circumglobal, anti-tropical in colder waters, north to ca 27°S (with colder inshore currents?). Found near all the major land masses and in oceanic waters. Widely recorded in waters off southern Australia, and at Macquarie and Heard Islands. Southernmost sighting at 67°41'S. Migratory, apparently in relation to seasonal abundance of favoured prey species. Strandings in all states, and at Lord Howe Island, but not in Northern Territory; pattern of events suggests movements occur to and perhaps along edge of continental shelf off southern Australia, but data are inconclusive.

7. Habitat

7.1 General

Temperate (ca 10–20°C) and subantarctic (ca 1–8°C) deep oceanic waters and zones of higher productivity along the continental slope, apparently venturing into the shallower waters of the shelf (<200 m) in pursuit of favoured prey species.

7.2 Key localities
None known in Australian waters.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (mainly NE Atlantic data, includes some Australian data)

9.1 Growth and age

Birth, weight/length:	74–79 kg/1.78 m (NE Atlantic); 55–70 kg/ 1.38–1.86 m (all lone dead strandings, Victoria)	
Weaning, age/length:	ca 23–27 months, prolonged 7 years/ ? m (male), 12 years/? m	evidence of suckling to (female)
Physical maturity, age/length:	25–30 years/ ? m	
Weight, maximum:	ca 3.0 tonnes (male), ca 1.8 tonnes (female)	
Age, maximum:	46 years (male), 59 years (female)	
Length, maximum:	7.20 m (male, Tasmania), 6.00 m (female, Tasmania)	

9.2 Reproduction

Sexual maturity, age/length:	various estimates: av. 17 years/ ca 4.0–5.0 m (male), 5–15 years/ ca 3.0–4.0 m (female)	
Calving interval:	3–4 years, with age, average 5.1 years	increasing
Mating season:	spring and summer (Tasmania)	

Calving season:	throughout year, but >85% births Sept to March (Tasmania)
Gestation:	12 months
Calving areas:	none known for Australian waters

9.3 Diet

Geographical associations between these whales and squid have been widely reported. Stomach contents confirm squid are the main prey, although some fish are also taken, e.g. strandlings in Tasmania had eaten both, but cephalopods were clearly preferred, with larger species and individuals selected, including: *Sepioteuthis australis*, a common neritic species in southern Australia; *Nototodarus gouldi*, predominantly oceanic, but moves into shallower waters in Tasmanian region; *Sepia apama*, occurs on upper continental slope and shelf; and *Enoploteuthis galaxias*, a small species rare on the continental shelf. *E. galaxias* also found in pilot whale stomachs in Western Australia.

9.4 Behaviour

Highly gregarious, usually travelling in small, socially cohesive groups ca 10 to 50, but also encountered in large herds of several hundred and occasionally of 1000+. Most animals remain within natal pod centred on reproductive females; matings occur between pods; no evidence of male dominance or competition, but scars suggestive of intraspecific aggression have been reported. Groups tend to bunch up when travelling and spread out when feeding. Satellite tracked individual (with conspecifics) in North Pacific averaged 80 km / day at average 3.3 km / hr; greatest distance in one day 234 km, greatest speed 16+ km / hr for periods > 3 hr; average 2020 dives / day, average duration 40 sec. Fast active predator; possibly cooperates in herding schools of prey. Capable of deep dives (1000+m), but generally feeds at much shallower depths during dives of 5–10 minutes. Entire herds may rest motionless at the surface; social activities include spy-hopping, tail-slapping; young animals may occasionally breach. Seen in association with common dolphins, bottlenose dolphins, southern right whale dolphins (Tasmania) and sperm whales (Tasmania), the latter at orange roughy (*Hoplostethus atlanticus*) sea mounts. A mass stranding in Tasmania ca 1868 included false killers and killer whales, but the circumstances are unclear.

9.5 Mortality and pathology

Possible wide variation in mortality rates; more females survive to adulthood. Prone to mass stranding; number involved and consequent mortality exacerbated by close relatedness within pods and social cohesion. Frequency of mass strandings may be a significant aspect of natural mortality, but cannot be certain without information on population size. Mass strandings on Australian coasts have occurred on average once per year since 1970, involving from five to ca 300 individuals, average ca 100. All but three events occurred September–March; 60% occurred December–March. Large numbers (1140–4200) of nematode *Stenurus globicephalae* in ear canals, gutteral pouches and auditory sinuses of four large (socially significant?) males from one mass stranding in Tasmania. Known pathogens: *Vibrio alginolyticus* from anus, blowhole and skin. Levels of heavy metals in the liver / kidney of a 4.85 m male were Cd 13 / 12, Cu 5.6 / 3.0, Zn 31 / 22 ppm; levels of organochlorines in the blubber of six large individuals 0.4–0.9 ppm, but 1.3 (DDT) and 2.8 ppm (DDE) in the blubber of a 2.6 m juvenile female (Tasmania).

9.6 Population abundance and rates of change

Widespread and apparently common, but no population assessments available for southern hemisphere populations.

10. Threats

10.1 Past

- Minor incidental takes by pelagic whalers last century; possibly some large catches in Tasmanian waters in the 1800s, otherwise southern hemisphere populations not significantly exploited commercially.

10.2 Current

- Possible entanglement in drift-nets and other nets set, lost or discarded in international waters.

10.3 Potential

- Competition from expanding commercial fisheries, especially in mid- to higher latitudes.
- Pollution leading to accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research

- Establish basic biological parameters.
- Investigate seasonal variation in distribution in relation to reproductive parameters.
- Assess degree of biological threat posed by pollutants.
- Undertake field surveys to improve definition of range in relation to oceanographic parameters, investigate seasonal variation in relation to latitude and establish indices of abundance.

11.2 Management

- Increase international efforts to ameliorate and/or remove possible current and potential threats.

12. Conservation actions already initiated

12.1 Research

- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which include scientific objectives and outline appropriate veterinary and research activities.
- Development of state and national strandings and sightings databases (some state museums; some state wildlife agencies; ANCA) to preserve and consolidate data for analysis.
- Biological studies of mass strandings, genetic comparisons with Faroe Islands population, sighting surveys using observer network: D Thiele, M Hindell (University of Tasmania).
- Veterinary studies on stranded specimens: T McManus, D Obendorf (Tasmanian Department of Agriculture).
- Investigation of stranding phenomena, salvage of material: J Wapstra (Tasmanian PWS/DELM); D Thiele, M Hindell (University of Tasmania); D Kitchener (WA Museum).
- Logged sightings of *Globicephala* sp. during cetacean aerial surveys off Fraser Island: P Corkeron, M Bryden.

12.2 Management

- Protection under federal and state laws.
- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which define management objectives and outline appropriate logistical responses by participating organisations and individuals.
- Development of international objectives and agreements (CITES, CMS, IWC) to protect cetaceans and marine environments.

13. Conservation actions required

13.1 Research

- Confirm specific identification of all *Globicephala* specimens in Australian museums.
- Maximise basic biological information gained from strandings and incidental captures by improving the speed and efficiency of reporting, scientific response, salvage and lodging of taxonomic materials in relevant museums.
- Mark rescued animals to provide means of later identification.
- Conduct follow-up investigations of taxonomic and genetic material, organ systems and stomach contents, health status including parasites, and pollutants in body tissues.
- Investigate genetic relationships including possibility of discrete populations.
- Develop field identification materials to improve accuracy of reporting encounters with pilot whales, which are difficult to differentiate to species.
- Obtain information on distribution via platforms of opportunity, e.g. observers on oceanographic research vessels, and by developing a wide network of voluntary observers, possibly involving merchant vessels, fishing vessels, spotter aircraft and ocean-going yachts.
- Obtain estimates of abundance by dedicated field survey.

13.2 Management

- Prompt and efficient responses to live single and mass strandings and entanglements, as directed by the importance of opportunistic biological studies and welfare considerations.
- Ensure dead specimens are made available to appropriate scientific museums.
- Encourage compliance by IWC member states with commission recommendation to report all incidental captures.
- Monitor development of fisheries directed at pelagic squid, possibly important in the diet of *G. melas.*

14. Organisations responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
University of Tasmania: D Thiele, M Hindell

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research

No, requires:

- A national program for the investigation of cetacean strandings, possibly based on the ANCA National Strandings and Sightings Database.

- A Stranding Investigation Fund for each state and the Northern Territory, possibly with joint contributions by the Federal Government and each state / Northern Territory government. (Alternatively, a central contingency fund, from which an average core cost of investigating each stranding event could be reimbursed to the agency, organisation and / or individual involved, on submission of a full stranding report to ANCA).
- A national program of cetacean survey which, although directed at species of concern, should include globicephalids and all other little known species. Would require preparation of a first-class field identification guide covering all Australasian species.

16.2 Management

Yes, but limited, requires:

- See 13.2.

17. Remarks

Widely recorded in waters off southern Australia, and at Macquarie and Heard Islands, by sightings and numerous stranding events. The latter, to 1994, include Western Australia (9 events), South Australia (16), Victoria (26), Tasmania (54, including five on the east coast of Flinders Island), New South Wales (4, including one at Lord Howe Island), Queensland (1).

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Short-finned pilot whale

1. Family	Delphinidae
2. Scientific name	*Globicephala macrorhynchus*
3. English name(s)	Short-finned pilot whale

4. Taxonomic status, including species and subgroups
Described by Gray in 1846 as *Globicephalus macrorhynchus*. Some evidence of genetically distinct populations, off Japan and in eastern Pacific, but not yet defined and no subgroups formally recognised.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, but possibly secure (NCA (b))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration
Circumglobal, equatorial to ca 41°S and ca 45°N. Evidence of genetically distinct populations in northern and eastern Pacific Ocean. Distribution in Australian region includes oceanic waters and continental seas. Strandings in Australia in Northern Territory and all states except Victoria; records on southern coasts may reflect influence of warm, south-flowing Indian and Pacific Ocean currents. Elsewhere, seasonal inshore–offshore movements occur of known groups, apparently in response to abundance and spawning of prey; likely but not apparent from meagre data for Australia.

7. Habitat

7.1 General
In Australian region occurs in tropical (ca 22–32°C) to temperate (ca 10–22°C) oceanic waters, approaching coastal seas.

7.2 Key localities
None known in Australia.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (data on southern Japanese form)

9.1 Growth and age

Birth, weight/length:	ca 55 kg/ca 1.4 m
Weaning, age/length:	2+ years/? m
Physical maturity, age/length:	ca 17 years/5+ m
Weight, maximum:	ca 2 tonne (male),

	ca 1.5 tonne (female)
Age, maximum:	46 years (male), 63 years (female)
Length, maximum:	5.89 m (male), 4.8 m (female)

9.2 Reproduction

Sexual maturity, age/length:	14.6 years/ ca 4.0–5.0 m (larger males mature earlier), 9 years/ 2.9–3.6 m (female)
Calving interval:	ca 5 years (females continue breeding until ca 17–34 years (av 24), producing an average of 4–5 calves)
Mating season:	year-round
Gestation:	14.9 months
Calving season:	diffusely seasonal, peak in July August
Calving areas:	none known for Australian waters

9.3 Diet

Feeds mainly on squid, cuttlefish and octopus and some fish. Stomach contents have included cephalopods such as *Loligo reynaudi* and *Lycoteuthis diadema* (Southern Africa), *Loligo opalescens* off California, and *Todarodes pacificus, Eucleoteuthis luminosa, Ommastrephes bartrami* and the giant octopus *Octopus dofleini* off Japan. Associations have been seen with appearance of the squid *Illex illecebrosus coindeti* off western Africa and with feeding tuna off Puerto Rico. Reported to herd and possibly attack *Stenella* dolphins and common dolphins escaping tuna purse-seine nets in eastern tropical Pacific.

9.4 Behaviour

Socially cohesive, in small groups of ca 10 to 30, but commonly in herds of several hundred; often accompanied by dolphins, especially bottlenose dolphins. Male pilot whales and dolphins tend to remain at the perimeter of the herd; subadult males protect creches of young. The mating system is polygynous; males migrate between schools after weaning. Breeding schools are matrilinear kinship groups. Large males can be aggressive towards human swimmers. Capable of diving to at least 600 m.

9.5 Mortality and pathology

Males at periphery of groups possibly more prone to attacks by killer whales.

9.6 Population abundance and rates of change

Widespread and apparently common. No information on numbers or trends in southern hemisphere populations.

10. Threats

10.1 Past
- Localised fisheries in Caribbean, off Japan, Indonesia and Sri Lanka, but not in Australian waters.

10.2 Current
- Entanglement in drift-nets and other nets set, lost or discarded in international waters.

10.3 Potential
- Competition from expanding commercial fisheries.
- Pollution leading to accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research
- Establish basic biological parameters.
- Establish seasonal variation in distribution in relation to reproductive parameters.
- Assess degree of biological threat posed by pollutants.
- Improve definition of range in relation to oceanographic parameters and season.
- Estimate abundance.

11.2 Management
- Increase international efforts to ameliorate and/or remove possible current and potential threats.

12. Conservation actions already initiated

12.1 Research
- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which outline scientific objectives and outline appropriate biological/veterinary research activities.
- Development of state and national strandings and sightings databases (some state museums; some state wildlife agencies; ANCA) to preserve and consolidate data for analysis.
- Opportunistic investigation of strandings and research on museum material by J Bannister (c/- WA Museum), G Ross (ABRS).
- Logged sightings of *Globicephala* sp. during cetacean aerial surveys off Fraser Island: P Corkeron, M Bryden (University of Sydney).

12.2 Management
- Protection under federal, state and Northern Territory laws.
- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which define management objectives and outline appropriate logistical responses by participating organisations and individuals.
- Development of international objectives and agreements (CITES, CMS, IWC) to protect cetaceans and marine environments.

13. Conservation actions required

13.1 Research
- Study existing museum material of *Globicephala* to check specific identification.
- Maximise basic biological information gained from strandings and incidental captures by improving the speed and efficiency of reporting, scientific response, salvage and lodging of taxonomic materials in relevant museums.
- Mark rescued animals to provide means of later identification.

- Conduct follow-up investigations of taxonomic and genetic material, organ systems and stomach contents, health status including parasites, and pollutants in body tissues.
- Investigate genetic relationships including possibility of discrete populations.
- Develop field identification materials to improve accuracy of reporting encounters with pilot whales, which are difficult to differentiate to species.
- Photo-identification and satellite telemetry of population off Fraser Island, Queensland.
- Obtain information on distribution via platforms of opportunity, e.g. observers on oceanographic research vessels, and by developing a wide network of voluntary observers, possibly involving merchant vessels, fishing vessels, spotter aircraft and ocean-going yachts.
- Obtain estimates of abundance by dedicated field survey.

13.2 Management

- Prompt and efficient responses to live single and mass strandings and entanglements, as directed by the importance of opportunistic biological studies and welfare considerations.
- Ensure dead specimens are made available to appropriate scientific museums.
- Encourage compliance by IWC member states with commission recommendation to report all incidental captures.
- Monitor development of fisheries directed at pelagic squid, possibly important in the diet of *G. macrorhynchus*.

14. Organisations responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
No current projects targeting this species.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research

No, requires:

- A national program for the investigation of cetacean strandings, possibly based on the ANCA National Strandings and Sightings Database.
- A Stranding Investigation Fund for each state and the Northern Territory, possibly with joint contributions by the Federal Government and each state / Northern Territory government. (Alternatively, a central contingency fund, from which an average core cost of investigating each stranding event could be reimbursed to the agency, organisation and / or individual involved, on submission of a full stranding report to ANCA).
- A national program of cetacean survey which, although directed at species of concern, should include *Globicephala* spp. and all other little known species. Would require preparation of a first-class field identification guide covering all Australasian species.

16.2 Management

Yes, but limited, requires:

- See 13.2.

17. Remarks

Relatively few stranding events in Australia—to 1994, Western Australia (2), South Australia (8), Tasmania (1), New South Wales (3), Queensland (3), Northern Territory (5, ID unconfirmed). Possibly reflects some observer bias and previous confusion with *G. melas* in more southern parts of range.

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Irrawaddy dolphin*

1. Family	Delphinidae
2. Scientific name	*Orcaella brevirostris*
3. English name(s)	Irrawaddy dolphin

4. Taxonomic status, including species and subgroups

First use of *Orcaella* was by Gray in 1866, in redescription of animal described by Owen the previous year. Only one species recognised. Phylogenetic status confused until recently when both genetic and morphologic evidence suggest closest affinities with Delphinidae and distinction from the externally similar Monodontidae.

5. Species survival status

5.1 Australian Action Plan status
Insufficiently known (K)

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration

Occurs (coastally) from the Bay of Bengal, through the Indo–Malay Archipelago to northern Australia; mainly coastal but in some places up rivers (e.g. Mandalay, Burma, and Lake Murray, PNG). In Australia, reported in Western Australia north of and

including Broome (18°S), Northern Territory, and in Queensland, north of Gladstone (23°50'S). Limited seasonal migration in Mekong River, Kampuchea.

7. Habitat

7.1 General
Coastal, estuarine, riverine. Tropical and subtropical. In shallow areas, may occur several km from shore.

7.2 Key localities
None yet known in Australian waters.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview
(data from south-east Asia)

9.1 Growth and age

Birth, weight/length:	12.3 kg/0.96 m**
Weaning, age/length:	2 years**/? m
Physical maturity, age/length:	not known
Weight, maximum:	not known
Age, maximum:	28 years
Length, maximum:	2.75 m (male), 2.32 m (female)

9.2 Reproduction

Sexual maturity, age/length:	not known/ca 2 m?
Calving interval:	not known
Mating season:	March–June (at 11°–12°N), April–June (at 0°–1°S)
Gestation:	14 months**
Calving season:	at least August–September
Calving area(s):	none known in Australian waters, near-term foetus and neonate recorded from Townsville

9.3 Diet
Data from analyses of stomach contents. Feeds on teleosts, cephalopods and crustaceans. Demersal, benthic and water column species taken.

9.4 Behaviour

Usually in groups of <6, occasionally in groups of up to 15. Mean group sizes observed in aerial surveys off Northern Territory 1.93 (n=27) dry season; 1.77 (n=43) wet season. No data on sex differences in group formation, or on social behaviour. Only clicks recorded—no whistles reported to date. Dominant frequency at about 60 kHz with no evidence of bifrequency sonar behaviour in river populations. Capacity for echolocation not demonstrated. Usually make short dives (30–60 sec), but can stay submerged for up to 12 minutes.

9.5 Mortality and pathology
Is known to strand.

9.6 Population abundance and rates of change
Minimum estimate for areas surveyed off Northern Territory 1227 ± 301, but uncorrected for animals below surface. No estimates of population rate of change.

10. Threats

10.1 Past
- Aboriginal hunting.
- Live capture for oceanaria in Queensland.

10.2 Current
- Incidental capture in shark-nets, barramundi nets.
- Overfishing of prey species.

10.3 Potential
- Pollution (organochlorines, particularly PCBs) a serious potential threat because of the species' inshore nature.
- Presumed habitat destruction and degradation, including noise pollution and harassment, particularly close to major cities (e.g. Cairns) and resort developments.
- Epizootics: marine mammals very susceptible to pathogen-induced mass mortalities.

11. Conservation objectives

11.1 Research
- Monitor abundance, especially in key areas, to determine possible impact of threats, e.g. pollutants, habitat degradation.
- Determine levels of pollutants in Irrawaddy dolphins and prey fish species to assess possible impact in different areas.
- Study habitat requirements to assess impacts of degradation.
- Derive a relationship between aerial survey estimates and absolute abundance to allow absolute abundance to be estimated and monitored.
- Compare genetics and morphology between Australian and other regions in order to assess taxonomic status of Australian animals.
- Establish life history parameters for Australian *Orcaella* to allow better interpretation of populations trends and effects of threats.

11.2 Management
- Ensure regular population monitoring throughout Australia to detect possible decreases in numbers.
- Minimise possible detrimental effects, e.g. water quality.
- Help ensure adequate stocks of dolphins' prey by contributing to fisheries management discussions.
- Netting closure or controls, where needed.

12. Conservation actions already initiated

12.1 Research

- Aerial surveys off Northern Territory coastline (W Freeland, Conservation Commission, Northern Territory).
- Aerial surveys through Great Barrier Reef Region—adjunct to dugong aerial surveys—H Marsh et al., James Cook University).
- Carcass salvage off Townsville and preliminary study of life history (H Marsh et al., James Cook University).
- Morphological variation and osteology of *O. brevirostris* along central Queensland coast (P Arnold, Museum of Tropical Queensland and G Heinsohn, James Cook University).

12.2 Management

- Legal protection under the *Whale Protection Act 1980* in the Australian EEZ and state and Northern Territory waters.
- Funding for aerial surveys—Great Barrier Reef Marine Park Authority, Queensland Fish Management Authority and Northern Territory Conservation Commission.

13. Conservation actions required

13.1 Research

- Using aerial survey, establish baseline estimate for minimum population in Australia, identify areas of highest density along the Australian coastline and monitor trends in population estimate.
- Determine relationship between baseline estimates from aerial survey and absolute abundance by developing correction factors based on proportion of time for which animals are available for sighting.
- Determine levels of pollutants occurring in populations in key areas, using biopsy of free-ranging animals.
- Determine level of genetic interchange between local populations in Australia and populations elsewhere in range.
- Determine causes of death of stranded animals, relate pollutant levels to those in key areas.
- Improve reporting of catches and carcass salvage of dolphins in inshore nets, especially shark nets off Queensland, including at least identifying animals to species.
- Determine habitat requirements.
- Establish basic life history parameters for animals in Australian waters from carcass salvage and specimens already collected and awaiting study.

13.2 Management

- Monitor watershed management, including effects on habitat and important prey species.
- Fisheries management should allow for requirements of upper predators (i.e. sharks, dolphins).
- Minimise incidental captures by closing or controlling netting in some areas.
- Initiate education programs on status of inshore dolphins.
- Ensure specimens available for appropriate scientific museums.

14. Organisation(s) responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA

(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
None.

16. Can research and management be carried out with existing resources? If no, what is required?
Planning for the conservation of *O. brevirostris* in Australian waters is required. Much of its range in Queensland is covered by the Great Barrier Reef Marine Park; the possibilities for management in Queensland waters are therefore good. Most management will relate to water quality and maintenance of fish stocks. Strategic planning for research, listed above, is also required. For example, monitoring will require commitment to fund aerial surveys over decades and can be linked to other inshore dolphins, e.g. *S. chinensis* and *T. truncatus*.

16.1 Research
No, requires:
- Coordinating and collating data from surveys dedicated to other marine species: one research assistant, one year minimum.
- Program to investigate pollutant loads in free-ranging animals: one biologist working in one area,* one year minimum.
- Carcass salvage.
- Program to investigate time budgets of animals in different areas, to assess relative importance of feeding/foraging in different areas:* one biologist working in two areas, one year minimum.
- Program to investigate genetic segregation between populations:* one biologist, two year minimum.

16.2 Management
No, requires:
- Federal/state working group to be formed to oversee environmental management of inshore habitats in northern Australia and monitor abundance of *Orcaella* and *Sousa*.

17. Remarks
Very little is known about the biology of Irrawaddy dolphins. As industrial development, mining, fishing, farming, urban development and tourism in northern Australia increase, so too will the impact on these animals. Australia is the only 'first world' country in this species' range and in many other countries it is under threat. It is vital that Australia takes a leading role in this species' conservation.

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Shepherd's beaked whale

1. Family	Ziphiidae
2. Scientific name	*Tasmacetus shepherdi*
3. English name(s)	Shepherd's beaked whale, Tasman beaked whale

4. Taxonomic status, including species and subgroups
Described by Oliver in 1937. Well defined taxon; no subspecies recognised.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, because of insufficient information (NCA (a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration
Possibly circumpolar in mid-latitudes of the southern hemisphere from 33° to 50°S. Known from only 19 stranded specimens and two unconfirmed sightings, mostly from New Zealand, elsewhere from Australia (South Australia, Western Australia), Tristan da Cunha, Argentina and Chile.

7. Habitat

7.1 General
Apparently prefers subantarctic (ca 1–8°C) and adjacent temperate (ca 10–20°C) deep oceanic waters. Possible northward movement in summer, approaching continental seas.

7.2 Key localities
None known in Australian waters.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone
(= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (mainly New Zealand data)

9.1 Growth and age

Birth, weight/length:	not known
Weaning, age/length:	not known
Physical maturity, age/length:	not known
Weight, maximum:	ca 2–2.5 tonnes
Age, maximum:	not known
Length, maximum:	7.10 m (male), 6.60 m (female)

9.2 Reproduction

Sexual maturity, age/length:	not known
Calving interval:	not known
Mating season:	not known
Calving season:	not known
Gestation:	not known
Calving areas:	none known

9.3 Diet

Little known. Rows of sturdy functional teeth in both jaws suggest that *Tasmacetus* is more piscivorous than other ziphiids. The bulk of the stomach contents of one Argentine specimen consisted of otoliths of an unidentified brotulid fish, an un-identified serranid and *Merluccius hubbsi*. Other remains, of a small crab *Peltarion spinulosum* (which occurs in near-shore waters to 77 fathoms), and one small squid beak were possibly the prey of ingested fish.

9.4 Behaviour

Two unconfirmed near-shore sightings, of a lone individual in New Zealand and a group of three in Western Australia. These animals showed their beaks when breathing; the blow inconspicuous. A powerful and active predator, presumed to be able to dive deeply in pursuit of prey. The precise function of the pair of V-shaped throat grooves (a feature of ziphiids) is unknown, but their arrangement suggests a capacity for distension which may facilitate passage of large whole prey down the oesophagous past the aryteno-epiglottideal tube.

9.5 Mortality and pathology

One New Zealand specimen (holotype) showed evidence of severe osteomyelitis of the lumbar vertebrae. No gross indications of pathology or parasites have been reported from other specimens.

9.6 Population abundance and rates of change

Not known.

10. Threats

10.1 Past

- None known.

10.2 Current

- Possible entanglement in drift-nets and other nets set, lost or discarded in international waters.

10.3 Potential

- Competition from expanding commercial fisheries in higher latitudes.
- Pollution leading to accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research

In the event of strandings or incidental captures:

- Contribute to existing data on biological parameters, including species-specific external characteristics.
- Assess degree of biological threat posed by pollutants.

11.2 Management

- Increase international efforts to ameliorate and/or remove possible current and potential threats.

12. Conservation actions already initiated

12.1 Research

- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which outline scientific objectives and appropriate biological/veterinary research activities.
- Development of state and national strandings and sightings databases (some state museums; some state wildlife agencies; ANCA), to preserve and consolidate data for analysis.
- Opportunistic investigation of strandings, research on museum material by G Ross (ABRS), A Baker (DoC) and review of data on colour pattern by G Ross (ABRS).

12.2 Management

- Protection under federal and state laws.
- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which define management objectives and outline appropriate logistical responses by participating organisations and individuals.
- Development of international objectives and agreements (CITES, CMS, IWC) to protect cetaceans and marine environments.

13. Conservation actions required

13.1 Research

- Maximise basic biological information gained from strandings by improving the speed and efficiency of reporting, scientific response, salvage and lodgement of taxonomic materials in relevant museums.
- Conduct follow-up investigations of taxonomic and genetic material, organ systems and stomach contents, health status including parasites, and pollutants in body tissues.
- Develop field identification materials to improve accuracy of reporting encounters with ziphiids, which are difficult to differentiate to species.
- Obtain information on distribution via platforms of opportunity, e.g. observers on oceanographic research vessels and ANARE resupply vessels, and by developing a wide network of voluntary observers, possibly involving merchant vessels, fishing vessels, spotter aircraft and ocean-going yachts.
- Obtain estimates of abundance by dedicated field survey, e.g. by expansion of IWC whale sighting cruises.

13.2 Management

- Prompt and efficient responses to live single and mass strandings and entanglements, as directed by the importance of opportunistic biological studies and welfare considerations.
- Ensure dead specimens are made available to appropriate scientific museums.
- Encourage compliance by IWC member states with commission recommendation to report all incidental captures.
- Monitor development of fisheries directed at pelagic squids, possibly important in the diet of *Tasmacetus.*

14. Organisations responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
No current projects targeting this species.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No, requires:
- A national program for the investigation of cetacean strandings and incidental captures, possibly based on the ANCA National Strandings and Sightings Database.
- A Stranding Investigation Fund for each state and the Northern Territory, possibly with joint contributions by the Federal Government and each state / Northern Territory government. (Alternatively, a central contingency fund, from which an average core cost of investigating each stranding event could be reimbursed to the agency, organisation and / or individual involved, on submission of a full stranding report to ANCA).
- A national program of cetacean survey which, although directed at species of concern, should include ziphiids and all other little known species. Would require preparation of a first-class field identification guide covering all Australasian species.

16.2 Management
Yes, but limited, requires:
- See 13.2.

17. Remarks
Known from few strandings, mainly in New Zealand (12 events), Australia (3), Tristan da Cunha (2), Argentina (3), Chile (1).

Selected references

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Arnoux's beaked whale

1. Family	Ziphiidae
2. Scientific name	*Berardius arnuxii*
3. English name(s)	Arnoux's beaked whale

4. Taxonomic status, including species and subgroups

Described by Duvernoy in 1851 as *Berardius arnuxii.* No subgroups known, but northern sibling species *Berardius bairdii* Stejneger possibly only subspecifically distinct.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, but possibly secure (NCA (b)).

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix I

6. Distribution, including migration

Circumglobal in southern hemisphere only, south of about 34°S to the Antarctic ice edge; uncommon in continental seas. Strands quite frequently on New Zealand coasts, but only three strandings in Australia—in Western Australia, South Australia and Tasmania—and possible sightings inshore off South Australia and south coast of New South Wales. Strandings in Australasian region occur in summer, suggesting a seasonal movement to vicinity of continental slope. Most sightings at sea are from the Tasman Sea and around the Albatross Cordillera in the South Pacific Ocean.

7. Habitat

7.1 General
Occurs widely within temperate (ca 10–20°C), subantarctic (ca 1–8°C) and Antarctic (ca 0–5°C) deep oceanic waters, particularly in the vicinity of sea mounts and submarine escarpments which generally are regions of higher prey densities.

7.2 Key localities
None known in Australian waters.

8. Marine protected areas managed for or relevant to the species

All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (New Zealand and Australian data, and comparisons with *B. bairdii*)

9.1 Growth and age

Birth, weight/length:	? kg/estimate 4.0 m as for *B. bairdii*	
Weaning, age/length:	not known	
Physical maturity, age/length:	estimate 20 years *B. bairdii*/ca 9 m	as for
Weight, maximum:	ca 8.5 tonnes	
Age, maximum:	estimate 50+ years	as for *B. bairdii*
Length, maximum:	9.34 m (male), 9.33 m, but possibly ca 10 m (female)	

9.2 Reproduction

Sexual maturity, age/length:	estimate 8–10 for *B. bairdii*/ ca 8.5 m (male), ca 9.0 m (female)	years as
Calving interval:	not known	
Mating season:	not known	
Calving season:	not known	
Gestation:	estimate 17 months as for *B. bairdii*	
Calving areas:	none known for Australian waters	

9.3 Diet

Little known. The stomach of one New Zealand specimen contained a large quantity of cephalopod beaks, identified as 'the common sea spider or octopus'. The northern hemisphere *B. bairdii* feeds on mid- and deep-water squids, octopus and fishes, but also takes pelagic fishes such as mackerel, sardines, pollack and saury.

9.4 Behaviour

Gregarious, often in groups of 6–10 (possible sightings of groups of 2–16 off south coast of New South Wales and of lone animal off South Australia) and occasionally up to 50 or more; one group of about 80 was observed to split up into subgroups of 8–15, which dispersed. Very shy of vessels. A powerful and active predator, but the mode of capture is not known. Capable of deep dives of ca 15–30 minutes' duration and possibly to at least 1000m; capable of much longer submersion, rising at distances of 6.5 km. In one encounter whales swam at ca 4 knots, frequently changing direction. Typically, rear of back and tail stock arched for terminal dive of a breathing sequence, flukes not shown. Breaching observed on several occasions. Adults of both sexes have erupted teeth, consisting of two pairs at the tip of the lower jaw, which are possibly used as weapons during agonistic encounters, resulting in heavy scarring of older animals. A few small supernumerary teeth have been noted in some individuals. Lacking functional gripping teeth, e.g. as in *Tasmacetus*, prey may be seized and disabled using the hard edges of the mandibles and

the rostral palate. The precise function of the pair of V-shaped throat grooves (a feature of ziphiids) is unknown, but their arrangement suggests a capacity for distension which may facilitate passage of larger whole prey down the oesophagous past the aryteno-epiglottideal tube.

9.5 Mortality and pathology

Little known, but presumed to carry cyamids, diatoms, barnacles, nematodes, cestodes and trematodes, as does *B. bairdii*. Presumably subject to attacks by killer whales (estimated to cause 40% of scarring on *B. bairdii*). Does not commonly strand. Occasionally trapped in pools within forming sea ice adjacent to the Antarctic continent.

9.6 Population abundance and rates of change

No information available about population size, possible sub-populations, or trends in numbers.

10. Threats

10.1 Past

- None known.

10.2 Current

- Possible entanglement in drift-nets and other nets set, lost or discarded in international waters.

10.3 Potential

- Competition from expanding commercial fisheries, particularly in higher latitudes.
- Pollution leading to accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research

- Establish basic biological parameters.
- Establish seasonal variation in distribution in relation to reproductive parameters.
- Assess degree of biological threat posed by pollutants.
- Improve definition of range in relation to oceanographic parameters and season.
- Estimate abundance.

11.2 Management

- Increase international efforts to ameliorate and/or remove current and potential threats.

12. Conservation actions already initiated

12.1 Research

- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which outline scientific objectives and appropriate biological/veterinary research activities.
- Development of state and national strandings and sightings databases (some state museums; some state wildlife agencies; ANCA) to preserve and consolidate data for analysis.
- Opportunistic investigation of strandings and research on museum material by J Bannister (c/- WA Museum), G Ross (ABRS) and A Baker (DoC, NZ).

12.2 Management

- Protection under federal and state laws.

- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which define management objectives and outline appropriate logistical responses by participating organisations and individuals.
- Development of international objectives and agreements (CITES, CMS, IWC) to protect cetaceans and marine environments.

13. Conservation actions required

13.1 Research

- Maximise basic biological information gained from strandings and incidental captures by improving the speed and efficiency of reporting, scientific response, salvage and lodging of taxonomic materials in relevant museums.
- Conduct follow-up investigations of taxonomic and genetic material, organ systems and stomach contents, health status including parasites, and pollutants in body tissues.
- Develop field identification materials to improve accuracy of reporting encounters with ziphiids, which are difficult to differentiate to species on external characteristics.
- Obtain information on distribution via platforms of opportunity, e.g. observers on oceanographic research vessels and Antarctic Division resupply vessels, and by developing a wide network of voluntary observers, possibly involving merchant vessels, fishing vessels, spotter aircraft and ocean-going yachts.
- Obtain estimates of abundance by dedicated field survey, e.g. by expansion of IWC whale sighting cruises.

13.2 Management

- Prompt and efficient responses to live single and mass strandings, and entanglements, as directed by the importance of opportunistic biological studies and welfare considerations.
- Ensure dead specimens are made available to appropriate scientific museums.
- Continued development of international policy and negotiation of agreements to conserve the living resources of the sea, including cetaceans.
- Encourage compliance by IWC member states with commission recommendation to report all incidental captures.
- Monitor development of fisheries directed at pelagic squid, possibly important in the diet of *B. arnuxii.*

14. Organisations responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
No current projects targeting this species.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No, requires:

- A national program for the investigation of cetacean strandings and incidental captures, possibly based on the ANCA National Strandings and Sightings Database.
- A Stranding Investigation Fund for each state and the Northern Territory, possibly with joint contributions by the Federal Government and each state / Northern Territory

government. (Alternatively, a central contingency fund, from which an average core cost of investigating each stranding event could be reimbursed to the agency, organisation and / or individual involved, on submission of a full stranding report to ANCA).
- A national program of cetacean survey which, although directed at species of concern, should include ziphiids and all other little known species. Would require preparation of a first-class field identification guide covering all Australasian species.

16.2 Management
Yes, but limited, requires:
- See 13.2.

17. Remarks
Few stranding events in Australia (3 to 1994) compared with New Zealand (49), possibly because the latter is within a region of preferred habitat.

Selected references

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Longman's beaked whale

1. Family	Ziphiidae
2. Scientific name	*Mesoplodon pacificus*
3. English name(s)	Longman's beaked whale

4. Taxonomic status, including species and subgroups
Described by Longman in 1926. Taxonomic status is uncertain. Was placed in a separate genus, *Indopacetus,* by Moore in 1968, but conservative view of most systematists is to retain *pacificus* within *Mesoplodon.*

5. Species survival status

5.1 Australian Action Plan status
No category assigned, because of insufficient information (NCA (a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration

Known only from two stranding records, at Mackay, Queensland in 1882 and Danane, Somalia in 1955. The taxon may be limited to low latitudes of the Indian and South Pacific oceans and apparently avoids coastal seas. A sighting of two large-beaked whales off the Seychelles in 1980 was possibly of this species.

7. Habitat

7.1 General

Apparently restricted to tropical (ca 22–32°C) deep oceanic waters.

7.2 Key localities

None known in Australian waters.

8. Marine protected areas managed for or relevant to the species

All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview

9.1 Growth and age

Birth, weight/length:	not known
Weaning, age/length:	not known
Physical maturity, age/length:	not known
Weight, maximum:	not known
Age, maximum:	not known
Length, maximum:	estimate ca 7.5 m, based on skull length (Mackay specimen)

9.2 Reproduction

Sexual maturity, age/length:	not known
Calving interval:	not known
Mating season:	not known
Calving season:	not known
Gestation:	not known
Calving areas:	none known

9.3 Diet

By analogy with other ziphiids, presumed to consist of mid- and deep-water squids and fishes.

9.4 Behaviour

Nothing known. By analogy with other ziphiids, presumed to be capable of deep dives in pursuit of prey. Presumed that only adult males have functional teeth, consisting of one pair at the tip of the lower jaw, possibly used as weapons during agonistic encounters.

9.5 Mortality and pathology

Not known.

9.6 Population abundance and rates of change

Not known.

10. Threats

10.1 Past
- None known.

10.2 Current
- Possible entanglement in drift-nets and other nets set, lost or discarded in international waters at low latitudes.

10.3 Potential
- Pollution leading to accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research
- Maximise possibility of obtaining an intact specimen

Consequent upon obtaining an intact specimen:
- Establish species-specific external characteristics.
- Maximise biological data obtained.
- Assess degree of biological threat posed by pollutants.
- Maximise opportunities for cetacean field surveys in tropical oceanic waters to improve definition of range in relation to oceanographic parameters, investigate seasonal variation in relation to latitude, and establish indices of abundance.

11.2 Management
- Increase international efforts to ameliorate and/or remove possible current and potential threats to ziphiids in tropical regions.

12. Conservation actions already initiated

12.1 Research
- Preparation of National Stranding Contingency Plan (1982), which outlines scientific objectives and appropriate biological/veterinary research activities.

12.2 Management
- Protection under federal and state laws.
- Preparation of National Stranding Contingency Plan (1982), which defines management objectives and outlines appropriate logistical responses by participating organisations and individuals.
- Development of international objectives and agreements (CITES, CMS, IWC) to protect cetaceans and marine environments.

13. Conservation actions required

13.1 Research
- Investigate all reports of stranded ziphiids in northern Australia.

Consequent upon obtaining an intact specimen:
- Maximise salvage of biological materials and information to be gained.
- Conduct follow-up investigations of taxonomic and genetic material, organ systems and stomach contents, health status including parasites, and pollutants in body tissues.
- Prepare and disseminate field identification materials, to provide means of recognising this ziphiid and facilitate reporting future encounters.
- Obtain information on distribution via platforms of opportunity, e.g. observers on oceanographic research vessels, and by developing a wide network of voluntary

observers, possibly involving merchant vessels, fishing vessels, spotter aircraft and ocean-going yachts.

13.2 Management

- Prompt and efficient responses to live single and mass strandings, and entanglements, as directed by the importance of opportunistic biological studies and welfare considerations.
- Encourage compliance by IWC member states with commission recommendation to report all incidental captures of ziphiids in tropical waters.

14. Organisations responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
No current projects targeting this species.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No, requires:

- A national program for the investigation of cetacean strandings and incidental captures, in which emphasis is placed on the northern coasts to increase probability of locating an intact specimen.
- See 13.1.

16.2 Management
Yes, but limited, requires:

- See 13.2.

17. Remarks
The least-known of all living cetaceans.

Selected references

Baker, A (1990). *Whales and Dolphins of Australia and New Zealand: An Identification Guide.* Victoria University Press, Wellington, New Zealand.

Klinowska, M (1991). *Dolphins, Porpoises and Whales of the World: The IUCN Red Data Book.* IUCN, Gland and Cambridge.

Leatherwood, S and Reeves, R R (1983). *The Sierra Club Handbook of Whales and Dolphins.* Sierra Club Books, San Francisco.

Blainville's beaked whale

1. Family	Ziphiidae
2. Scientific name	*Mesoplodon densirostris*
3. English name(s)	Blainville's beaked whale, dense-beaked whale

4. Taxonomic status, including species and subgroups
Described by de Blainville in 1817 as *Delphinus densirostris.* No subspecies recognised.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, because of insufficient information (NCA (a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration
Oceanic and circumglobal in low to mid-latitudes in all oceans in both hemispheres. Recorded from the northern Tasman Sea. Stranding records from northern and southern Australia (at 40°50'S in Tasmania) except in South Australia and Northern Territory, but data insufficient to infer seasonal occurrence or migration. Strandings on western and eastern coasts may be linked to south-flowing warm currents, i.e. Leeuwin and East Australian currents, respectively. A specimen stranded at Macquarie Island (54°30'S) was apparently a vagrant far beyond the supposed normal range.

7. Habitat

7.1 General
Apparently prefers tropical (ca 22–32°C) to temperate (ca 10–20°C) oceanic regions; sighted in waters 700–1000 m deep, adjacent to much deeper waters of 5000 m.

7.2 Key localities
None known in Australian waters.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview
(mainly South African data)

9.1 Growth and age

Birth, weight / length:	_60 kg / (1.9 m largest foetus), estimate < 2.4 m
Weaning, age / length:	not known
Physical maturity, age / length:	ca 8–9 years / ca 4.5 m
Weight, maximum:	ca 1 tonne

Age, maximum:	not known
Length, maximum:	5.8 m, possibly ca 6.4 m (male), 4.71 m (female)

9.2 Reproduction

Sexual maturity, age / length:	ca 8–9 years / ca 4.5 m
Mating season:	infer summer
Calving interval:	not known
Calving season:	possibly late summer–autumn
Gestation:	not known
Calving areas:	none known for Australian waters

9.3 Diet

Little known, appears to consist of mid- and deep-water squid and fish. The stomach of one South African specimen contained 21 fish otoliths, most of *Lampanyctus*, plus few *Scopelogadus* and *Cepola*(?), and another contained single beaks of the squids *Todarodes sagittatus* and *Octopoteuthis* sp.

9.4 Behaviour

Groups of three to seven reported off Hawaii; four to six off Point Lookout, Queensland. Generally wary of vessels. Presumed to actively pursue prey, but the mode of capture is not known; apparently capable of deep dives. Only adult males have functional teeth, consisting of a single pair which erupt from a prominence near the middle of the lower jaw and which appear to be used as weapons during agonistic encounters, leading to heavy scarring of older males; scarring of females suggests vigorous intersexual behaviour, possibly active herding by males during breeding period. Lacking functional gripping teeth, prey may be seized and disabled using the hard edges of the mandibles and the rostral palate. The precise function of the pair of V-shaped throat grooves (a feature of ziphiids) is unknown, but their arrangement suggests a capacity for distension which may facilitate passage of larger whole prey down the oesophagous past the aryteno-epiglottideal tube.

9.5 Mortality and pathology

Strandings uncommon. Prone to superficial wounding by feeding cookie-cutter sharks (*Isistius* sp.), especially on flanks and ventrum; possibly vulnerable to predation by killer and false killer whales. Internal parasites include nematodes *Anisakis* sp. and acanthocephalan *Bolbosoma vasculosum* in stomach and intestine. Two vaginal fibromas were noted in a stranded female.

9.6 Population abundance and rates of change

Unknown.

10. Threats

10.1 Past

- None known.

10.2 Current

- Unreported incidental captures in fisheries.

- Possible entanglement in drift-nets and other nets lost or discarded in international waters.

10.3 Potential

- Competition from expanding commercial fisheries, especially on pelagic squid at lower latitudes.
- Pollution leading to accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research

- Establish basic biological parameters and improve knowledge of species-specific external characteristics.
- Establish seasonal variation in distribution in relation to reproductive parameters.
- Assess degree of biological threat posed by pollutants.
- Improve definition of range in relation to oceanographic parameters and season
- Establish indices of abundance.

11.2 Management

- Increase international efforts to ameliorate and/or remove possible current and potential threats.

12. Conservation actions already initiated

12.1 Research

- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which outline scientific objectives and appropriate biological/veterinary research activities.
- Development of state and national strandings and sightings databases (some state museums; some state wildlife agencies; ANCA), to preserve and consolidate data for analysis.
- Opportunistic investigation of strandings and research on museum material by J Bannister (c/- WA Museum), J Dixon (Museum of Victoria), C Kemper (SA Museum), R Paterson (Queensland Museum), G Ross (ABRS), R Warneke (marine mammal consultant), A Baker (DoC, NZ).

12.2 Management

- Protection under federal and state laws.
- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which define management objectives and outline appropriate logistical responses by participating organisations and individuals.
- Development of international objectives and agreements (CITES, CMS, IWC) to protect cetaceans and marine environments.

13. Conservation actions required

13.1 Research

- Maximise basic biological information gained from strandings and incidental captures, by improving the speed and efficiency of reporting, scientific response, salvage and lodging of taxonomic materials in relevant museums.
- Conduct follow-up investigations of taxonomic and genetic material, organ systems and stomach contents, health status including parasites, and pollutants in body tissues.
- Develop field identification materials to improve accuracy of reporting encounters with *Mesoplodon* species, which are difficult to differentiate to species.

- Obtain information on distribution via platforms of opportunity, e.g. observers on oceanographic research vessels, and by developing a wide network of voluntary observers, possibly involving merchant vessels, fishing vessels, spotter aircraft and ocean-going yachts.
- Obtain estimates of abundance by dedicated field survey, e.g. by expansion of IWC whale sighting cruises.

13.2 Management

- Prompt and efficient responses to live strandings and entanglements, as directed by the importance of opportunistic biological studies and welfare considerations.
- Ensure dead specimens are made available to appropriate scientific museums.
- Encourage compliance by IWC member states with commission recommendation to report all by-catches.
- Monitor development of fisheries directed at pelagic squid, possibly important in the diet of *M. densirostris.*

14. Organisations responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
No current projects targeting this species.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research

No, requires:

- A national program for the investigation of cetacean strandings and incidental captures, possibly based on the ANCA National Strandings and Sightings Database.
- A Stranding Investigation Fund for each state and the Northern Territory, possibly with joint contributions by the Federal Government and each state / Northern Territory government. (Alternatively, a central contingency fund, from which an average core cost of investigating each stranding event could be reimbursed to the agency, organisation and / or individual involved, on submission of a full stranding report to ANCA).
- A national program of cetacean survey which, although directed at species of concern, should include ziphiids and all other little known species. Would require preparation of a first-class field identification guide covering all Australasian species.

16.2 Management

Yes, but limited, requires:

- See 13.2.

17. Remarks

Possibly the most widely distributed species of *Mesoplodon.* Strands quite frequently in South Africa (ca 40 events in 20 years). Fewer stranding events in Australia (to 1994), possibly because of low observer effort along northern coasts—Western Australia (1),

Victoria (1), Tasmania (1), New South Wales (1), Queensland (7), Northern Territory (nil), and one at Lord Howe Island.

Selected references

Baker, A (1990). *Whales and Dolphins of Australia and New Zealand: An Identification Guide.* Victoria University Press, Wellington, New Zealand.

Klinowska, M (1991). *Dolphins, Porpoises and Whales of the World: The IUCN Red Data Book.* IUCN, Gland and Cambridge.

Leatherwood, S and Reeves, R R (1983). *The Sierra Club Handbook of Whales and Dolphins.* Sierra Club Books, San Francisco.

Mead, J G (1989). Beaked whales of the genus *Mesoplodon.* In: *Handbook of Marine Mammals Vol. 4: River Dolphins and the Larger Toothed Whales.* Ridgway, S H and Harrison, R (Eds). Academic Press, London, pp. 349–430.

Ross, G J B (1984). The smaller cetaceans of the south-east coast of Southern Africa. *Ann Cape Prov Mus (Nat Hist)* **15**(2): 173–410.

Strap-toothed beaked whale

1. Family	Ziphiidae
2. Scientific name	*Mesoplodon layardii*
3. English name(s)	Strap-toothed beaked whale, strap-toothed whale, Layard's beaked whale

4. Taxonomic status, including species and subgroups

Formally described by Gray in 1865 as *Ziphius layardii.* No subspecies recognised.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, but possibly secure (NCA (b))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration

Southern hemisphere only. Circumpolar between ca 25°S and 60°S, based on some sightings, but mainly on reports of strandings in South Africa, South America, New Zealand and in Australia (all states except Northern Territory, but most have been on the southern and eastern coasts); also from Macquarie and Heard Islands. Occurrences south of 38°S throughout the year; occurrences north of 38°S appear seasonal. Majority of strandings in Australia occur from January to April, indicating a seasonal influx during mid- to late summer.

7. Habitat

7.1 General

Apparently prefers deep oceanic waters of temperate (ca 10–20°C) to subantarctic (ca 1–8°C) regions. May seasonally feed in zones of higher productivity adjacent to the continental slope as well as using adjacent waters for calving.

7.2 Key localities
None known in Australian waters.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (mainly New Zealand and Australian data)

9.1 Growth and age

Birth, weight/length:	? kg/ca 2.2–2.4 m
Weaning, age/length:	? years/ca 3.8 m
Physical maturity, age/length:	? years/ca 5.2 m
Weight, maximum:	ca 2 tonnes
Length, maximum:	6.13 m (male), 6.25 m (female)
Age, maximum:	not known

9.2 Reproduction

Sexual maturity, age/length:	? years/ca 5.0 m
Mating season:	infer summer
Calving season:	summer–autumn
Gestation:	ca 9–12 months
Calving areas:	none known for Australian waters

9.3 Diet
Most of prey items in stomachs of South African specimens were pelagic squid (93.3% by number); the remainder were unidentified fish otoliths and crustaceans. Some of the 14 species of squid recorded occur at great depth. The predominant species were *Histioteuthis* sp. and *Taonius pavo* (48.7 and 16.8% by number, 41.3 and 20.9% by weight, 63.6 and 45.5% by frequency of occurrence, respectively).

9.4 Behaviour
Little known. Occurs singly, in female:calf pairs and in small groups of two or three, which may be all female or include one or two males. Generally wary of ships, either sinking slowly or diving with a lateral roll exposing a flipper, but not the flukes, rising 10–15 minutes later at least 400 m away. Exposes beak when rising to breathe, blow inconspicuous. Only mature males have functional teeth, consisting of a single pair near the middle of the lower jaw, which appear to be used as weapons during agonistic encounters, resulting in heavy scarring of older animals. In older males these teeth arch over the rostrum, restricting the gape, but prey ingested is of similar size to that taken by females and immature males. Probably fast and active in the pursuit of prey, but the mode of capture is not known; apparently capable of deep dives. Lacking functional gripping teeth, prey may be seized and disabled using the hard edges of the mandibles and the rostral palate. The precise function of the pair of V-shaped throat grooves (a feature of

ziphiids) is unknown, but their arrangement suggests a capacity for distension which may facilitate passage of larger whole prey down the oesophagous past the aryteno-epiglottideal tube.

9.5 Mortality and pathology
Individuals of all ages (i.e. relative lengths) strand. Australian records are mostly singletons, but also include female/calf pairs (3 events) and groups of two to three individuals (8 events). Possibly vulnerable to attack by killer whales. Levels of DDT and PCBs in the blubber of a 5.3 m male were 0.96–1.30 and 0.20–0.29 mg/kg, repectively, which is low by comparison with inshore species of cetaceans.

9.6 Population abundance and rates of change
Not known. Possibly seasonally common off southern Australia, based on frequency of strandings.

10. Threats

10.1 Past
- None known.

10.2 Current
- Possible entanglement in drift–nets and other nets set, lost or discarded in international waters.

10.3 Potential
- Competition from expanding fisheries, especially on pelagic squids.
- Pollution leading to accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research
- Establish basic biological parameters and improve knowledge of species-specific external characteristics.
- Establish seasonal variation in distribution in relation to reproductive parameters.
- Assess degree of biological threat posed by pollutants.
- Improve definition of range in relation to oceanographic parameters and season.
- Establish indices of abundance.

11.2 Management
- Increase international efforts to ameliorate and/or remove current and potential threats.

12. Conservation actions already initiated

12.1 Research
- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, outline scientific objectives and appropriate biological/veterinary research activities.
- Development of state and national strandings and sightings databases (some state museums; some state wildlife agencies; ANCA), to preserve and consolidate data for analysis.
- Reviews of stranding series, by J Dixon (Museum of Victoria) and D Nicol (University of Tasmania).
- Opportunistic investigation of strandings and research on museum material by J Bannister (c/- WA Museum), J Dixon (Museum of Victoria), C Kemper (SA Museum), G Ross (ABRS), R Warneke (marine mammal consultant), A Baker (DoC, NZ).

12.2 Management

- Protection under federal and state laws.
- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which define management objectives and outline appropriate logistical responses by participating organisations and individuals.
- Development of international objectives and agreements (CITES, CMS, IWC) to protect cetaceans and marine environments.

13. Conservation actions required

13.1 Research

- Maximise basic biological information gained from strandings and incidental captures by improving the speed and efficiency of reporting, scientific response, salvage and lodging of taxonomic materials in relevant museums.
- Conduct follow-up investigations of taxonomic and genetic material, organ systems and stomach contents, health status including parasites, and pollutants in body tissues.
- Develop field identification materials to improve accuracy of reporting encounters with *Mesoplodon* species, which are difficult to differentiate to species.
- Obtain information on distribution via platforms of opportunity, e.g. observers on oceanographic research vessels and ANARE resupply vessels, and by developing a wide network of voluntary observers, possibly involving merchant vessels, fishing vessels, spotter aircraft and ocean-going yachts.
- Obtain estimates of abundance by dedicated field survey, e.g. by expansion of IWC whale sighting cruises.

13.2 Management

- Prompt and efficient responses to live single and mass strandings and entanglements, as directed by the importance of opportunistic biological studies and welfare considerations.
- Ensure dead specimens are made available to appropriate scientific museums.
- Encourage compliance by IWC member states with commission recommendation to report all incidental captures.
- Monitor development of fisheries directed at pelagic squid, possibly important in the diet of *M. layardii.*

14. Organisations responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
No current projects targeting this species.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research

No, requires:

- A national program for the investigation of cetacean strandings and incidental captures, possibly based on the ANCA National Strandings and Sightings Database.
- A Stranding Investigation Fund for each state and the Northern Territory, possibly with joint contributions by the Federal Government and each state / Northern Territory government. (Alternatively, a central contingency fund, from which an average core

cost of investigating each stranding event could be reimbursed to the agency, organisation and/or individual involved, on submission of a full stranding report to ANCA).
- A national program of cetacean survey which, although directed at species of concern, should include ziphiids and all other little known species. Would require preparation of a first-class field identification guide covering all Australasian species.

16.2 Management
Yes, but limited, requires:
- See 13.2.

17. Remarks
The most commonly stranded ziphiid in Australia—68 events to 1994—on the south coast of Western Australia (5 events), South Australia (27), Victoria (5), Tasmania (13), New South Wales (14), Queensland (4), plus Macquarie Island (2), Heard Island (1). Also strands frequently in New Zealand (58 events to mid-1986).

Selected references

Baker, A (1990). *Whales and Dolphins of Australia and New Zealand: An Identification Guide.* Victoria University Press, Wellington, New Zealand.

Dixon, J (1980). A recent stranding of the Strap-toothed whale, *Mesoplodon layardii* (Gray) (Ziphiidae) from Victoria, and a review of Australian records of the species. *Victorian Nat* **97**(1): 34–41.

Kemper, C M and Ling, J K (1991). Whale strandings in South Australia (1881–1989). *Trans R Soc S Aust* **115**(1): 37–52.

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Nicol, D J (1987). A review and update of the Tasmanian cetacean stranding record to the end of February 1986. *Univ Tasm Environ Working Paper* No. **21**: 1–97.

Ross, G J B (1984). The smaller cetaceans of the south-east coast of southern Africa. *Ann Cape Prov Mus (Nat Hist)* **15**(2): 173–410.

Hector's beaked whale

1. Family	Ziphiidae
2. Scientific name	*Mesoplodon hectori*
3. English name(s)	Hector’s beaked whale

4. Taxonomic status, including species and subgroups
Described by Gray in 1871 as *Berardius hectori.* No subspecies recognised.

5. Species survival status

5.1 Australian Action Plan status

No category assigned, because of insufficient information (NCA (a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration
Southern circumglobal in mid-latitudes, ca 35° to 55°S, and in eastern North Pacific off southern California. Known from strandings in Argentina, Chile, Falkland Islands, South Africa, New Zealand and in Australia from South Australia and Tasmania.

7. Habitat

7.1 General
Apparently prefers subantarctic (ca 1–8°C) and temperate (ca 10–20°C) deep oceanic waters, rarely venturing into continental seas.

7.2 Key localities
None known in Australian waters.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (few data from New Zealand, South Africa and Australia)

9.1 Growth and age

Birth, weight/length:	? kg/ca 1.8 m
Weaning, age/length:	not known
Physical maturity, age/length:	? years/ca 4.0 m
Weight, maximum:	ca 800 kg
Age, maximum:	not known
Length, maximum:	ca 4.5 m

9.2 Reproduction

Sexual maturity, age/length:	? years/ca 4.0 m
Calving interval:	not known
Mating season:	not known
Calving season:	not known
Gestation:	not known
Calving areas:	none known for Australian waters

9.3 Diet
Beaks of *Octopoteuthis deletron* and portion of an unidentified invertebrate were found in the stomach of a stranded animal in California. Diet is presumed to be mainly mid- and deep-water squid and some fish.

9.4 Behaviour
Presumed to actively pursue prey, but the mode of capture is not known; possibly capable of deep dives. Only adult males have functional teeth, consisting of one pair near the tip

of the lower jaw, which appear to be used as weapons during agonistic encounters. Lacking functional gripping teeth, prey may be seized and disabled using the hard edges of the mandibles and the rostral palate. The precise function of the pair of V-shaped throat grooves (a feature of ziphiids) is unknown, but their arrangement suggests a capacity for distension which may facilitate passage of larger whole prey down the oesophagous past the aryteno-epiglottideal tube.

9.5 Mortality and pathology
Not known. Possibly subject to predation by killer whales.

9.6 Population abundance and rates of change
Not known.

10. Threats

10.1 Past
- None known.

10.2 Current
- Possible entanglement in drift-nets set, lost or discarded in international waters.

10.3 Potential
- Competition from expanding commercial fisheries, especially on pelagic squid.
- Pollution leading to accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research
- Establish basic biological parameters and improve knowledge of species-specific external characteristics.
- Establish seasonal variation in distribution in relation to reproductive parameters.
- Assess degree of biological threat posed by pollutants.
- Improve definition of range in relation to oceanographic parameters and season.
- Establish indices of abundance.

11.2 Management
- Increase international efforts to ameliorate and/or remove possible current and potential threats.

12. Conservation actions already initiated

12.1 Research
- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which outline scientific objectives and appropriate biological/veterinary research activities.
- Development of state and national strandings and sightings databases (some state museums; some state wildlife agencies; ANCA), to preserve and consolidate data for analysis.
- Opportunistic investigation of strandings and research on museum material by J Bannister (c/- WA Museum), J Dixon (Museum of Victoria), C Kemper (SA Museum), G Ross (ABRS), D Thiele (University of Tasmania), R Warneke (marine mammal consultant), A Baker (DoC, NZ).

12.2 Management
- Protection under federal and state laws.

- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which define management objectives and outline appropriate logistical responses by participating organisations and individuals.
- Development of international objectives and agreements (CITES, CMS, IWC) to protect cetaceans and marine environments.

13. Conservation actions required

13.1 Research

- Maximise basic biological information gained from strandings and incidental captures by improving the speed and efficiency of reporting, scientific response, salvage and lodging of taxonomic materials in relevant museums.
- Conduct follow-up investigations of taxonomic and genetic material, organ systems and stomach contents, health status including parasites, and pollutants in body tissues.
- Develop field identification materials to improve accuracy of reporting encounters with *Mesoplodon* species, which are difficult to differentiate to species.
- Obtain information on distribution via platforms of opportunity, e.g. observers on oceanographic research vessels and ANARE resupply vessels, and by developing a wide network of voluntary observers, possibly involving merchant vessels, fishing vessels, spotter aircraft and ocean-going yachts.
- Obtain estimates of abundance by dedicated field survey, e.g. by expansion of IWC whale sighting cruises.

13.2 Management

- Prompt and efficient responses to live single and mass strandings and entanglements, as directed by the importance of opportunistic biological studies and welfare considerations.
- Ensure dead specimens are made available to appropriate scientific museums.
- Encourage compliance by IWC member states with commission recommendation to report all incidental captures.
- Monitor development of fisheries directed at pelagic squids, possibly important in the diet of *M. hectori.*

14. Organisations responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
No current projects targeting this species, but stomach contents from cow and calf to be analysed by D Thiele, University of Tasmania.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No, requires:

- A national program for the investigation of cetacean strandings and incidental captures, possibly based on the ANCA National Strandings and Sightings Database.
- A Stranding Investigation Fund for each state and the Northern Territory, possibly with joint contributions by the Federal Government and each state / Northern Territory

government. (Alternatively, a central contingency fund, from which an average core cost of investigating each stranding event could be reimbursed to the agency, organisation and / or individual involved, on submission of a full stranding report to ANCA).

- A national program of cetacean survey which, although directed at species of concern, should include ziphiids and all other little known species. Would require preparation of a first-class field identification guide covering all Australasian species.

16.2 Management
Yes, but limited, requires:

- See 13.2.

17. Remarks
Few stranding events in Australia to 1994—South Australia (1) and Tasmania (2). Because of the relatively anterior position of the mandibular teeth, may be confused with young *B. arnuxii* or possibly with *M. mirus*.

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Ross, G J B (1984). The smaller cetaceans of the south-east coast of Southern Africa. *Ann Cape Prov Mus (Nat Hist)* **15**(2): 173–410.

Gray's beaked whale

1. Family	Ziphiidae
2. Scientific name	*Mesoplodon grayi*
3. English name(s)	Gray’s beaked whale, Scamperdown whale

4. Taxonomic status, including species and subgroups
Described by von Haast in 1876. No subspecies recognised.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, but possibly secure (NCA (b))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration
Circumglobal at higher latitudes in the southern hemisphere. Widely recorded from strandings in Argentina, Chile, South Africa, New Zealand and Australia, from southern Western Australia to southern New South Wales and including Tasmania, and by sightings in the Indian Ocean, to latitudes as low as 25°S south of Madagascar. Known from the northern hemisphere only by one stranding in the Netherlands, presumably an anomalous vagrant. The majority of strandings occur from December to April, indicating a seasonal movement inshore (and to lower latitudes?), possibly associated with calving and mating.

7. Habitat

7.1 General
Apparently prefers temperate (ca 10–20°C) to subantarctic (ca 1–8°C) oceanic waters, deeper than 1800 m.

7.2 Key localities
None known in Australian waters.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone
(= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (mainly New Zealand, some Australian data)

9.1 Growth and age

Birth, weight/length:	? kg/ca 2.1 m
Weaning, age/length:	ca 1 year/ca 3.6 m
Physical maturity, age/length:	? years/ca 4.5 m
Weight, maximum:	ca 1.5 tonnes
Age, maximum:	not known
Length, maximum:	ca 5.5 m

9.2 Reproduction

Sexual maturity, age/length:	? years/ca 4.5 m
Calving interval:	not known, possibly 2–3 years
Mating season:	not known, possibly summer
Gestation:	not known
Calving season:	late spring–early summer
Calving area(s):	none known for Australian waters

9.3 Diet
Diet assumed to consist of mid- and deep-water squid and fish.

9.4 Behaviour

Little known. Groups of two to three sighted and stranded; larger social aggregations also occur, e.g. mass strandings of 25 individuals in 1875 and of eight in 1982 at the Chatham Islands, New Zealand. When rising to blow, pokes its long snout out of the water. Probably fast and active in pursuit of prey, but mode of capture unknown; apparently capable of deep dives. Both sexes have rows of 17–22 small, slim, conical teeth towards rear of upper jaw, shallow-rooted and apparently of little functional use. Only adult males have fully functional teeth, consisting of a single pair near middle of lower jaw, which appear to be used as weapons during agonistic behaviour, resulting in heavy scarring of older animals. Lacking functional gripping teeth, prey may be seized and disabled using the hard edges of the mandibles and the rostral palate. The precise function of the pair of V-shaped throat grooves (a feature of ziphiids) is unknown, but their arrangement suggests a capacity for distension which may facilitate passage of larger whole prey down the oesophagous past the aryteno-epiglottideal tube.

9.5 Mortality and pathology

Severe osteomyelitis noted in aged, stranded specimens, possibly contributing to death.

9.6 Population abundance and rates of change

No absolute measures of abundance. Frequent strandings suggest *M. grayi* may be common off New Zealand, in the Indian Ocean off southern Western Australia, and off Tasmania.

10. Threats

10.1 Past

- None known.

10.2 Current

- Possible entanglement in drift-nets and other nets set, lost or discarded in international waters.

10.3 Potential

- Competition from expanding commercial fisheries, especially on pelagic squids.
- Pollution leading to accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research

- Establish basic biological parameters and improve knowledge of species-specific external characteristics.
- Establish seasonal variation in distribution in relation to reproductive parameters.
- Assess degree of biological threat posed by pollutants.
- Improve definition of range in relation to oceanographic parameters and season.
- Establish indices of abundance.

11.2 Management

- Increase international efforts to ameliorate and/or remove possible current and potential threats.

12. Conservation actions already initiated

12.1 Research

- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which outline scientific objectives and appropriate biological/veterinary research activities.

- Development of state and national strandings and sightings databases (some state museums; some state wildlife agencies; ANCA), to preserve and consolidate data for analysis.
- Opportunistic investigation of strandings and research on museum material by J Bannister (c/- WA Museum), J Dixon (Museum of Victoria), C Kemper (SA Museum), R Paterson (Queensland Museum), G Ross (ABRS), R Warneke (marine mammal consultant), A Baker (DoC, NZ).

12.2 Management

- Protection under federal and state laws.
- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which define management objectives and outline appropriate logistical responses by participating organisations and individuals.
- Development of international objectives and agreements (CITES, CMS, IWC) to protect cetaceans and marine environments.

13. Conservation actions required

13.1 Research

- Maximise basic biological information gained from strandings and incidental captures by improving the speed and efficiency of reporting, scientific response, salvage and lodging of taxonomic materials in relevant museums.
- Conduct follow-up investigations of taxonomic and genetic material, organ systems and stomach contents, health status including parasites, and pollutants in body tissues.
- Develop field identification materials to improve accuracy of reporting encounters with *Mesoplodon* species, which are difficult to differentiate to species.
- Obtain information on distribution via platforms of opportunity, e.g. observers on oceanographic research vessels and ANARE resupply vessels, and by developing a wide network of voluntary observers, possibly involving merchant vessels, fishing vessels, spotter aircraft and ocean-going yachts.
- Obtain estimates of abundance by dedicated field survey, e.g. by expansion of IWC whale sighting cruises.

13.2 Management

- Prompt and efficient responses to live single and mass strandings, and entanglements, as directed by the importance of opportunistic biological studies and welfare considerations.
- Ensure dead specimens are made available to appropriate scientific museums.
- Encourage compliance by IWC member states with commission recommendation to report all incidental captures.
- Monitor development of fisheries directed at pelagic squids, possibly important in the diet of *M. grayi.*

14. Organisations responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
No current projects targeting this species.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research

No, requires:

- A national program for the investigation of cetacean strandings and incidental captures, possibly based on the ANCA National Strandings and Sightings Database.
- A Stranding Investigation Fund for each state and the Northern Territory, possibly with joint contributions by the Federal Government and each state / Northern Territory government. (Alternatively, a central contingency fund, from which an average core cost of investigating each stranding event could be reimbursed to the agency, organisation and / or individual involved, on submission of a full stranding report to ANCA).
- A national program of cetacean survey which, although directed at species of concern, should include ziphiids and all other little known species. Would require preparation of a first-class field identification guide covering all Australasian species.

16.2 Management

Yes, but limited, requires:

- See 13.2.

17. Remarks

High frequency of strandings in New Zealand (84 events to mid-1986). The second most commonly stranded ziphiid in Australia, 48 events (after *M. layardii*, 67 events)—in southern Western Australia (16), South Australia (8), Victoria (3), Tasmania (14), New South Wales (7).

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Ross, G J B (1984). The smaller cetaceans of the south-east coast of Southern Africa. *Ann Cape Prov Mus (Nat Hist)* **15**(2): 173–410.

Andrews' beaked whale

1. Family	Ziphiidae
2. Scientific name	*Mesoplodon bowdoini*
3. English name(s)	Andrews' beaked whale

4. Taxonomic status, including species and subgroups
Described by Andrews in 1908. No subspecies recognised, but possibly conspecific with, or only subspecifically different from, *M. carlhubbsi* Moore.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, because of insufficient information (NCA (a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration
Majority of records from temperate waters of the South Pacific and Indian oceans. Population centres may be far from land. Few strandings within this range, in Chile and the Falkland Islands, but mainly in New Zealand and in southern Australia, in Western Australia, South Australia, Victoria and New South Wales; one at Macquarie Island in the subantarctic. Most records in spring and summer, possibly related to a movement into warmer coastal waters for calving and mating.

7. Habitat

7.1 General
Apparently prefers deep oceanic waters, possibly in higher latitudes, of temperate region (ca 10–20°C).

7.2 Key localities
None known in Australian waters.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview
(mainly New Zealand data)

9.1 Growth and age

Birth, weight/length:	? kg/est. 1.8 m
Weaning, age/length:	not known
Physical maturity, age/length:	? years/ca 4.3 m
Weight, maximum:	ca 1 tonne
Age, maximum:	not known

Length, maximum:	4.57 m (male), 4.67 m (female)

9.2 Reproduction

Sexual maturity, age/length:	ca 4.3 m (female)
Calving interval:	not known
Mating season:	not known
Calving season:	spring
Gestation:	not known
Calving areas:	none known in Australian waters

9.3 Diet

Little known, assumed to be mid- and deep-water squid and fish.

9.4 Behaviour

An active predator, presumed to be a strong swimmer capable of deep dives in pursuit of prey, but the mode of capture is not known. Only adult males have erupted teeth, consisting of a single pair near the middle of the lower jaw which appear to be used as weapons during agonistic encounters. Lacking functional gripping teeth, prey may be seized and disabled using the hard edges of the mandibles and the rostral palate. The precise function of the pair of V-shaped throat grooves (a feature of ziphiids) is unknown, but their arrangement suggests a capacity for distension which may facilitate passage of larger whole prey down the oesophagous past the aryteno-epiglottideal tube.

9.5 Mortality and pathology

Strands uncommonly. Possibly subject to attack by killer whales.

9.6 Population abundance and rates of change

Unknown.

10. Threats

10.1 Past

- None known.

10.2 Current

- Possible entanglement in drift-nets and other nets set, lost or discarded in international waters.

10.3 Potential

- Competition from expanding commercial fisheries, particularly on pelagic squids in temperate waters.
- Pollution leading to accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research

- Establish basic biological parameters and improve knowledge of species-specific external characteristics.
- Establish seasonal variation in distribution in relation to reproductive parameters.
- Assess degree of biological threat posed by pollutants.
- Improve definition of range in relation to oceanographic parameters and season.
- Estimate abundance.

11.2 Management

- Increase international efforts to ameliorate and/or remove possible current and potential threats.

12. Conservation actions already initiated

12.1 Research

- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which outline scientific objectives and appropriate biological/veterinary research activities.
- Development of state and national strandings and sightings databases (some state museums; some state wildlife agencies; ANCA) to preserve and consolidate data for analysis.
- Opportunistic investigation of strandings and research on museum material by J Bannister (c/- WA Museum), J Dixon (Museum of Victoria), C Kemper (SA Museum), G Ross (ABRS), R Warneke (marine mammal consultant), A Baker (DoC, NZ).

12.2 Management

- Protection under federal and state laws.
- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which define management objectives and outline appropriate logistical responses by participating organisations and individuals.
- Development of international objectives and agreements (CITES, CMS, IWC) to protect cetaceans and marine environments.

13. Conservation actions required

13.1 Research

- Maximise basic biological information gained from strandings and incidental captures by improving the speed and efficiency of reporting, scientific response, salvage and lodging of taxonomic materials in relevant museums.
- Conduct follow-up investigations of taxonomic and genetic material, organ systems and stomach contents, health status including parasites, and pollutants in body tissues.
- Develop field identification materials to improve accuracy of reporting encounters with *Mesoplodon* species, which are difficult to differentiate to species.
- Obtain information on distribution via platforms of opportunity, e.g. observers on oceanographic research vessels and ANARE resupply vessels, and by developing a wide network of voluntary observers, possibly involving merchant vessels, fishing vessels, spotter aircraft and ocean-going yachts.
- Obtain estimates of abundance by dedicated field survey, e.g. by expansion of IWC whale sighting cruises.

13.2 Management

- Prompt and efficient responses to live single and mass strandings and entanglements, as directed by the importance of opportunistic biological studies and welfare considerations.
- Ensure dead specimens are made available to appropriate scientific museums.
- Continued development of international policy and negotiation of agreements to conserve the living resources of the sea, including cetaceans.
- Encourage compliance by IWC member states with commission recommendation to report all incidental captures.
- Monitor development of fisheries directed at pelagic squid, possibly important in the diet of *M. bowdoini.*

14. Organisations responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
No current projects targeting this species.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No, requires:
- A national program for the investigation of cetacean strandings and incidental captures, possibly based on the ANCA National Strandings and Sightings Database.
- A Stranding Investigation Fund for each state and the Northern Territory, possibly with joint contributions by the Federal Government and each state / Northern Territory government. (Alternatively, a central contingency fund, from which an average core cost of investigating each stranding event could be reimbursed to the agency, organisation and / or individual involved, on submission of a full stranding report to ANCA).
- A national program of cetacean survey which, although directed at species of concern, should include ziphiids and all other little known species. Would require preparation of a first-class field identification guide covering all Australasian species.

16.2 Management
Yes, but limited, requires:
- See 13.2.

17. Remarks
Does not commonly strand. Only 10 stranding events in New Zealand, including one from Campbell Island, and nine events in Australia to 1994—Western Australia (3), South Australia (3), Victoria (1), New South Wales (2), and one at Macquarie Island.

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Mead, J G (1989). Beaked whales of the genus *Mesoplodon*. In: *Handbook of Marine Mammals Vol. 4: River Dolphins and the Larger Toothed Whales.* Ridgway, S H and Harrison, R (Eds). Academic Press, London, pp. 349–430.

True's beaked whale

1. Family	Ziphiidae
2. Scientific name	*Mesoplodon mirus*
3. English name(s)	True's beaked whale

4. Taxonomic status, including species and subgroups:
Described by True in 1913. Well-defined taxon, but slight cranial differences between northern and southern populations, if geographically isolated, may warrant subspecific recognition.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, because of insufficient information (NCA (a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration
Distribution in the northern hemisphere appears limited to North Atlantic north of ca 30° to ca 50°N, off USA, Nova Scotia, Ireland and the Outer Hebrides. Southern hemisphere records, all of strandings in South Africa and in southern Australia, in Western Australia, Victoria and Tasmania, indicate possibly localised populations. Migration doubtful, but may be seasonal movements.

7. Habitat

7.1 General
Inferred from strandings in northern hemisphere to prefer temperate and adjacent colder oceanic waters. Southern hemisphere records are all in temperate (ca 10–20°C) regions. Assumed to prefer deep oceanic waters.

7.2 Key localities
None known in Australian waters.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (mainly northern hemisphere data, some South African)

9.1 Growth and age

Birth, weight/length:	? kg/ca 2.2 m
Weaning, age/length:	ca 1 year/ca 3.5 m
Physical maturity, age/length:	? years/ca 4.8 m
Weight, maximum:	ca 1.5 tonnes
Age, maximum:	not known
Length, maximum:	5.34 m (male),

	5.18 m (female)

9.2 Reproduction

Sexual maturity, age/length:	? years/ca 4.8 m (female)
Calving interval:	not known
Mating season:	not known
Calving season:	summer
Gestation:	not known
Calving areas:	none known for Australian waters

9.3 Diet

Diet appears to be squid and small fish. Stomachs of stranded individuals have contained traces of unidentified squids, and one South African specimen contained beaks of a common inshore squid, *Loligo reynaudi*.

9.4 Behaviour

No confirmed observations of living specimens in the wild. Probably fast and active in the pursuit of prey, but the mode of capture is not known; possibly capable of deep dives. Only adult males have functional teeth, consisting of a single pair at the tip of the lower jaw, which appear to be used as weapons during agonistic encounters. Lacking functional gripping teeth, prey may be seized and disabled using the hard edges of the mandibles and the rostral palate. The precise function of the pair of V-shaped throat grooves (a feature of ziphiids) is unknown, but their arrangement suggests a capacity for distension which may facilitate passage of larger whole prey down the oesophagous past the aryteno-epiglottideal tube.

9.5 Mortality and pathology

Does not commonly strand. Parasites recorded: barnacles *Xenobalanus globicipitis* on trailing edge of flukes; nematode *Anisakis simplex* in stomachs.

9.6 Population abundance and rates of change

Not known.

10. Threats

10.1 Past

- None known.

10.2 Current

- Possible entanglement in drift-nets and other nets set, lost or discarded in international waters.

10.3 Potential

- Competition from expanding commercial fisheries, especially on pelagic squids.
- Pollution leading to accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research

- Establish basic biological parameters and improve knowledge of species-specific external characteristics.
- Establish seasonal variation in distribution in relation to reproductive parameters.
- Assess degree of biological threat posed by pollutants.
- Improve definition of range in relation to oceanographic parameters and season.

- Establish indices of abundance.

11.2 Management

- Increase international efforts to ameliorate and/or remove possible current and potential threats.

12. Conservation actions already initiated

12.1 Research

- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which outline scientific objectives and appropriate biological/veterinary research activities.
- Development of state and national strandings and sightings databases (some state museums; some state wildlife agencies; ANCA), to preserve and consolidate data for analysis.
- Opportunistic investigation of strandings and research on museum material by J Bannister (c/- WA Museum), J Dixon (Museum of Victoria), C Kemper (SA Museum), G Ross (ABRS), R Warneke (marine mammal consultant), A Baker (DoC, NZ).

12.2 Management

- Protection under federal and state laws.
- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which define management objectives and outline appropriate logistical responses by participating organisations and individuals.
- Development of international objectives and agreements (CITES, CMS, IWC) to protect cetaceans and marine environments.

13. Conservation actions required

13.1 Research

- Maximise basic biological information gained from strandings and incidental captures by improving the speed and efficiency of reporting, scientific response, salvage and lodging of taxonomic materials in relevant museums.
- Conduct follow-up investigations of taxonomic and genetic material, organ systems and stomach contents, health status including parasites, and pollutants in body tissues.
- Develop field identification materials to improve accuracy of reporting encounters with *Mesoplodon* species, which are difficult to differentiate to species.
- Obtain information on distribution via platforms of opportunity, e.g. observers on oceanographic research vessels and ANARE resupply vessels, and by developing a wide network of voluntary observers, possibly involving merchant vessels, fishing vessels, spotter aircraft and ocean-going yachts.
- Obtain estimates of abundance by dedicated field survey, e.g. by expansion of IWC whale sighting cruises.

13.2 Management

- Prompt and efficient responses to live single and mass strandings and entanglements, as directed by the importance of opportunistic biological studies and welfare considerations.
- Ensure dead specimens are made available to appropriate scientific museums.
- Encourage compliance by IWC member states with commission recommendation to report all incidental captures.
- Monitor development of fisheries directed at pelagic squids, possibly important in the diet of *M. mirus.*

14. Organisations responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
No current projects targeting this species.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No, requires:
- A national program for the investigation of cetacean strandings and incidental captures, possibly based on the ANCA National Strandings and Sightings Database.
- A Stranding Investigation Fund for each state and the Northern Territory, possibly with joint contributions by the Federal Government and each state / Northern Territory government. (Alternatively, a central contingency fund, from which an average core cost of investigating each stranding event could be reimbursed to the agency, organisation and / or individual involved, on submission of a full stranding report to ANCA).
- A national program of cetacean survey which, although directed at species of concern, should include ziphiids and all other little known species. Would require preparation of a first-class field identification guide covering all Australasian species.

16.2 Management
Yes, but limited, requires:
- See 13.2.

17. Remarks
Known southern hemisphere strandings from South Africa (20 events by 1986) and from southern Australia to 1994—Western Australia (2), Victoria (1) and Tasmania (1).

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Ross, G J B (1984). The smaller cetaceans of the south-east coast of Southern Africa. *Ann Cape Prov Mus (Nat Hist)* **15**(2): 173–410.

Ginkgo-toothed beaked whale

1. Family	Ziphiidae
2. Scientific name	*Mesoplodon ginkgodens*
3. English name(s)	Ginkgo-toothed beaked whale, ginkgo-toothed whale

4. Taxonomic status, including species and subgroups
Described by Nishiwaki and Kamiya in 1958. No subspecies recognised.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, because of insufficient information (NCA (a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration
Known only from lower latitudes of the Pacific and Indian oceans on either side of the equator to ca 37°S. Thought to be more common in the western North Pacific than elsewhere. Recorded in Australian waters by only four stranding events, three on the southern New South Wales coast and a fourth in western Victoria.

7. Habitat

7.1 General
Apparently prefers temperate (ca 10–20°C) and tropical (ca 22–32°C) deep oceanic waters.

7.2 Key localities
None known in Australian waters.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (data from meagre Japanese and Australian records)

9.1 Growth and age

Birth, weight/length:	not known
Weaning, age/length:	not known
Physical maturity, age/length:	? years/ca 4.5 m
Weight, maximum:	ca 1.5 tonnes
Age, maximum:	not known
Length, maximum:	ca 5.0 m

9.2 Reproduction

Sexual maturity, age/length:	ca 4.5 m
Calving interval:	not known
Mating season:	not known
Calving season:	not known
Gestation:	not known
Calving areas:	none known for Australian waters

9.3 Diet

No data available, but assumed to be mid- and deep-water squid and fish.

9.4 Behaviour

Not so far observed at sea. Likely to be wary of ships, as are other *Mesoplodon* species. Presumed to actively pursue prey, but the mode of capture is not known; apparently capable of deep dives. Only mature males have (barely) functional teeth, consisting of a single pair which develop in a prominence near the middle of the lower jaw and which appear to be used as weapons during agonistic encounters. However, older males very lightly tooth-scarred compared with other ziphiid males, apparently because teeth tips hardly exposed above gum. Lacking functional gripping teeth, prey may be seized and disabled using the hard edges of the mandibles and the rostral palate. The precise function of the pair of
V-shaped throat grooves (a feature of ziphiids) is unknown, but their arrangement suggests a capacity for distension that may facilitate passage of larger whole prey down the oesophagous past the aryteno-epiglottideal tube.

9.5 Mortality and pathology

Strands infrequently.

9.6 Population abundance and rates of change

Not known.

10. Threats

10.1 Past

- None known.

10.2 Current

- Occasionally taken incidentally in net fisheries.
- Possible entanglement in drift-nets set, lost or discarded in international waters.

10.3 Potential

- Competition from expanding commercial fisheries, especially on pelagic squids.
- Pollution leading to accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research

- Establish basic biological parameters and improve knowledge of species-specific external characteristics.
- Establish seasonal variation in distribution in relation to reproductive parameters.
- Assess degree of biological threat posed by pollutants.
- Improve definition of range in relation to oceanographic parameters and season.
- Establish indices of abundance.

11.2 Management

- Increase international efforts to ameliorate and/or remove possible current and potential threats.

12. Conservation actions already initiated

12.1 Research

- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which outline scientific objectives and appropriate biological/veterinary research activities.
- Development of state and national strandings and sightings databases (some state museums; some state wildlife agencies; ANCA), to preserve and consolidate data for analysis.
- Opportunistic investigation of strandings and research on museum material by J Bannister (c/- WA Museum), J Dixon (Museum of Victoria), C Kemper (SA Museum), G Ross (ABRS), R Warneke (marine mammal consultant), A Baker (DoC, NZ).

12.2 Management

- Protection under federal, state and Northern Territory laws.
- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which define management objectives and outline appropriate logistical responses by participating organisations and individuals.
- Development of international objectives and agreements (CITES, CMS, IWC) to protect cetaceans and marine environments.

13. Conservation actions required

13.1 Research

- Maximise basic biological information gained from strandings and incidental captures by improving the speed and efficiency of reporting, scientific response, salvage and lodging of taxonomic materials in relevant museums.
- Conduct follow-up investigations of taxonomic and genetic material, organ systems and stomach contents, health status including parasites, and pollutants in body tissues.
- Develop field identification materials to improve accuracy of reporting encounters with *Mesoplodon* species, which are difficult to differentiate to species.
- Obtain information on distribution via platforms of opportunity, e.g. observers on oceanographic research vessels, and by developing a wide network of voluntary observers, possibly involving merchant vessels, fishing vessels, spotter aircraft and ocean-going yachts.
- Obtain estimates of abundance by dedicated field survey.

13.2 Management

- Prompt and efficient responses to live single and mass strandings and entanglements, as directed by the importance of opportunistic biological studies and welfare considerations.
- Ensure dead specimens are made available to appropriate scientific museums.
- Continued development of international policy and negotiation of agreements to conserve the living resources of the sea, including cetaceans.
- Encourage compliance by IWC member states with commission recommendation to report all incidental captures.
- Monitor development of fisheries directed at pelagic squids, possibly important in the diet of *M. ginkgodens.*

14. Organisations responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
No current projects targeting this species.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No, requires:

- A national program for the investigation of cetacean strandings and incidental captures, possibly based on the ANCA National Strandings and Sightings Database.
- A Stranding Investigation Fund for each state and the Northern Territory, possibly with joint contributions by the Federal Government and each state / Northern Territory government. (Alternatively, a central contingency fund, from which an average core cost of investigating each stranding event could be reimbursed to the agency, organisation and / or individual involved, on submission of a full stranding report to ANCA).
- A national program of cetacean survey which, although directed at species of concern, should include ziphiids and all other little known species. Would require preparation of a first-class field identification guide covering all Australasian species.

16.2 Management
Yes, but limited, requires:

- See 13.2.

17. Remarks
Only recently recognised in Australia (to 1994), by strandings in New South Wales (3 events) and Victoria (1). Increasing observer awareness and activity in northern Western Australia, Northern Territory, Queensland and New South Wales likely to yield further stranded specimens.

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Cuvier's beaked whale

1. Family	Ziphiidae
2. Scientific name	*Ziphius cavirostris*
3. English name(s)	Cuvier's beaked whale, goose-beaked whale

4. Taxonomic status, including species and subgroups
Described by Cuvier in 1823. Well defined taxon, no subspecies recognised.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, but possibly secure (NCA (b))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix II

6. Distribution, including migration
Circumglobal except polar waters, also found in Mediterranean Sea. Ranges far from continental land masses; a summer sighting in the subantarctic south of New Zealand at 52°S, and two strandings at Macquarie Island at 54°S. Recorded by strandings in all Australian states and Northern Territory, mostly from January to July, suggesting some seasonality of occurrence. Apparently a year-round resident in some parts of its range, e.g. off New Zealand and Japan.

7. Habitat

7.1 General
Tropical (ca 22–32°C) to sub-polar
(ca 1–8°C) deep oceanic waters.

7.2 Key localities
None known in Australia.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone
(= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview
(mainly Japanese data)

9.1 Growth and age

Birth, weight/length:	? kg/ca 2.70 m
Weaning, age/length:	not known
Physical maturity, age/length:	? years/5.9–6.13 m
Weight, maximum:	ca 3.5 tonnes
Age, maximum:	47 years (male), 28 years (female)
Length, maximum:	6.93 m (male),

	6.60 m (female)

9.2 Reproduction

Sexual maturity, age/length:	ca 11 years/ ca 5.5 m
Calving interval:	not known
Mating season:	infer all year
Calving season:	all year, no seasonal pattern
Gestation:	not known
Calving areas:	none known for Australian waters

9.3 Diet

Limited data from Japanese fisheries indicate a wide variety of squid comprised the bulk of the diet of animals taken in waters slightly less than 1000 m, but deep-water fish predominated in stomachs of animals taken in deeper waters; decapod and mysid shrimps were also recorded. Stranded animals on South African coast contained beaks of ca 15 species of oceanic squid, in at least eight families; otoliths of morid fish *Antimora* sp., crustacean fragments (cf *Gnathophausia*) and flotsam, including plastic debris, pumice stones and a large seed. The stomach of a large male stranded in Victoria contained beaks of ca 500 individual squid, 15 (60% of the total estimated intake by weight) being *Mesonychoteuthis hamitoni*; histioteuthids accounted for a further 20%, the remainder representing the families Mastigoteuthidae, Onychoteuthidae, Vampyroteuthidae.

9.4 Behaviour

Appears to be wary of boats and therefore uncommonly observed at sea. Group size varies from one to seven, solitary animals most frequently encountered, but larger schools to ca 25 individuals have been reported; lone animals appear to be adult males. Mass strandings of five and six individuals recorded. The blow is low, diffuse and directed forward. Breaching has been observed. Often raises flukes out of water before commencing vertical descent. Apparently capable of deep dives and can remain below for at least 30 minutes. Presumed to actively pursue prey, but mode of capture unknown. Only adult males have functional teeth, consisting of a single pair at the tip of the lower jaw which appear to be used as weapons during agonistic encounters, leading to heavy scarring of older animals. Lacking functional gripping teeth, prey may be seized and disabled using the hard edges of the mandibles and the rostral palate. The precise function of the pair of V-shaped throat grooves (a feature of ziphiids) is unknown, but their arrangement suggests a capacity for distension which may facilitate passage of large whole prey down the oesophagous past the aryteno-epiglottideal tube.

9.5 Mortality and pathology

Strands quite frequently. Ectoparasitic barnacles *Xenobalanus* sp. occur on the flukes and dorsal fin and *Conchoderma* (?) on erupted apical teeth. Internal parasites include the nematodes *Anisakis* sp., *Crassicauda boops* and *C. crassicauda*, and the cestode *Phyllobothrium* sp. Thickened arterial walls (arteriosclerosis) of stranded specimens may be related to the species' deep-diving habit. An adult male from temperate Australian waters was heavily scarred by cookie-cutter shark (*Isistius* sp.) bites. Decline in the incidental catch of *Ziphius* in the continuing Japanese *Berardius* fishery indicates the presence of a local population and its sensitivity to over-fishing. Tissues of a 6.18 m male contained 1.9mg/kg of

mercury and organochlorines at the following levels: DDT, 1.2mg/kg, DDE, 1.2mg/kg and DDD, 0.25mg/kg.

9.6 Population abundance and rates of change
Widely distributed, apparently local populations, e.g. off Japan, possibly off New Zealand, but no data on their size
or range.

10. Threats

10.1 Past
- Small-scale fisheries off Japan and Lesser Antilles.

10.2 Current
- Possible entanglement in drift-nets and other nets set, lost or discarded in international waters.

10.3 Potential
- Competition from expanding commercial fisheries, especially on pelagic squids.
- Pollution leading to accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research
- Establish basic biological parameters and improve knowledge of species-specific external characteristics.
- Establish seasonal variation in distribution in relation to reproductive parameters.
- Assess degree of biological threat posed by pollutants.
- Improve definition of range in relation to oceanographic parameters and season.
- Establish indices of abundance.

11.2 Management
- Increase international efforts to ameliorate and/or remove current and potential threats.

12. Conservation actions already initiated

12.1 Research
- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which outline scientific objectives and appropriate biological/veterinary research activities.
- Development of state and national strandings and sightings databases (some state museums; some state wildlife agencies; ANCA), to preserve and consolidate data for analysis.
- Opportunistic investigation of strandings and research on museum material by J Bannister (c/- WA Museum), J Dixon (Museum of Victoria), C Kemper (SA Museum), R Paterson (Queensland Museum), G Ross (ABRS), R Warneke (marine mammal consultant), A Baker (DoC, NZ).

12.2 Management
- Protection under federal and state laws.
- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which define management objectives and outline appropriate logistical responses by participating organisations and individuals.
- Development of international objectives and agreements (CITES, CMS, IWC) to protect cetaceans and marine environments.

13. Conservation actions required

13.1 Research

- Maximise basic biological information gained from strandings and incidental captures by improving the speed and efficiency of reporting, scientific response, salvage and lodging of taxonomic materials in relevant museums.
- Conduct follow-up investigations of taxonomic and genetic material, organ systems and stomach contents, health status including parasites, and pollutants in body tissues.
- Develop field identification materials to improve accuracy of reporting encounters with ziphiids.
- Obtain information on distribution via platforms of opportunity, e.g. observers on oceanographic research vessels and ANARE resupply vessels, and by developing a wide network of voluntary observers, possibly involving merchant vessels, fishing vessels, spotter aircraft and ocean-going yachts.
- Obtain estimates of abundance by dedicated field survey, e.g. by expansion of IWC whale sighting cruises.

13.2 Management

- Prompt and efficient responses to live single and mass strandings and entanglements, as directed by the importance of opportunistic biological studies and welfare considerations.
- Ensure dead specimens are made available to appropriate scientific museums.
- Encourage compliance by IWC member states with commission recommendation to report all incidental captures.
- Monitor development of fisheries directed at pelagic squids important in the diet of *Z. cavirostris.*

14. Organisations responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
No current projects targeting this species.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research

No, requires:

- A national program for the investigation of cetacean strandings, possibly based on the ANCA National Strandings and Sightings Database.
- A Stranding Investigation Fund for each state and the Northern Territory, possibly with joint contributions by the Federal Government and each state / Northern Territory government. (Alternatively, a central contingency fund, from which an average core cost of investigating each stranding event could be reimbursed to the agency, organisation and / or individual involved, on submission of a full stranding report to ANCA).
- A national program of cetacean survey which, although directed at species of concern, should include ziphiids and all other little known species. Would require preparation of a first-class field identification guide covering all Australasian species.

16.2 Management
Yes, but limited, requires:
- See 13.2.

17. Remarks
***Ziphius cavirostris* is the most cosmopolitan of the beaked whales. Recorded in Australian waters by 31 strandings (to 1994)—Western Australia (5 events), South Australia (2), Victoria (3), Tasmania (13), New South Wales (2), Queensland (3), Northern Territory (1), including two at Macquarie Island. Frequently strands on New Zealand coasts.**

Selected references

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Nicol, D J (1987). A review and update of the Tasmanian cetacean stranding record to the end of February 1986. *Univ Tasm Environ Studies Working Paper* No. **21**. 96 pp.

Southern bottlenose whale

1. Family	Ziphiidae
2. Scientific name	*Hyperoodon planifrons*
3. English name(s)	Southern bottlenose whale

4. Taxonomic status, including species and subgroups
Described by Flower in 1882, from a specimen found at Lewis Island, Dampier Archipelago, WA. No subspecies recognised, but several sightings of an undescribed *Hyperoodon* in central and eastern tropical Pacific and North Pacific waters (not the closely related sibling species *H. ampullatus*, which is restricted to the North Atlantic).

5. Species survival status

5.1 Australian Action Plan status
No category assigned, but possibly secure (NCA (b))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix I

6. Distribution, including migration
Circumglobal in southern hemisphere, at mid- to high latitudes south of 29°S to the edge of the polar pack ice; commonly sighted in some sectors of the Southern Ocean south of

60°S; may also occur in the central to eastern tropical Pacific from 5°N – 15°S, 80–170°W and North Pacific from ca 20–34°N, 130–142°W. Relatively few strandings anywhere, mainly in New Zealand and on the southern coasts of Australia. Apparently rarely ventures into continental seas. Evidence of seasonal occurrence in waters off Southern Africa, in summer, but data for southern Australia are inconclusive.

7. Habitat

7.1 General
Apparently prefers deep oceanic waters in temperate (ca 10–20°C) to Antarctic (ca 0–5°C) regions.

7.2 Key localities
None known in Australian waters.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (South African, Australian and New Zealand data, and comparisons with *H. ampullatus*)

9.1 Growth and age

Birth, weight/length:	ca 150–200 kg/ca 2.5–2.9 m
Weaning, age/length:	ca 1 year (as for *H. ampullatus*)/ ca 3.7–4.0 m
Physical maturity, age/length:	not known
Weight, maximum:	ca 4 tonnes
Length, maximum:	7.14 m (male), 7.80 m (female)
Age, maximum:	estimates as for *H. ampullatus*: 50+ years (male), 37+ years (female)

9.2 Reproduction

Sexual maturity, age/length:	estimate 9–11 years (as for *H. ampullatus*) /ca 6.5 m (male), ? m (female)
Calving interval:	not known
Mating season:	possibly summer
Calving season:	spring–early summer
Gestation:	estimate ca 12 months (as for

	H. ampullatus)
Calving areas:	none known for Australian waters

9.3 Diet

Stomachs of specimens from antarctic and subantarctic waters contained the remains of squid and some krill (*Euphausia superba*), possibly ingested incidentally with normal prey items. The stomach of one South Australian specimen contained a large quantity of squid beaks, cf *Polypus variolatus*, but identification doubtful, and the intestine of one South African specimen contained four cephalopod beaks. The stomach of a dependent or recently weaned juvenile from Victoria contained the tunicates *Pyrosoma atlantica* and *Thetys vagina*. The northern hemisphere *H. ampullatus* feeds mainly on squid, but also on a variety of fish, holothurians, starfish and prawns. Stones, fish-netting and plastic bags have been found in stomachs.

9.4 Behaviour

Sighted off Southern Africa and in antarctic waters in small social groups of three to 10. A powerful and active predator, observed to remain below the surface for long periods and assumed to dive deeply in pursuit of prey, possibly to 1000+m, and stay down for periods of more than an hour. The flukes may be shown before a vertical descent; has been observed to breach. Only adult males have functional teeth, consisting of a single pair located at the tip of the lower jaw and which appear to be used as weapons in agonistic encounters, leading to heavy scarring of older animals. The massive forehead (melon) of this species may be used to concentrate bursts of high energy sound to acoustically stun prey. Lacking functional gripping teeth, prey may be seized and disabled using the hard edges of the mandibles and the rostral palate. The precise function of the pair of V-shaped throat grooves (a feature of ziphiids) is unknown, but their arrangement suggests a capacity for distension which may facilitate passage of larger whole prey down the oesophagous past the aryteno-epiglottideal tube. The northern species *H. ampullatus* exhibits care-giving behaviour, possibly a defence against attacks by killer whales.

9.5 Mortality and pathology

Strandings uncommon. A young male specimen from Victoria carried whale lice *Platycyamus thompsoni* and scars, possibly from bites by the small shark *Isistius* sp., and had recent tooth rakes possibly caused by a killer whale. Levels of organochlorines in the blubber of this animal were 0.38 ppm DDE; 0.09 ppm Dieldrin; 0.35 ppm HCB; and 0.06 ppm PCBs. Blubber of a young male from South Africa contained 1.2 ppm DDE; 0.07 ppm Dieldrin; and no detectable levels of PCBs.

9.6 Population abundance and rates of change

No information available about population size, possible sub-populations, or trends in numbers, but data accumulated by IWC whale sighting cruises in the Southern Ocean since mid-1980s may yield a population estimate.

10. Threats

10.1 Past

- None known.

10.2 Current

- Incidental captures in pelagic drift-net fishery in Tasman Sea.
- Entanglement in drift-nets and other nets set, lost or discarded in international waters at higher latitudes.

10.3 Potential

- Competition from expanding commercial fisheries, especially for pelagic squids at higher latitudes.
- Pollution leading to accumulation of toxic substances in body tissues.

11. Conservation objectives

11.1 Research

- Contribute data (from strandings) on basic biological parameters and on seasonal variation in distribution in relation to reproductive parameters.
- Assess degree of biological threat posed by pollutants.
- Improve definition of range in relation to oceanographic parameters and season.
- Estimate abundance.

11.2 Management

- Increase international efforts to ameliorate and/or remove current and potential threats.

12. Conservation actions already initiated

12.1 Research

- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which outline scientific objectives and appropriate biological/veterinary research activities.
- Development of state and national strandings and sightings databases (some state museums; some state wildlife agencies; ANCA) to preserve and consolidate data for analysis.
- Opportunistic investigation of strandings and research on museum material: J Bannister (c/- WA Museum), J Dixon (Museum of Victoria), C Kemper (SA Museum), G Ross (ABRS), R Warneke (marine mammal consultant), A Baker (DoC, NZ).

12.2 Management

- Protection under federal and state laws.
- Preparation of National Stranding Contingency Plan (1982) and some state stranding contingency plans, which define management objectives and outline appropriate logistical responses by participating organisations and individuals.
- Development of international objectives and agreements (CITES, CMS, IWC) to protect cetaceans and marine environments.

13. Conservation actions required

13.1 Research

- Maximise basic biological information gained from strandings by improving the speed and efficiency of reporting, scientific response, salvage and lodging of taxonomic materials in relevant museums.
- Conduct follow-up investigations of taxonomic and genetic material, organ systems and stomach contents, health status including parasites, and pollutants in body tissues.
- Develop field identification materials to improve accuracy of reporting encounters with ziphiids, which are difficult to differentiate to species on external characteristics.
- Obtain information on distribution via platforms of opportunity, e.g. observers on oceanographic research vessels and Antarctic Division resupply vessels, and by developing a wide network of voluntary observers, possibly involving merchant vessels, fishing vessels, spotter aircraft and ocean-going yachts.
- Obtain estimates of abundance by dedicated field survey, e.g. by expansion of IWC whale sighting cruises.

13.2 Management

- Prompt and efficient responses to live single and mass strandings, and entanglements, as directed by the importance of opportunistic biological studies and welfare considerations.
- Ensure dead specimens are made available to appropriate scientific museums.
- Continued development of international policy and negotiation of agreements to conserve the living resources of the sea, including cetaceans.
- Encourage compliance by IWC member states with commission recommendation to report all incidental captures.
- Monitor development of fisheries directed at pelagic squid, possibly important in the diet of *H. planifrons.*

14. Organisations responsible for conservation of species

14.1 International: CITES, CMS

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
No current projects targeting this species.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No, requires:
- A national program for the investigation of cetacean strandings, possibly based on the ANCA National Strandings and Sightings Database.
- A Stranding Investigation Fund for each state and the Northern Territory, possibly with joint contributions by the Federal Government and each state / Northern Territory government. (Alternatively, a central contingency fund, from which an average core cost of investigating each stranding event could be reimbursed to the agency, organisation and / or individual involved, on submission of a full stranding report to ANCA).
- A national program of cetacean survey which, although directed at species of concern, should include ziphiids and all other little known species. Would require preparation of a first-class field identification guide covering all Australasian species.

16.2 Management
Yes, but limited, requires:
- See 13.2.

17. Remarks
Australia is potentially a useful source of biological data and materials on *H. planifrons* because of relative frequency of stranding events compared with other southern continents, i.e. 14 events (to 1994)—Western Australia (2), South Australia (7), Victoria (2), Tasmania (1), New South Wales (2).

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Sperm whale

1. Family	Physeteridae
2. Scientific name	*Physeter macrocephalus*
3. English name(s)	Sperm whale

4. Taxonomic status, including species and subgroups

First described by Linnaeus, 1758. No taxonomically valid subgroups currently recognised.

5. Species survival status

5.1 Australian Action Plan status

Insufficiently known (K). Status indeterminate until surveys conducted, particularly off south-west Australia, see 9.6 and 10.1.

5.2 IUCN status

Insufficiently known

5.3 CITES status

Appendix I

6. Distribution, including migration

Worldwide. In deep water, off continental shelf, i.e. beyond 200 m depth. Recorded from all Australian states. Females and young males restricted to warmer waters, i.e. north of ca 45°S in southern hemisphere, adult males travelling to and from colder waters. Concentrated in a narrow area only a few miles wide at shelf edge off Albany, WA, moving westwards through the year. Similar concentrations elsewhere, e.g. south-west of Kangaroo Island, SA. Off Western Australian west coast, where shelf slopes less steeply, less concentrated close to shelf edge and more widely dispersed offshore. In open ocean,

generalised movement southwards in summer, and corresponding movement northwards in winter, separate in each hemisphere.

7. Habitat

7.1 General

Pelagic, offshore, in deep water only. Population headquarters in temperate/tropical waters where breeding/nursing schools, and groups of young males, occur. Concentrations found where seabed rises steeply from great depth, e.g. on 'steep-to' coasts and near oceanic islands, probably associated with concentrations of major food—deep-sea cephalopods—in areas of upwelling. Only adult males, usually solitary or in small loose groups, found in cold waters, i.e. south of ca 45°S.

7.2 Key localities

Between Cape Leeuwin and Esperance, WA, close to edge of continental shelf (averaging 20–30 nautical miles offshore); sw of Kangaroo Island, SA; off Tasmanian west and south coasts; off New South Wales, including Wollongong; off Stradbroke Island, Queensland.

8. Marine protected areas managed for or relevant to the species

All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (based on both overseas and Australian data)

9.1 Growth and age

Birth, weight/length:	ca 400 kg/4.0 m
Weaning, age/length:	ca 2 years/6.7 m
Physical maturity, age/length:	35–60 years/ 15.2 –16.1 m (male), 25–45 years/ 10.4–11.0 m (female)
Weight, max:	57.1 tonnes (male), 24.0 tonnes (female)
Age, max:	ca 60 years, both sexes
Length, max:	18.3 m (male) 12.5 m (female)

9.2 Reproduction

Sexual maturity, age/length:	18–21 years/ 11.0–12.0 m (male)*, 7–13 years/ 8.3–9.2 m (female)

Calving interval:	4–6 years
Mating season:	Sept–Dec
Gestation:	14–15 months
Calving season:	Nov–March
Calving area(s):	temperate and tropical oceanic waters, but no specific localities recognised

9.3 Diet

Major food oceanic cephalopods, frequently taken at depth; other food includes deep-sea angler fish, mysid shrimps. Stomach contents can include remains of large squid species, e.g. *Architeuthis* >2 m, but generally medium-sized, 0.20–1.00 m.

9.4 Behaviour

Sound production—clicks or sharp, broad-band pulses produced most commonly. Clicks can carry up to 10 km under water and comprise a series of multiple pulses, unique to sperm whales. Probably used both for echolocation and communication, the latter classified as: contact calls, usually during deep diving; social sounds, at the surface; identity codas, unique for each whale; generalised codas, common to all animals in an area. Techniques now available for determining distribution and abundance from analysis of underwater sounds.

Swimming—rarely exceed 7.5 km / hr at surface, often almost motionless, but can reach up to 30 km / hr when disturbed.

Diving—prolonged and deep divers, often over 60 mins, one record of a group diving for 138 mins, although mode less than 45 min. Longest and deepest divers are large males. Maximum depths between 1135 m (entangled in deep-sea cable) and 3195 m (from field observations and stomach contents), although modal depths much shallower.

Blow rate—at surface, blow regularly five to six times / min. Whalers believed they blow once for each minute spent below surface.

Social behaviour—two kinds of schools, breeding and bachelor. Former include females of all ages and immature and younger pubertal males. Large, socially mature males accompany schools only during breeding season, and then for short periods of possibly only a few hours. Average school size about 25 animals, although aggregations of such schools have been reported, sometimes up to low thousands, e.g. a remarkable report of ‘animals spouting from horizon to horizon...’ over seven to eight hours in a stream 70 miles wide, Tasman Sea, February 1978. Females believed to remain in same school throughout life. Bachelor schools comprise older pubertal males and sexually, but not socially, mature males, all of similar size and age. Socially mature males leave such schools to associate with breeding schools, either solitary or in small groups of usually less than six animals.

9.5 Mortality and pathology

Little information. Breeding schools have been observed being attacked by killer whales—defensive action may be to form ‘daisy’ pattern, heads to centre, tails at periphery. Many parasites, epizootics and other organisms reported but none shown particularly to cause morbidity or mortality.

Strand relatively frequently but without likely effect on population status. In 160 years’ strandings records from Tasmania, the second species most frequently reported—31 events with 10 herd strandings.

Ambergris, formed from impacted faeces, recovered occasionally during whaling, in 1–5% of individuals; also found floating at sea surface (voided naturally?) or washed up on shore. Effect on individual animals uncertain, though a few individuals taken with relatively large amounts, e.g. up to several hundred kg.

9.6 Population abundance and rates of change
See 10.1. Southern hemisphere 'Division 5' animals (90–130°E, i.e. including animals caught off Albany, WA) estimated, in 1980, to have declined by 91% (males >20 years) and 26% (females >13 years) between 1947 (taken as the start of major 20th century sperm whaling) and 1979. Concerns over excessive reduction of breeding males were a contributing factor to cessation of whaling in 1978. Results heavily dependent on model structure and assumptions, and little reliance now on absolute abundance estimates. Information lacking on current status; present 'Australian' populations, sexes combined, likely however to number in the tens of thousands.

10. Threats

10.1 Past
- Overfishing, in early to mid-19th century, largely from pelagic US, UK, French vessels, caused some population declines, probably off Australia as elsewhere. Twentieth century sperm whaling from Albany, WA, in several phases, most recently 1955–1978. Coupled with pelagic whaling in south-east Indian, Southern and south-west Pacific oceans (including Tasman Sea), resulted in significant stock decline, especially off south-west Western Australia, possibly allied with decreased female reproductive rate associated with reduction of breeding males.

10.2 Current
- Possible direct disturbance by:
  - collision with large vessels on shipping lanes beyond edge of continental shelf
  - seismic operations in similar area
  - net entrapment in deep-sea gill-nets
  - pollution, including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea, leading to bio-accumulation of toxic substances in body tissues.

10.3 Potential
- As 10.2.
  - Indirect disturbance possible through global and ocean warming, and depletion of the ozone layer, leading to altered distribution and abundance of prey species.

11. Conservation objectives

11.1 Research
- Establish current status of population in Albany, WA, area for comparison with that at end of whaling in 1978, and determine whether any recovery has occurred since then.
- Assess possible effect of fishing on food resources in other deep-water areas of likely fisheries importance within EEZ, e.g. off Kangaroo Island, SA, western and southern Tasmania, south-eastern New South Wales.

11.2 Management
- Minimise possible detrimental effects on population(s), e.g. from fishing operations.
- Ensure international regulation to maintain stocks at an acceptable level.

12. Conservation actions already initiated

12.1 Research

- Investigation of biology and population status off south-west Western Australia (1964–67)—J Bannister; (1978–80)—G Kirkwood / K Allen / J Bannister, CSIRO, WA Museum.
- Pollution studies (1992)—E Cannella / D Kitchener, WA Museum.
- Schooling aggregations (1986)—R Paterson, Queensland Museum.
- Investigation of design of aerial survey pilot study for long-term monitoring of sperm whales off Albany, WA (1981)—G Kirkwood, CSIRO.

12.2 Management

- International protection through IWC, including Indian Ocean Sanctuary and Southern Ocean Sanctuary.
- Legal protection of all cetaceans within Australian EEZ, with corresponding provisions under state Acts.
- Funding assistance for research programs leading to information important for management.
- Encouragement of and assistance to public / private organisations interested in cetacean welfare.

13. Conservation actions required

13.1 Research

- Carry out recommended program for monitoring population status off Albany, WA.
- Review existing information on distribution and abundance, e.g. off South Australia, Tasmania and southern New South Wales.
- Ensure regular collation of strandings and sightings data, including genetics and pollutants analysis.
- Ensure continued cooperation with other national agencies, e.g. Japan, IWC, conducting research in relevant neighbouring ocean areas, in the context of Australian Government initiatives for research in the Southern Ocean Sanctuary.
- Undertake yacht-based studies, including telemetry, of behaviour and ecology in suitable areas, possibly off southern New South Wales, south-east Queensland.

13.2 Management

- Continue action within IWC and other international forums (e.g. CITES, CMS) to maintain protection or other appropriate measures to ensure population viability.
- Seek Commonwealth agencies' support to develop a working group to address fishing impacts, particularly on this species but including other cetacean species.
- Ensure specimens available for appropriate scientific museums.

14. Organisations responsible for conservation of species

14.1 International: CITES, CMS, IWC

14.2 National: ANCA
(Australian EEZ = 200 n miles)

14.3 State: government wildlife agencies (state waters = 3 n miles)

15. Other organisations and individuals involved
None specifically other than in 12 and 14 above.

16. Can research and management be carried out with existing resources? If no, what is required?
No, requires:

- Funding, to undertake monitoring off Albany, WA—for one year's survey, to be repeated at least once, at five-year intervals, as well as other actions in 13.1.

17. Remarks

Species studied intensively during whaling operations at Albany, WA, including distribution around coast from east of Albany to north of Carnarvon and offshore to 150 n miles.

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Canella, E G and Kitchener, D J (1992). Differences in mercury levels in female sperm whales, *Physeter macrocephalus* (Cetacea: Odontoceti). *Aust Mammal* **15**: 121–123.

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Paterson, R A (1986). An analysis of four large accumulations of sperm whales observed in the modern whaling era. *Sci Rep Whales Res Inst Tokyo* **37**: 167–172.

Rice, D W (1989). Sperm whale *Physeter macrocephalus*. In: *Handbook of Marine Mammals Vol. 4: River Dolphins and the Larger Toothed Whales.* Ridgway, S H and Harrison, R (Eds). Academic Press, London, pp. 177–233.

Pygmy sperm whale

1. Family	Kogiidae
2. Scientific name	*Kogia breviceps*
3. English name(s)	Pygmy sperm whale

4. Taxonomic status, including species and subgroups

Named by de Blainville, 1838, as *Physeter breviceps*. No subspecies currently recognised, but closely related species, dwarf sperm whale, *K. simus*, only confirmed in 1966, and records before then could refer to either.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, because of insufficient information (NCA (a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Not on either Appendix I or II

6. Distribution, including migration

Cosmopolitan, apart from polar or sub-polar seas, oceanic—more so than dwarf sperm whale, q.v. Not known to migrate or exhibit strong seasonal movements. Recorded (as stranded animals only) from all states but not Northern Territory. From studies of food organisms, seems not to approach as close inshore as *K. simus*.

7. Habitat

7.1 General

Oceanic, apart from colder waters.

7.2 Key localities

No specific localities recognised.

8. Marine protected areas managed for or relevant to the species

All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (mainly from overseas sources)

9.1 Growth and age

Birth, weight/length:	? kg/ca 1.2 m
Weaning, age/length:	ca 1 year/ ? m
Physical maturity, age/length:	? years/? 3.3 m
Weight, maximum:	? 400 kg
Age, maximum:	? years
Length, maximum:	ca 3.3 m

9.2 Reproduction

Sexual maturity, age/length:	? years/ca 2.7 m (both sexes)
Calving interval:	? 2 years
Mating season:	summer
Gestation:	9–11 months
Calving season:	spring
Calving area(s):	none known but probably in temperate and tropical seas

9.3 Diet

Main food reported as squid, benthic fish and crabs.

9.4 Behaviour

Sound production—sounds associated with echolocation (clicks, buzzes, grating sounds) have been recorded, but apparently not highly vocal. ‘Museau de singe’, believed associated with sound production, as in other sperm whales, present in right nasal passage.

Surface behaviour—occur individually or in small groups up to six animals. Frequently lie almost motionless at surface; said to breach occasionally.

9.5 Mortality and pathology

Little information. Strand relatively frequently, often as cow/calf pairs.

9.6 Population abundance and rates of change

No information. One of the commonest species to strand in some areas. Identification at sea difficult.

10. Threats

10.1 Past

- No commercial catching. No particular threats recognised; in some parts of the world taken in fisheries for small cetaceans.

10.2 Current

- Possible direct threats from:
  - seismic operations
  - collision with large vessels
  - entanglement in fishing gear
  - pollution, including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways, leading to accumulation of toxic substances in body tissues.

10.3 Potential

- As 10.2.

11. Conservation objectives

11.1 Research

- Investigate identity, distribution, abundance, basic biology and pollutant levels, to provide base-line information on current status of this little-known species.

11.2 Management

- Ensure protection against harassment or other disturbance, including from fishing operations, to minimise possible detrimental effects.

12. Conservation actions already initiated

12.1 Research

- None apart from opportunistic information from strandings or sightings.

12.2 Management

- Legal protection of all cetaceans within Australian EEZ, with corresponding provisions under state Acts.
- Education programs at Commonwealth and state level.
- Encouragement of and assistance to public/private organisations interested in cetacean welfare.

13. Conservation actions required

13.1 Research

- Ensure regular collation of strandings and sightings data, including diet, genetic and pollutant analysis.
- Undertake sightings program within Australian EEZ.

13.2 Management

- Require reporting and salvage of specimens incidentally caught or stranded.
- Ensure specimens available for appropriate scientific museums.

14. Organisations responsible for conservation of species

14.1 International: ***CITES, CMS, IWC***

14.2 National: ***ANCA***
(Australian EEZ = 200 n miles)

14.3 State: ***government wildlife agencies (state waters = 3 n miles)***

15. Other organisations and individuals involved
None current.

16. Can research and management be carried out with existing resources?
If no, what is required?

16.1 Research
No, requires:
- Special funding required to obtain basic biological information from incidentally-caught animals and undertake sightings program.

Selected references

Caldwell, D K and Caldwell, M C (1989). Pygmy sperm whale *Kogia breviceps* (de Blainville 1838): dwarf sperm whale *Kogia simus* Owen, 1866. In: *Handbook of Marine Mammals Vol. 4: River Dolphins and the Larger Toothed Whales.* Ridgway, S H and Harrison, R (Eds). Academic Press, London, pp. 235–260.

Handley, C O (1966). A synopsis of the genus *Kogia* (pygmy sperm whale). In: *Whales, Dolphins and Porpoises.* Norris, K R (Ed). Univ of California Press, Berkeley and Los Angeles, pp. 62–69.

Klinowska, M (1991). *Dolphins, Porpoises and Whales of the World: The IUCN Red Data Book.* IUCN, Gland and Cambridge.

Dwarf sperm whale

1. Family	Kogiidae
2. Scientific name	*Kogia simus*
3. English name(s)	Dwarf sperm whale

4. Taxonomic status, including species and subgroups
Although first named by Owen, 1866, species not confirmed as separate from *K. breviceps*, pygmy sperm whale, until 1966. No subspecies recognised.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, because of insufficient information (NCA (a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Not on Appendices I or II

6. Distribution, including migration

Cosmopolitan apart from polar or sub-polar seas. Oceanic, but approaching coasts more than pygmy sperm whale. Not known to migrate or exhibit strong seasonal changes. Recorded (as stranded animals) from Western Australia, South Australia, Tasmania, New South Wales, possibly Northern Territory; one live sighting from South Australia.

7. Habitat

7.1 General

Oceanic, apart from colder waters, but more coastal than pygmy sperm whale.

7.2 Key localities

No specific localities recognised.

8. Marine protected areas managed for or relevant to the species

All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (mainly from overseas sources)

9.1 Growth and age

Birth, weight/length:	? kg/ca 0.95 m
Weaning, age/length:	? ca 1 year/? m
Physical maturity, age/length:	? years/? 2.3 m
Weight, maximum:	? 270 kg
Age, maximum:	? years
Length, maximum:	ca 2.7 m

9.2 Reproduction

Sexual maturity, age/length:	? years/ ca 2.1–2.2 m (both sexes)
Calving interval:	? 1–2 years
Mating season:	summer
Gestation:	9.5 months
Calving season:	spring
Calving area(s):	temperate to tropical seas, exact localities not identified

9.3 Diet

Main food squid; fish and crustaceans also taken.

9.4 Behaviour

Sound production—believed to be similar to pygmy sperm whale

Surface behaviour— found in groups of up to 10 animals, possibly in three kinds of pods: cows and calves, immatures, adults of both sexes. Unobtrusive at sea, often found 'rafting' at surface.

9.5 Mortality and pathology

Little information. Strand much less frequently than pygmy sperm whale.

9.6 Population abundance and rates of change

No information.

10. Threats

10.1 Past
- No commercial catching. Occasionally taken as by-catch in fisheries for small cetaceans.

10.2 Current
- Possible direct threats from:
  - seismic operations
  - collision with large vessels
  - entanglement in fishing gear
  - defence operations
  - pollution, including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea, leading to bio-accumulation of toxic substances in body tissues.

10.3 Potential
- As 10.2.

11. Conservation objectives

11.1 Research
- Investigate identity, distribution, abundance, basic biology and pollutant levels, to provide base-line information on current status of this little known species.

11.2 Management
- Ensure protection against harassment or other disturbance, including from fishing operations, to minimise possible detrimental effects.

12. Conservation actions already initiated

12.1 Research
- None apart from opportunistic information from strandings or sightings.

12.2 Management
- Legal protection of all cetaceans within Australian EEZ, with corresponding provisions under state Acts.
- Education programs at Commonwealth and state level.
- Encouragement of and assistance to public/private organisations interested in cetacean welfare.

13. Conservation actions required

13.1 Research
- Ensure regular collation of strandings and sightings data, including diet, genetic and pollutant analysis.
- Undertake sightings program within Australian EEZ.

13.2 Management
- Require reporting and salvage of specimens incidentally caught or stranded.
- Ensure specimens available for appropriate scientific museums.

14. Organisations responsible for conservation of species

14.1 International: *CITES, CMS, IWC*

14.2 National: *ANCA*
(Australian EEZ = 200 n miles)

14.3 State: *government wildlife agencies (state waters = 3 n miles)*

15. Other organisations and individuals involved
None current.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No. requires:
- Special funding required to obtain basic biological information from incidentally-caught animals and undertake sightings program.

Selected references

Caldwell, D K and Caldwell, M C (1989). Pygmy sperm whale *Kogia breviceps* (de Blainville 1838): dwarf sperm whale *Kogia simus* Owen, 1866. In: *Handbook of Marine Mammals Vol. 4: River Dolphins and the Larger Toothed Whales*. Ridgway, S H and Harrison, R (Eds). Academic Press, London, pp. 235–260.

Handley, C O (1966) A synopsis of the genus *Kogia* (pygmy sperm whale). In: *Whales, Dolphins and Porpoises*. Norris, K R (Ed). Univ of California Press, Berkeley and Los Angeles, pp. 62–69.

Klinowska, M (1991). *Dolphins, Porpoises and Whales of the World: The IUCN Red Data Book*. IUCN, Gland and Cambridge.

Southern right whale*

1. Family	Balaenidae
2. Scientific name	*Eubalaena australis*
3. English name(s)	Southern right whale

4. Taxonomic status, including species and subgroups
First described by Desmoulins, 1822, as *Balaena australis*. Genus *Eubalaena* recognised since Gray's, 1864, description, *Balaena* being reserved for the distinct and restricted arctic bowhead whale, *B. mysticetus*. Possible conspecificity with the northern right whale, *E. glacialis*, recently discounted, on morphological and genetic grounds. No subspecies currently recognised.

5. Species survival status

5.1 Australian Action Plan status
Vulnerable (V). Population very severely reduced; probably increasing but not yet secure. See 9.6.

5.2 IUCN status
Vulnerable

5.3 CITES status
Appendix I

6. Distribution, including migration
Southern hemisphere circumpolar between approximately 30° and 60°S. Generalised movement from higher latitudes where feeding occurs in summer to warmer, lower latitudes for breeding in winter. Approaches coasts in winter. In Australia distributed

around the southern coastline from Perth, WA to Sydney, NSW, including Tasmania. Range possibly extending: recent sightings from Shark Bay and North West Cape, WA and north of Sydney to Cape Byron, NSW. Adult females sighted most frequently close to coast, coming inshore to give birth on a mainly three-year cycle (see 9.2).

7. Habitat

7.1 General

Pelagic in summer, feeding in the open Southern Ocean. Onshore in winter, particularly calving females which usually remain very close to coast. Sightings from much of coastal range although some localities preferred.

7.2 Key localities

Consistent winter calving locations in recent years at Doubtful Island Bay (Point Ann and Point Charles) and east of Israelite Bay, WA; at Head of the Bight, SA; and intermittently (and smaller) off South Australian gulfs and Warrnambool, Victoria.

In western and central southern coast some preference by calving females for shallow north-east trending bays over sandy bottoms. Animals found in a narrow band generally no more than 1 km from the shoreline; evidence of medium range (200 km) coastwise movements. Summer feeding grounds not determined specifically, though a concentration of 75 animals was observed mainly between 42 and 43°S and 118 and 119°E (approx 500 nautical miles south of Albany, WA) in December–January 1988–92, and again (though in smaller numbers) in December 1995; no animals found there, or nearer the coast, in February–March 1992; presumed further south at that time. Recent sightings near 65°S, at ca 135°E, in summer.

8. Marine protected areas managed for or relevant to the species

Various exist within animals' range but provide no greater protection than whales receive generally. All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (based on both overseas and Australian data)

9.1 Growth and age

Birth, weight/length:	1000–1500 kg/5.5 m
Weaning, age/length:	ca 11–12 months/? m
Physical maturity, age/length:	age not known/ ca 16 m (males slightly less than females)
Weight, maximum:	ca 80 tonnes
Age, maximum:	50+ years (presumed)
Length, maximum:	17.5 m (males slightly less than females)

9.2 Reproduction

Sexual maturity, age/length:	9–10 years/12–13 m

Calving interval:	generally 3 years
Mating season:	mainly July–August
Gestation:	ca 11–12 months
Calving season:	June–August
Calving area(s):	onshore, in preferred localities (see 7.2)

9.3 Diet

Observations, lack of suitable prey and whaling data imply no feeding near coast in winter, calving females effectively fasting four+ months. Baleen structure and recent observations suggest prey is mainly smaller plankton, e.g. pelagic larval crustacea (*Munida gregaria)* and copepods, taken primarily in open ocean, presumably south of ca 40°S, in summer. Possibility of competition with sei whale, *Balaenoptera borealis*, copepod feeder in southern hemisphere. Presumed not to compete greatly for prey with other balaenopterids that feed predominantly on *Euphausia superba* (krill) in Antarctic, despite records from South Georgia of right whales with krill in stomach.

9.4 Behaviour

Sound production— short, relatively low frequency belches, moans, pulses recorded. 'Blows' often clearly audible in air.

Swimming speeds—near shore, generally slow, but capable of 15+ km / hr over short distances. Migration speeds unknown but medium range coastal movements indicate 2.7–4.2 km / hr over 24 hours for cow / calf pairs.

Blow rate—when inactive average 1 / min though highly variable; when active or travelling, irregular up to five minutes apart, often blowing several times before diving. Individuals, usually inactive single adults, can stay underwater for 10+ minutes.

Surface activity—includes fluking, tail slaps, flipper slaps, rolling, belly-up for long periods, breaching—all observed frequently in coastal waters.

Courtship / mating—tactile, 'surface active' animals frequently seen. Immatures often observed in tactile courting behaviour clearly not involving effective mating. Mature adult associations including intromission can involve a single pair or more frequently a tight group, three to 15 animals, with up to seven males pursuing a single female. Promiscuous mating system with little or no male–male aggression, probably with intra-uterine sperm competition. Male–male sexual activity documented.

Cow–calf behaviour—calves develop most behaviour patterns and reduced respiration rates within first two months. Separation distances and active behaviour increase with age, though separation distance decreases just before departure from coastal waters. High variability in behaviour of cows with young calves; generalisations about patterns difficult at species level. At least two strategies adopted by pregnant females: resident in preferred calving sites for entire winter season; mobile over large areas of coastline.

Feeding behaviour—prey dynamics, morphology and limited observation suggest 'skimming' feeding at or near surface, though feeding at depth recorded for northern right whale.

9.5 Mortality and pathology

Little information. Rarely strand. Calves, possibly adults, vulnerable to killer whales, *Orcinus orca*, particularly during migration and in high latitudes though no authenticated records. At least one instance of severe skin infection. At Head of the Bight, SA, neonatal

mortality may be 5%+ in first three months. In coastal South African waters several deaths from ship collisions—one possibly similar incident reported for South Australia. Likely population structure and growth rate imply relatively high juvenile, and low adult, mortality.

9.6 Population abundance and rates of change

Population using Australian coast thought to number ca 6–800, though with three-year calving cycle and probably irregular movements of large proportion of the population (males, non-calving females, juveniles) only a percentage visits each year. Tendency for animals to remain close inshore for long periods can lead to repeat sightings and false belief that species is relatively common.

Increase observed off southern Western Australian coast since 1977, of some 10% per year, but exact rate confounded by increasing evidence of within and between year movements (mainly the latter) between there and waters further east. Off South Africa and South America, annual increases of ca 7% observed. Numbers at Head of Bight, SA fairly consistent from year to year.

10. Threats

10.1 Past

- As with all southern hemisphere right whales, gross exploitation, both shore-based and pelagic, particularly in the early 1800s, reduced numbers off Australia to only small remnants. Continued low-level catches until at least the 1930s and, despite international protection, at least into the late 1960s, are likely to have prevented significant recovery until recently.

10.2 Current

- Direct disturbance possible, particularly in near-shore concentration/calving areas, from:
  - whale watching and research vessels/aircraft, pleasure craft, swimmers and divers
  - low-flying aircraft
  - coastal industrial activity, e.g. seismic, drilling, sandmining and shipping operations
  - defence operations
  - collision with large vessels, particularly on shipping routes on eastern seaboard, in Bass Strait, across the Great Australian Bight
  - entanglement in fishing gear—at least three recent examples
  - pollution, including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea, leading to bio-accumulation of toxic substances in body tissues, though less serious for species rarely feeding in low latitudes.

10.3 Potential

- As 10.2, and likely to increase with increased whale watching pressure, industrial activity, pollution levels, compounded by increase in right whale numbers (see 9.6). Latter will also affect availability of suitable coastal calving habitat.

11. Conservation objectives

11.1 Research

- Monitor extent of current and future population increase, to determine its ability to recover from very low levels.
- Refine knowledge of population's basic biology, genetic structure, population size (original and current), distribution and movements, and resource requirements, e.g.

critical habitat, for comparison with other recovering populations and to provide information on localities where special protection may be required.
- Assess effects of possible disturbance in key areas, e.g. from whale watching, pollution, oil and mineral exploration and exploitation, essential in developing measures to alleviate or prevent such effects.

11.2 Management
- Ensure population potential for recovery to a (defined) proportion of initial stock size, including by:
  – minimising human impacts on individual whales and the population
  – preservation of key habitats.

12. Conservation actions already initiated

12.1 Research
- Establish population status and photo-identify individuals off southern Western Australia (since 1976), and off Western Australia and South Australia (since 1993)—J Bannister, c/- WA Museum.
- Establish population status and photo-identify individuals off southern South Australia (1986–1991)—J Ling/D Needham, SA Museum.
- Establish population status and photo-identify individuals off south-east South Australia/Victoria (1992–93)—C Kemper/R Warneke, SA Museum/Private.
- Investigate behaviour and ecology and photo-identify individuals, Head of the Bight, SA (since 1991)—S Burnell/P Corkeron/M Bryden, University of Sydney.
- Investigate biology and photo-identify individuals, Doubtful Island Bay, WA—R Holst, University of Western Australia.

12.2 Management
- International protection through IWC, including Indian Ocean Sanctuary and Southern Ocean Sanctuary.
- Legal protection of all cetaceans within Australian EEZ, under *Whale Protection Act 1980*, with corresponding provisions under state Acts.
- Education programs at Commonwealth and state level, including release of guidelines for activities near whales.
- Funding assistance for research programs leading to information important for management and conservation.
- Encouragement of and assistance to public/private organisations interested in cetacean welfare.

13. Conservation actions required

13.1 Research
- Continue monitoring population status off Western Australia, South Australia, Victoria, and northwards into New South Wales, through aerial survey.
- Continue photo-identification of individuals off Western Australia, South Australia, Victoria, and northwards into New South Wales, and compare individuals within and between areas, also with any from waters south of Australia, e.g. from Japanese research expeditions, and from New Zealand.
- Continue behavioural and ecological studies and photo-identify individuals at preferred sites, e.g. Head of the Bight, SA.
- Obtain and analyse tissue samples from ‘Australian’ individuals, particularly to determine population structure and extent of homozygosity in a population increasing from very low levels, and to delineate southern populations.

- Using telemetry, investigate extent and range of coastal movements, determine migration routes, locate summer feeding grounds.
- Survey and quantify environmental / geographic parameters of preferred calving locations.
- Investigate short- and long-term effects of whale watching on individual whales.
- Investigate effects of industrial development, including acoustic disturbance, particularly on migration patterns and behaviour.
- Obtain information from stranded specimens, including morphology and genetics.

13.2 Management

- Provide funding assistance and support to organisations / individuals conducting required research, including through levies on commercial whale watching.
- Continue to seek cooperation from industry to implement research programs.
- Through legislation, prohibit / minimise detrimental impacts and protect preferred habitat, e.g. calving and nursery areas at Head of the Bight, SA, and Doubtful Island Bay, WA, on basis of present knowledge, particularly to provide Marine Protected Areas, and prepare oil spill response plans.
- Increase surveillance at key sites during the calving / nursing season (May–October); increase consultation with users of such habitats (e.g. fishers, recreational groups, industry and developers).
- Ensure action within IWC and other international forums (e.g. CITES, CMS) to maintain protection or other appropriate measures to ensure population viability.
- Expand education and public awareness programs and encourage public / private sector involvement in species' conservation.
- Promote whale watching subject to appropriate research and management.
- Ensure specimens available for appropriate scientific museums.

14. Organisations responsible for conservation of species

14.1 International: ***CITES, CMS, IWC***

14.2 National: ***ANCA***
(Australian EEZ = 200 n miles)

14.3 State: ***government wildlife agencies (state waters = 3 n miles)***

15. Other organisations and individuals involved
See 12.1 and 14. Research funding support from ANCA, BHPP particularly.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research

- Partly. High proportion of recent research, particularly in South Australia and Victoria, financed by non-government bodies. Such support, while invaluable, often very short-term and specific. Long-term monitoring and life history studies require dedicated funding for survey implementation over valid time frames (minimum 6+ years). Particular current need for ongoing funding to maintain population monitoring and undertake genetic studies.

17. Remarks
Thorough genetic assessment will require ongoing support from not only Commonwealth but also all relevant state management agencies.

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Pygmy right whale

1. Family	Neobalaenidae
2. Scientific name	*Caperea marginata*
3. English name(s)	Pygmy right whale

4. Taxonomic status, including species and subgroups
Described as *Balaena marginata* by Gray in 1846. No taxonomic confusion at the specific or generic level but has been periodically placed either in its own monospecific family, Neobalaenidae, or in Balaenidae. Recent studies combining genetics and morphology

have concluded that Neobalaenidae is a valid taxon. No subspecies described or recognised.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, but possibly secure (NCA(b))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix I

6. Distribution, including migration
Southern hemisphere between about 30° and 52°S, one South African record from 23°S. Around Australia, most northerly locality is Perth (32°30'S). Strandings and sightings from south-western Western Australia, South Australia, Victoria, southern New South Wales and Tasmania. No records from the Great Australian Bight proper. Not recorded from Macquarie or Heard Islands. Strandings all year on Australian coast suggest it is not migratory.

7. Habitat

7.1 General
Temperate and subantarctic waters. Sightings reported in oceanic, pelagic and inshore situations. Stranding records suggest concentrations in Bass Strait, south-eastern Tasmania, Kangaroo Island, southern Eyre Peninsula and possibly south-western Western Australia, close to habitats rich in marine life and possibly the zooplankton upon which it feeds (e.g. copepods and euphausiids).

7.2 Key localities
Possibly those listed in 7.1.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (based mainly on Australian/New Zealand information)

9.1 Growth and age

Birth, weight/length:	? kg/estimate 1.6–2.2 m
Weaning, age/length:	? months/ca 3.0 m
Physical maturity, age/length:	? years/ca 5.5 m
Weight, maximum:	3430 kg
Age, maximum:	not known
Length, maximum:	6.4 m

9.2 Reproduction

Sexual maturity, age/length:	not known

Calving interval:	not known
Mating season:	not known
Gestation:	not known
Calving season:	possibly year round
Calving area(s):	none known, juveniles strand frequently in South Australia and Bass Strait

9.3 Diet

Zooplankton, limited information suggests copepods and euphausiids. Very fine baleen bristles suggest small food items. Feeding grounds unknown but seen skimming surface off Fremantle, WA.

9.4 Behaviour

Observed in groups of up to 80, but usually singly or less than 10. Described as inconspicuous. Reported to be slow swimmer (3–5 knots), but recent photographs show a clear wake made by animal travelling very quickly. Extensive flexing of the entire body during swimming. Observed swimming with pilot whales, dolphins, sei whales and minke whales. Thump-like sounds, mostly in pairs between 60 and 120 Hz, have been recorded.

9.5 Mortality and pathology

Net deaths have been recorded. Examination of stranded animals has not shown any significant pathology, although one case showed heavy loads of intestinal cestodes. Many strandings in shallow, shoaling bays. Levels of toxic pollutants low in pygmy right whales stranded in Australia.

9.6 Population abundance and rates of change

No estimates of population size. Judging by frequency of strandings (about two to three per year), probably not rare in southern Australian waters.

10. Threats

10.1 Past

- Never the object of a directed fishery, as were other baleen whales, but was probably occasionally taken opportunistically. Small number of animals taken for scientific study. Incidental mortality in nets in South Africa and South Australia.

10.2 Current

- No known cases of illegal capture in Australian waters. Unlikely to be seriously affected by toxic contaminants because of its feeding at a low level in the food chain and its distribution.

10.3 Potential

- Entanglement in drift-nets set outside Australian Territorial Waters and in lost or discarded netting.

11. Conservation objectives

11.1 Research

- Determine distribution and abundance in Australian waters to assess possible impact of threats, particularly effect of direct and indirect fishing activities.

- Determine main feeding grounds and whether resident or migratory in order to assess impact of threats outside Australian waters.
- Determine nursery/calving areas to assess importance of Australian waters for reproduction.
- Determine taxonomic relationships with other major localities in southern hemisphere.

11.2 Management
- Minimise possible detrimental effects on population(s) e.g. from fishing activities.
- Ensure nursery/calving grounds are protected and disturbance minimised therein.

12. Conservation actions already initiated

12.1 Research
- General biology (e.g. distribution, diet, relative age, morphological and genetic variability) being studied by C Kemper, SA Museum, using stranded specimens and sighting reports.
- Planned joint work between D Schell, University of Alaska, and C Kemper studying isotope levels in baleen to determine location of feeding grounds.
- IWC/IDCR sightings cruises in waters south of Australia.

12.2 Management
- Requirement to report incidental catch within Australian Territorial Waters.

13. Conservation actions required

13.1 Research
- Carry out sighting program in southern waters, particularly around Tasmania and off South Australia.
- Obtain basic biological information (including diet and reproductive status) from stranded and incidentally-caught animals.
- Obtain funding for taxonomic comparisons with other continents.

13.2 Management
- Ensure adequate protection of species in Australian and nearby waters.
- Require reporting and salvage of specimens incidentally caught or stranded.
- Ensure specimens available to appropriate scientific museums.

14. Organisation(s) responsible for conservation of species

14.1 International: ***CITES, CMS, IWC***

14.2 National: ***ANCA***
(Australian EEZ = 200 n miles)

14.3 State: ***government wildlife agencies (state waters = 3 n miles)***

15. Other organisations and individuals involved
G J B Ross, Bureau of Flora and Fauna, Australian Nature Conservation Agency
P B Best, Mammal Research Unit, University of Pretoria, South Africa

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No, requires:
- Basic biological information from stranded animals (includes assistance with preparation and curation of specimens).

- Sighting program operated from existing cruises: minimum requirement two observers on appropriate vessels for one year.
- Funding to study specimens held in other continents.

16.2 Management
No, requires:
- Appropriate guidelines/legislation, where not provided.

17. Remarks
Pygmy right whales and minke whales are difficult to distinguish when sighted at sea. A sighting program involving trained observers is needed.

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Minke whale

1. Family	Balaenopteridae
2. Scientific name	*Balaenoptera acutorostrata*
3. English name(s)	Minke whale

4. Taxonomic status, including species and subgroups
First described by Lacépède, 1804. Taxonomy confused, but seem to be three subspecies: *B. acutorostrata acutorostrata*—North Atlantic; *B. acutorostrata davidsoni*—North Pacific; *B. acutorostrata bonaerensis*—southern hemisphere ('dark-shoulder form'). Some recent authors argue the latter is a separate species. In addition, diminutive or dwarf form described from South Africa, South America, Australia, and New Zealand, more

closely related to North Atlantic subspecies than others, probably meriting subspecific status.

5. Species survival status

5.1 Australian Action Plan status
Dark-shoulder form: Secure (S), see 9.6 Diminutive form: No category assigned, because of insufficient information (NCA(a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix I

6. Distribution, including migration
Worldwide, oceanic. Extensive migrations between cold water feeding grounds and warmer water breeding grounds, but less predictable than most other rorquals and possibly not migrating as far into warm waters as other balaenopterids; some populations, e.g. in North Pacific, apparently not migrating at all.
Migration paths presumably widespread; exact locations of breeding grounds not known. Dark-shoulder form major southern hemisphere feeding grounds in Antarctic waters, individuals migrating further south than most rorquals except blue whale. Diminutive form extends north to at least ca 12°S on east coast and possibly as far as 20°S on west coast; seems generally not to travel to the Antarctic, although records as far as
58–65°S. Dark-shoulder form may not migrate as far north as diminutive form; off eastern Australia most northerly record at only ca 21°S, although occurs near the equator off Brazil. Species recorded from all Australian states but not Northern Territory.

7. Habitat

7.1 General
Generally oceanic, but not restricted to deeper water; recorded close to coasts.

7.2 Key localities
Australian records relatively common, from strandings, many diminutive form. Supplementary details to original (South African) diminutive form description from a 7.1 m female trapped in lagoon at Hook Reef, Queensland (19° 52'S). Diminutive form regularly sighted in northern Great Barrier Reef area at 14–16°S, June–July.

8. Marine protected areas managed for or relevant to the species
Ningaloo Marine Park, WA; Great Barrier Reef Marine Park, Queensland.
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone
(= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (mainly from overseas information, on dark-shoulder form)
9.1 Growth and age—Dark-shoulder form

Birth, weight/length: ? kg/ ca 2.8 m
Weaning, age/length: 3–6 months/ 5.7 m?

Physical maturity, age/length:	? years/ ca 10 m	Weight, maximum:	ca 10 tonnes?
Age, maximum:	<50 years		
Length, maximum:	9.8 m (male), 10.7 m (female)		

9.2 Reproduction—Dark-shoulder form

Sexual maturity, age/length:	5–8 years/7.3 m	(male),
	6–8 years/7.9 m	(female)
Calving interval:	1 year	
Mating season:	Aug–Sept	
Gestation:	ca 10 months	
Calving season:	June–July	
Calving area(s):	? temperate–tropical waters, specific areas not identified	

9.1 Growth and age—Diminutive form

Birth, weight/length:	? kg/ca 2 m
Weaning, age/length:	not known
Physical maturity, age/length:	not known
Weight, maximum:	not known
Age, maximum:	not known
Length, maximum:	6.8 m (male), ? (female)

9.2 Reproduction—Diminutive form

Sexual maturity, age/length:	not known
Calving interval:	not known
Mating season:	not known
Gestation:	not known
Calving season:	May–June
Calving area(s):	? temperate–tropical waters

9.3 Diet

Southern hemisphere animals (dark-shoulder form) feed predominantly on *Euphausia superba* and some smaller euphausiid species. A diminutive form minke caught at 58°S had been feeding on myctophids, others at 60–61°S on fish and one at 65°S on euphausiids. Characterised, as other rorquals, as ‘swallowers’ or ‘gulpers’.

9.4 Behaviour

Sound production—as for other rorquals, little evidence of echolocation, although a variety of sounds reported, including frequency-modulated ‘sweeps’, grunts, whistles, clanging bells.

Swimming—one of the faster rorquals, typically surfacing once or twice before sounding. Recorded as evading ships by ‘running’, ‘diving’ and with ‘low profile’ behaviour, hardly breaking the surface and with an inconspicuous blow. Diminutive form breaches regularly in northern Great Barrier Reef area.

Social activity—often occur singly or in groups of two to three, though feeding concentrations may be encountered; diminutive form usually alone or in pairs.

'Ship-seeking' behaviour may occur, where individuals approach slow-moving or stationary vessels. Earlier view that it might confound sightings estimates now discounted; at normal sighting survey speeds (10–12 knots) ship avoidance seems more likely. Diminutive form regularly approaches anchored charter boats and may approach snorkellers and divers. Well-marked segregation often evident, by sex and age.

9.5 Mortality and pathology

May be heavily preyed on by killer whales in the Antarctic; one estimate that they formed 85% of killer whales' diet.

9.6 Population abundance and rates of change

Recent estimates based on sightings surveys give southern hemisphere population total of some 700 000 animals, with two groups relevant to Australia—area IV (70–130°E), ca 90 000, Area V (130–170°W), ca 210 000. Estimates are for the proportion of the population south of 60°S in summer, and therefore exclude the diminutive form. Equivocal evidence of possible change in population status resulting directly from whaling, particularly for Area IV, where catching greatest —ca 35 000 taken there to 1990. Evidence not conclusive either way that minke whales increased because of other rorquals' depletion.

10. Threats

10.1 Past

- A major commercial target only from ca 1970 in the Antarctic, following depletion of larger species. The most important species after 1980. Coastal operations caught minke whales off South Africa and South America from mid-1960s, but no catching from Australian land stations.

10.2 Current

- Direct disturbance possible from:
  - seismic operations
  - collision with large vessels
  - entanglement in fishing gear
  - defence operations
  - pollution, including increasing amount of debris at sea, oil spills and dumping of industrial wastes into waterways and the sea, leading to bio-accumulation of toxic substances in body tissues though less serious for species rarely feeding in low latitudes.

10.3 Potential

- As 10.2.

11. Conservation objectives

11.1 Research

- Investigate identity, distribution, abundance and pollutant levels, for both forms, but particularly diminutive form, to provide information on current status.

11.2 Management

- Minimise possible detrimental effects on population(s) in Australian waters, to ensure population status is maintained or, as necessary, enhanced.

12. Conservation actions already initiated

12.1 Research

- None current apart from opportunistic information from strandings and sightings, information from IWC/IDCR sightings cruises and Japanese research whaling cruises in relevant areas of Southern Ocean (mainly dark-shouldered form), and collation of incidental sightings and photographic records in central and northern Great Barrier Reef area (diminutive form).

12.2 Management

- International protection through IWC, including Indian Ocean Sanctuary and Southern Ocean Sanctuary.
- Legal protection of all cetaceans within Australian EEZ, with corresponding provisions under state Acts.
- Education programs at Commonwealth and state level.
- Encouragement of and assistance to public/private organisations interested in cetacean welfare.

13. Conservation actions required

13.1 Research

- Ensure regular collation of strandings and sightings data, including genetic and pollutant analysis.
- Ensure continued cooperation with other national agencies, e.g. Japan, IWC conducting research cruises in relevant Southern Ocean areas, in the context of Commonwealth Government initiatives for research in the Southern Ocean Sanctuary.

13.2 Management

- Continue action within IWC and other international forums (e.g. CITES, CMS) to maintain protection or other appropriate measures to ensure population viability.
- Ensure specimens available for appropriate scientific museums.

14. Organisations responsible for conservation of species

14.1 International: ***CITES, CMS, IWC***

14.2 National: ***ANCA***
(Australian EEZ = 200 n miles)

14.3 State: ***government wildlife agencies (state waters = 3 n miles)***

15. Other organisations and individuals involved
H Marsh, James Cook University; P Arnold, Museum of Tropical Queensland, Townsville, Queensland

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research

- Possibly, though special funding may be required to ensure genetic analysis and cooperation with overseas agencies.

17. Remarks
Australia will remain heavily dependent on cooperative sightings programs, e.g. IWC/IDCR cruises or programs to be developed in the context of the Southern Ocean Sanctuary, for information on such widely dispersed oceanic species.

Reefs where regular sightings of diminutive form occur, e.g. northern Great Barrier Reef, may be potential study sites. Whale watching, for diminutive form, may become a regular feature of dive charters in northern Great Barrier Reef in winter.

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Sei whale

1. Family	Balaenopteridae
2. Scientific name	*Balaenoptera borealis*
3. English name(s)	Sei whale

4. Taxonomic status, including species and subgroups
Described by Lesson, 1828. No currently recognised subspecies. Until relatively recently, confused with Bryde's whale,
***B. edeni*, particularly in commercial catch records.**

5. Species survival status

5.1 Australian Action Plan status
Vulnerable (V), see 9.6 and 10.1

5.2 IUCN status
Vulnerable

5.3 CITES status
Appendix I

6. Distribution, including migration
Worldwide, oceanic, undertaking long migrations between warm water breeding grounds and colder water feeding grounds, but in southern hemisphere not migrating as far south as other baleen whales except Bryde's whales. More deep-water than close relative Bryde's whale, not often found near coasts. Infrequently recorded in Australian waters, records only from Western Australia, eastern Great Australian Bight, Tasmania

(some reported sightings recently to the south) and Queensland; some sightings records may be confused with Bryde's whales.

7. Habitat

7.1 General
In southern hemisphere restricted mainly north of the Antarctic Convergence in summer; in Indian Ocean in January–March northern limit is 35–40°S. Spend winter north of 30°S.

7.2 Key localities
None specific for Australian waters. Recorded from Western Australia, eastern Great Australian Bight, Tasmania, Queensland. The commonest baleen whale reported in sightings by whalers off Albany, WA, during sperm whaling, but not distinguished in records from Bryde's whale.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (from overseas information)

9.1 Growth and age

Birth, weight / length:	0.7 tonnes / 4.5 m
Weaning, age / length:	6 months / ca 9 m
Physical maturity, age / length:	? years / 15–16 m
Weight, maximum:	? tonnes
Age, maximum:	ca 60 years
Length, maximum:	17.7 m (male), 21 m (female)

9.2 Reproduction

Sexual maturity, age / length:	7–11 years / 13.5 m (male), 13.9 m (female)
Calving interval:	2 years
Mating season:	April–August
Gestation:	12 months
Calving season:	April–August
Calving area(s):	tropical seas, exact localities not identified

9.3 Diet
Feed mainly on pelagic copepods (*Calanus* spp.), also occasionally euphausiids, amphipods. Possibility of competition with southern right whales, feeding in same areas and on same prey.

9.4 Behaviour
Swimming—among the fastest rorquals.

Blow rate—normally do not dive deeply; more regular breathing pattern than other rorquals, blowing at 20–30 second intervals, followed by shallow dives of ca 15 minutes.

Segregation—highly marked, different age and sex classes migrating at different times within the general pattern. Migrate to colder waters later than blue and fin whales; pregnant females first; older and larger animals travelling further south than smaller and younger animals.

Feeding—classified as 'skimmers', swimming through plankton swarms with open mouths. Can also 'gulp' food. Can be found in large concentrations on feeding grounds, otherwise generally in small groups of up to about six.

9.5 Mortality and pathology

Presumably subject to attack by killer whales and / or sharks, but little information.

9.6 Population abundance and rates of change

Southern hemisphere populations very severely reduced over only a short period, ca 1960–1977. Initial pre-whaling numbers likely to have been around 100 000, reduced to about 25 000. No regular or major catches from Australian coastal stations; four animals taken from 1958 to 1963.

10. Threats

10.1 Past

- In southern hemisphere only caught in large numbers as numbers of blue and fin whales declined, particularly from the 1960s, but stocks soon reduced; protected from 1977.

10.2 Current

- Direct disturbance possible by:
  - seismic operations
  - collision with large vessels
  - entanglement in fishing gear
  - pollution, including increasing amounts of plastic debris at sea, oil spills, and dumping of industrial wastes into waterways and the sea, leading to bio-accumulation of toxic substances in body tissues, though less serious for species rarely feeding in low latitudes.

10.3 Potential

- As 10.2.

11. Conservation objectives

11.1 Research

- Investigate identity, distribution, abundance and pollutant levels, to provide information on current status.

11.2 Management

- Minimise possible detrimental effects on population(s) in Australian waters, to permit recovery to a (defined) level.

12. Conservation actions already initiated

12.1 Research

- None apart from opportunistic information from strandings or sightings, and cooperation with, for example, Japanese agencies conducting research cruises in relevant areas of Southern Ocean.

12.2 Management

- International protection through IWC, including Indian Ocean Sanctuary and the Southern Ocean Sanctuary.
- Legal protection of all cetaceans within Australian EEZ, with corresponding provisions under state Acts.
- Education programs at Commonwealth and state level.
- Encouragement of and assistance to public/private organisations interested in cetacean welfare.

13. Conservation actions required

13.1 Research
- Ensure regular collation of strandings and sightings data, including genetic and pollutant analysis.
- Ensure continued cooperation with other national agencies, e.g. Japan, IWC, conducting research cruises in relevant Southern Ocean areas, in the context of Commonwealth Government initiatives for research in the Southern Ocean Sanctuary.

13.2 Management
- Continue action within IWC and other international forums (e.g. CITES, CMS) to maintain protection or other appropriate measures to maintain population viability.
- Ensure specimens available for appropriate scientific museums.

14. Organisations responsible for conservation of species

14.1 International: ***CITES, CMS, IWC***

14.2 National: ***ANCA***
(Australian EEZ = 200 n miles)

14.3 State: ***government wildlife agencies (state waters = 3 n miles)***

15. Other organisations and individuals involved
None currently.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
- Special funding will be required to ensure genetic analysis and cooperation with overseas agencies.

17. Remarks
Australia will remain heavily dependent on cooperative sightings programs, e.g. IWC/IDCR cruises or programs developed in the context of the Southern Ocean Sanctuary, for information on such widely dispersed oceanic species, but attempts should be made to obtain information on the species in areas such as south of Tasmania and in the eastern Great Australian Bight where recent sightings have been reported.

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Bryde's whale

1. Family	Balaenopteridae
2. Scientific name	*Balaenoptera edeni*
3. English name(s)	Bryde's whale

4. Taxonomic status, including species and subgroups

First described by Anderson, 1878. Some confusion for many years with the sei whale, *B. borealis*; included with it, for example, in commercial catch returns, until at least 1970. No subspecies formally recognised, but several morphological forms exist, possibly meriting subspecific rank.

5. Species survival status

5.1 Australian Action Plan status
No category assigned, but possibly secure (NCA (a))

5.2 IUCN status
Insufficiently known

5.3 CITES status
Appendix I

6. Distribution, including migration

The least migratory balaenopterid, restricted to tropical and temperate waters, from the equator to ca 40°S. Some question whether northern and southern hemisphere populations are distinct, although as in other balaenopterids, breeding seasons appear mainly to be six months apart. In several areas, a large offshore and a smaller inshore form, the former showing some seasonal movements, the latter largely sedentary. Recorded from all Australian states except Northern Territory. Doubt over some specimens' exact identity: three from Western Australia and two from the east coast intermediate between *B. edeni* and *B. borealis*, the sei whale; three from Victoria and another from Western Australia typical *B. edeni*. Animals from the Solomon Islands reportedly smaller than elsewhere and may form a separate stock.

7. Habitat

7.1 General
Temperate to tropical waters, both oceanic and inshore, bounded by latitudes 40°N and S, or the 20°isotherm. In Indian Ocean, concentrations found south-west of Indonesia, and off Australian west coast; in west Pacific, concentrations off Queensland, south-east of PNG, and between Solomons and New Zealand.

7.2 Key localities
Recorded from several coastal Australian localities, e.g. the Abrolhos Islands and north of Shark Bay, WA, and off Queensland. Likely to be found along either east or west coast, less so along the south coast.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (mainly from overseas information)

9.1 Growth and age

Birth, weight/length:	? kg/ca 3.4 m
Weaning, age/length:	<1 year/? m
Physical maturity, age/length:	? years/ca 13 m
Weight, maximum:	? tonnes
Age, maximum:	? 50 years
Length, maximum:	15.5 m

(above vary between individual populations)

9.2 Reproduction

Sexual maturity, age/length:	ca 10 years/ just <12 m
Calving interval:	ca 2 years
Mating season:	throughout year (inshore form), autumn/winter (offshore form)
Gestation:	ca 1 year
Calving season:	as mating season
Calving area(s):	temperate/tropical waters, exact locations not identified

9.3 Diet
Inshore forms feed very largely on shoaling fish e.g. anchovies, offshore forms on euphausiids. Remarkable instance of such feeding on extensive anchovy shoal close to cliffs north of Shark Bay, WA, July 1993.

9.4 Behaviour
Sound production—as for other balaenopterids, not known to echolocate; only sounds so far recorded seem to be powerful low frequency moans.

Swimming—reported swimming at more than 10 knots while feeding, but maximum speed likely to be greater.

Diving—reported to blow four or five times before making prolonged dives, for up to 20 minutes, thus different from sei whales which blow more regularly and dive more shallowly.

Surface behaviour—rarely show flukes on diving; often rise steeply to surface, exposing the head, rolling and humping the tailstock. Frequently accelerate and change direction sharply; when feeding often roll on to their sides or churn water at the surface, closely resembling behaviour of fin whales.

Feeding behaviour—characterised as 'swallowers'.

9.5 Mortality and pathology
Little information. Presumably subject to attack by killer whales and sharks.

9.6 Population abundance and rates of change
Little information. Some catches in the eastern Indian Ocean and west Pacific, but possibly little effect on population status.

10. Threats

10.1 Past
- Because of its distribution, less subject to whaling than other southern hemisphere balaenopterids. Never the subject of any major Australian fishery, though eight taken during post-World War II humpback whaling off west coast, 1958–63.

10.2 Current
- Direct disturbance possible from:
  - seismic operations
  - collision with large vessels (one recently off northern Tasmania)
  - entanglement in fishing gear
  - defence operations
  - pollution, including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea, leading to bio-accumulation of toxic substances in body tissues
  - over-fishing of prey species, particularly commercial species such as anchovy.

10.3 Potential
- As 10.2.

11. Conservation objectives

11.1 Research
- Investigate identity, distribution, abundance, basic biology and pollutant levels, to provide base-line data on current status of this little known species.

11.2 Management
- Ensure protection against harassment or other disturbance, including from fishing operations, to minimise possible detrimental effects.

12. Conservation actions already initiated

12.1 Research
- None apart from opportunistic information from strandings or sightings, and cooperation with, for example, Japanese agencies conducting research cruises in relevant areas of eastern Indian and western Pacific oceans.

12.2 Management
- International protection through IWC, including Indian Ocean Sanctuary.
- Legal protection of all cetaceans within Australian EEZ, with corresponding provisions under state Acts.
- Education programs at Commonwealth and state level.

- Encouragement of and assistance to public / private organisations interested in cetacean welfare.

13. Conservation actions required

13.1 Research
- Ensure regular collation of strandings and sightings data, including genetic and pollutants analysis.
- Ensure continued cooperation with other national agencies, e.g. Japan, conducting research cruises in relevant eastern Indian and western Pacific Ocean areas.

13.2 Management
- Continue action within IWC and other international forums (e.g. CITES, CMS) to maintain protection or other appropriate measures to ensure population viability.
- Ensure specimens available for appropriate scientific museums.

14. Organisations responsible for conservation of species

14.1 International: *CITES, CMS, IWC*

14.2 National: *ANCA*
(Australian EEZ = 200 n miles)

14.3 State: *government wildlife agencies (state waters = 3 n miles)*

15. Other organisations and individuals involved
None current.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No, requires:
- Special funding will be required to ensure genetic analysis and cooperation with overseas agencies.

17. Remarks
Australia will remain heavily dependent on cooperative sightings programs, e.g. Japanese agency cruises in warmer waters, for information on such widely dispersed oceanic species.

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Blue whale

1. Family	Balaenopteridae
2. Scientific name	*Balaenoptera musculus*
3. English name(s)	Blue whale

4. Taxonomic status, including species and subgroups
First described by Linnaeus, 1758, as *Balaena musculus*. Two subspecies recognised: *B. musculus musculus*—the 'true' blue whale; *B. musculus brevicauda*—the pygmy blue whale.

5. Species survival status

5.1 Australian Action Plan status
'True' blue: Endangered (E), see 9.6. 'Pygmy' blue: No category assigned, because of insufficient information (NCA (a))

5.2 IUCN status
Endangered

5.3 CITES status
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6. Distribution, including migration
Oceanic, worldwide. Extensive migrations between warm water (low latitude) breeding and cold water (high latitude) feeding grounds; in southern hemisphere, between latitudes approx 20°S and 60–70°S.

Pygmy blue subspecies occurs only in southern hemisphere, particularly in Indian Ocean, and migrates less far south: headquarters north of 50°S in summer.

Species recorded from all Australian states. Migration paths widespread, not obviously following coastlines or oceanographic features; exact breeding ground locations unknown.

7. Habitat

7.1 General
Oceanic, worldwide, but not restricted to deeper waters.

7.2 Key localities
Can occur relatively close to coast. Recent sightings include off Rottnest Island, within a few miles of Dampier Archipelago, WA; in Great Australian Bight, e.g. off South Australia and western Victoria; off south-east Victoria; in Bass Strait; off south-east New South Wales, off east and west Tasmania. Has stranded in Victoria, South Australia, Tasmania, Western Australia, Queensland. Recent strandings and near coast identifications have been mostly pygmy blues. Of 15 sightings between the Western Australian south coast and 45°S in February–March 1993, only one identified as a 'true' blue whale, the remainder pygmy blues. Concentrations, identified as mainly pygmy blues, found off Rottnest Island, WA, and Portland, Victoria, in December 1995.

8. Marine protected areas managed for or relevant to the species
All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone

(= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (mainly from overseas sources)

9.1 Growth and age—'True' blue

Birth, weight/length:	? kg/6–7 m ca 6 m
Weaning, age/length:	7 months/16 m
Physical maturity, age/length:	ca 30 years/ 24–25 m (male), 26–27 m (female)
Weight, maximum:	130 tonnes+
Age, maximum:	80–90 years
Length, maximum:	30.5 m

9.2 Reproduction—'True' blue

Sexual maturity, age/length:	5–10 years/22 m (male), 23–24 m (female)
Calving interval:	2–3 years
Mating season:	winter, peak July
Gestation:	10–11 months
Calving season:	winter, peak May–June?
Calving area(s):	tropical, open ocean, specific areas not identified

9.1 Growth and age—Pygmy blue

Birth, weight/length:	ca 6 m
Weaning, age/length:	as for true blue?
Physical maturity, age/length:	? 30 years/21 m (male), 22 m (female)
Weight, maximum:	? kg
Age, maximum:	? <50years
Length, maximum:	24.4 m

9.2 Reproduction—Pygmy blue

Sexual maturity, age/length:	? years/<19 m (male), 19 m (female)
Calving interval:	2–3 years
Mating season:	winter, peak July
Gestation:	10–11 months
Calving season:	winter, peak July
Calving area(s):	tropical, ? open ocean, specific areas not identified

9.3 Diet

'True' blues' feeding restricted to colder, i.e. Antarctic, waters, almost exclusively on *Euphausia superba.* Pygmy blues feed further north, on smaller euphausiids—reports of possible feeding behaviour, e.g. off Rottnest Island, WA, Portland, Victoria and in Bass Strait. Possibly little competition between 'true' blues and other balaenopterids feeding on *E. superba,* as 'true' blues distributed further south, e.g. right to ice edge, except with minke whale, similarly distributed.

9.4 Behaviour

Sound production—as for other baleen whales, evidence of echolocation equivocal. Commonest sounds are low frequency moans, presumed for communication. Recent US naval evidence demonstrates long transmission distances and potential for analysing distribution.

Swimming—current estimates: 2–6.5 km / hr while feeding; 5–33 km / hr cruising or migrating; 20–48 km / hr when chased.

Blow rate—general pattern of 10–20 shallow dives at 12–20 second intervals followed by a deep dive of 10–30 mins.

Social activity—usually solitary or in small groups of two to three. No information on courtship or breeding behaviour.

Feeding—generally characterised as 'swallowers' or 'gulpers'; in one day may consume 2–4 tonnes of food.

9.5 Mortality and pathology

Little information on life-threatening disease or parasitism. Calves and possibly adults subject to attack by killer whales, and possibly sharks. Individuals occasionally strand, but with no likely effect on population status.

9.6 Population abundance and rates of change

Southern hemisphere populations of 'true' blues drastically reduced through twentieth century overfishing, mainly in the Antarctic. No major Australian coastal blue whale fishery, although 21 animals, all pygmy blues, were taken during humpback whaling, 1954–1963. Initial southern hemisphere population estimated at 160 000–240 000, including 10 000 pygmy blues; current population may be <1000 'true' blues, with some 6000 pygmy blues. Recent Antarctic sightings surveys have found little or no evidence for increase in 'true blues' since total protection in 1965; previously unreported USSR pelagic catches, into the early 1970s and involving both 'under' and 'over' reporting, may well have delayed any possible recovery.

10. Threats

10.1 Past

- Over-hunting (of 'true' blues) in commercial whaling operations, leading to drastic reduction in population numbers to only a small remnant of original, e.g. in southern hemisphere from ca 200 000 to perhaps fewer than 1000 currently.

10.2 Current

- Direct disturbance possible from:
  - seismic operations
  - collision with large vessels
  - entanglement in fishing gear
  - defence operations
  - pollution, including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea, leading to bio-

accumulation of toxic substances in body tissues, though less serious for species rarely feeding in low latitudes.

10.3 Potential
- As 10.2, and likely to increase if stock numbers themselves increase.

11. Conservation objectives

11.1 Research
- Investigate identity, distribution, abundance and pollutant levels, to provide information on current status of both forms.

11.2 Management
- Minimise possible detrimental effects on population(s) in Australian waters, to permit recovery if possible, particularly of 'true' blue.

12. Conservation actions already initiated

12.1 Research
- None apart from opportunistic information from strandings or sightings, and cooperation with, for example, Japanese agencies conducting research cruises in relevant areas of Southern Ocean.

12.2 Management
- International protection through IWC, including Indian Ocean Sanctuary and Southern Ocean Sanctuary.
- Legal protection of all cetaceans within Australian EEZ, with corresponding provisions under state Acts.
- Education programs at Commonwealth and state level.
- Encouragement of and assistance to public / private organisations interested in cetacean welfare.

13. Conservation actions required

13.1 Research
- Investigate feasibility of undertaking acoustic and shipboard / aircraft surveys for distribution / abundance in Australian waters, particularly where species is known to occur, e.g. off Eden, NSW, south-western Western Australia, in eastern Great Australian Bight and Bass Strait.
- Ensure continued cooperation with other national agencies, e.g. Japan, IWC, conducting research cruises in relevant Southern Ocean areas in the context of Australian Government initiatives for research in the Southern Ocean Sanctuary.
- Ensure regular collation of strandings and sightings data, including genetic and pollutant analysis.

13.2 Management
- Ensure action within IWC and other international forums (e.g. CITES, CMS) to maintain protection or other appropriate measures to ensure population viability.
- Ensure specimens available for appropriate scientific museums.

14. Organisations responsible for conservation of species

14.1 International: ***CITES, CMS, IWC***

14.2 National: ***ANCA***
(Australian EEZ = 200 n miles)

14.3 State: ***government wildlife agencies (state waters = 3 n miles)***

15. Other organisations and individuals involved
None current.

16. Can research and management be carried out with existing resources?
If no, what is required?

16.1 Research
No, requires:
- Special funding to undertake feasibility study on current status, ensure genetic analysis and cooperation with overseas agencies.

17. Remarks
Australia will remain heavily dependent on cooperative sightings programs, e.g. IWC/IDCR cruises,or programs to be developed in the context of the Southern Ocean Sanctuary, for information on such widely dispersed oceanic species. It should, however, also be possible to obtain information on both forms within Australian waters from studies in selected areas where they occur, hence the recommendation for a feasibility study under 13.1.

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Fin whale

1. Family	Balaenopteridae
2. Scientific name	*Balaenoptera physalus*
3. English name(s)	Fin whale

4. Taxonomic status, including species and subgroups
Described by Linnaeus, 1758, as *Balaena physalus*. No currently accepted subspecies.

5. Species survival status

5.1 Australian Action Plan status
Vulnerable (V), following extreme reduction through whaling, see 9.6 and 10.1

5.2 IUCN status
Vulnerable

5.3 CITES status
Appendix I

6. Distribution, including migration

Oceanic, worldwide. Extensive migrations between warm water breeding grounds and cold water feeding grounds. In southern hemisphere do not go quite as far south as blue or minke whales, not occurring as close to ice edge. Tend to enter and leave Antarctic waters after blue whales but before sei whales. Migration paths oceanic, not obviously following coastlines, at least off Australia. Recorded from all states except New South Wales, and Northern Territory.

7. Habitat

7.1 General

Oceanic, worldwide, generally in deeper water.

7.2 Key localities

None obvious in Australian waters. Some reported by whalers off Albany, WA, e.g. 14 in four years 1974–77; at least three taken in coastal whaling from Australian land stations from 1949 to 1963.

8. Marine protected areas managed for or relevant to the species

All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (from overseas information)

9.1 Growth and age

Birth, weight/length:	1.9 tonnes/6.4 m
Weaning, age/length:	6–7 months/12 m
Physical maturity, age/length:	< 15 years/ca 23 m
Weight, maximum:	ca 90 tonnes
Age, maximum:	90–100 years
Length, maximum:	25 m (male), 27 m (female)

9.2 Reproduction

Sexual maturity, age/length:	6–10 years/ 19.2 m (male), 19.9 m (female)
Calving interval:	2–3 years
Mating season:	April–August
Gestation:	11.25 months
Calving season:	April–August
Calving area(s):	tropical waters, exact locations not identified

9.3 Diet

In southern hemisphere feed largely on Antarctic krill, *Euphausia superba.*

9.4 Behaviour

Sound production—as for other baleen whales, thought not to echolocate. Range of sounds produced, from high frequency downward-sweeping pulses to low frequency rumbles.

Swimming—one of the fastest rorquals, speeds over 30 km / hr recorded. On migration calculated to cover 90 nm / day. Characteristically a series of shallow dives, 10–20 seconds long, followed by a longer dive for 15 minutes plus.

Social activity—sometimes found singly or in pairs; can form larger groupings, up to 100 or more, on feeding grounds. Segregation by sex and class, with males preceding females on migration, pregnant females in advance of others, immatures last.

Feeding—characterised as 'gulpers', observed feeding on sides at surface, making lateral scoop, mouth open, throat distended.

9.5 Mortality and pathology

Little information. Presumably subject to attack by killer whales and sharks, particularly calves.

9.6 Population abundance and rates of change

Southern hemisphere population estimated at around 500 000 pre-exploitation, reduced by whaling to possibly as little as 25 000. Little information on any change in numbers since protection in 1976.

10. Threats

10.1 Past

- Severely depleted in southern hemisphere by 20th century whaling. Second in commercial importance to blue whales. Protected from 1975 in southern hemisphere.

10.2 Current

- Direct disturbance possible from:
  - seismic operations
  - collision with large vessels
  - entanglement in fishing gear
  - pollution, including increasing amount of debris at sea, oil spills and dumping of industrial wastes into waterways and the sea, leading to bio-accumulation of toxic substances in body tissues.

10.3 Potential

- As 10.2.

11. Conservation objectives

11.1 Research

- Investigate identity, distribution, abundance and pollutant levels to assess possible impact of threats.

11.2 Management

- Minimise possible detrimental efffects on population(s) to ensure population potential for recovery to a (defined) level.

12. Conservation actions already initiated

12.1 Research

- None apart from opportunistic information from strandings or sightings, and cooperation with, for example, Japanese agencies conducting research cruises in relevant areas of Southern Ocean.

12.2 Management

- International protection through IWC, including Indian Ocean Sanctuary and Southern Ocean Sanctuary.
- Legal protection of all cetaceans within Australian EEZ, with corresponding provisions under state Acts.
- Education programs at Commonwealth and state level.
- Encouragement of and assistance to public/private organisations interested in cetacean welfare.

13. Conservation actions required

13.1 Research

- Ensure regular collation of strandings and sightings data, including genetic and pollutant analysis.
- Ensure continued cooperation with other national agencies, e.g. Japan, IWC, conducting research cruises in relevant Southern Ocean areas, in the context of Australian Government initiatives for research in the Southern Ocean Sanctuary.

13.2 Management

- Continue action within IWC and other international forums (e.g. CITES, CMS) to maintain protection or other appropriate measures to ensure population viability.
- Ensure specimens available for appropriate scientific museums.

14. Organisations responsible for conservation of species

14.1 International: *CITES, CMS, IWC*

14.2 National: *ANCA*
(Australian EEZ = 200 n miles)

14.3 State: *government wildlife agencies (state waters = 3 n miles)*

15. Other organisations and individuals involved
None current.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No, requires:

- Special funding will be required to ensure genetic analysis and cooperation with overseas agencies.

17. Remarks
Australia will remain heavily dependent on cooperative sightings programs, e.g. IWC/IDCR cruises, for information on such widely dispersed oceanic species.

Selected references

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Humpback whale

1. Family	Balaenopteridae
2. Scientific name	*Megaptera novaeangliae*
3. English name(s)	Humpback whale

4. Taxonomic status, including species and subgroups
Described by Borowski, 1781, as *Balaena novaeangliae.* No taxonomically valid subgroups currently recognised, although several separate populations recognised, based on breeding and/or feeding separation, e.g. in southern hemisphere, see 6.

5. Species survival status

5.1 Australian Action Plan status
Vulnerable (V), see 9.6

5.2 IUCN status
Vulnerable

5.3 CITES status
Appendix I

6. Distribution, including migration
Worldwide. Coastal off Australia in winter and spring, recorded from all states except Northern Territory. Annual migrations between warm water breeding grounds, ca 15–20°S (but some records much further north), and summer colder water (Antarctic) feeding grounds, to 60–70°S. Northern and southern hemisphere populations distinct, given temporal migration separation. At least six southern hemisphere populations, based on Antarctic feeding distribution and location of breeding grounds either side of each continent. Off Australia, wintering animals off west coast (Group IV population) shown from marking, genetics and song to be distinct from those off east coast (Group V population), though latter more closely related to those wintering off Tonga. May approach close to coast on migration, e.g. within a path not more than 10 n miles wide off Shark Bay, WA, and Stradbroke Island, Queensland. Only northward migrating animals found off Western Australian south coast. Animals seen in eastern Great Australian Bight in early winter, e.g. at Head of the Bight, and near Kangaroo Island, SA, presumably strays from Group V population. Not all animals may migrate south each year; some summer sightings, e.g. in Coral Sea and Torres Strait near Murray Islands, although Coral Sea animals may be late migrants. Reported sex ratio bias towards males in east coast migration; perhaps not all females migrate north each year.

7. Habitat

7.1 General
Antarctic pelagic, in summer; temperate–subtropical/tropical coastal in winter.

7.2 Key localities

Western Australia: Cape Naturaliste / Geographe Bay, north of Rottnest Island, Shark Bay, North West Cape, off Dampier Archipelago, coastal islands off Kimberley; New South Wales: southern coast, off Coffs Harbour, Cape Byron; Queensland: off Stradbroke Island, Hervey Bay, islands in Great Barrier Reef, especially Whitsunday Passage area.

Exact locations of breeding grounds unknown, although much breeding occurs in central Great Barrier Reef area, on east coast; probably a wide range of opportunity for breeding, over several degrees of latitude on each coast. Feeding areas concentrated in Antarctic waters between 80 and 110°E (Group IV), 150 and 180°E (Group V), but with occasional overlap.

8. Marine protected areas managed for or relevant to the species

Ningaloo Marine Park, Marmion Marine Park, WA; Great Barrier Reef Marine Park, Hervey Bay Marine Park, Moreton Bay Marine Park, Queensland.

All cetaceans protected under state legislation to 3 n miles and under Australian legislation within Australian Exclusive Economic Zone (= 200 n miles). Species subject to IWC regulations (see Item 2.3) protected within Indian Ocean Sanctuary and Southern Ocean Sanctuary (see Item 5.4.6).

9. Biological overview (from both Australian and overseas sources)

9.1 Growth and age

Birth, weight / length:	2000 kg / 4–5 m	
Weaning, age / length:	up to 11 months /	7.5–9 m
Physical maturity, age / length:	? 12–15 years / 13.4 m (male), 13.7 m (female)	
Weight, maximum:	ca 45 tonnes	
Age, maximum:	? ca 50 years	
Length, maximum:	18 m	

9.2 Reproduction

Sexual maturity, age / length:	4–10 years / 11.6 m (male), 12.1 m (female)
Calving interval:	2–3 years, sometimes twice / 3 years, or even annual
Mating season:	June–October
Gestation:	11–11.5 months
Calving season:	June–October
Calving area(s):	tropical coastal waters, exact locations not yet identified but see 7 above

9.3 Diet

Feed mainly in Antarctic waters, i.e. south of ca 55°S. In southern hemisphere almost exclusively on *Euphausia superba* (krill)—elsewhere small shoaling fish and occasional benthic organisms. Some evidence of feeding on fish and plankton swarms in warmer waters, e.g. off Eden, NSW and on larval *Munida gregaria* on southern migration off New Zealand, but catches in subtropics off north-west Western Australia and eastern Australia showed almost no evidence of local feeding.

9.4 Behaviour

Sound production—many different sound types produced, with 'songs' on breeding grounds and possibly elsewhere. Songs different between populations, e.g. substantially different on east and west Australian coasts; apparently the same within one population in one year, but changing slightly between years. Songs thought mainly to be from breeding males.

Swimming—can average 8km/hr on migration.

Blow rate—short dives last 2–4 mins with irregular blows at surface over 1 minute; longer dives 8–15 minutes, with tail flukes lifted on diving, at surface ca 4 min, blowing regularly.

Surface activity—flipper and tail slaps, lobtailing, spyhopping, breaching, all common. Social groups of up to seven animals may form, predominantly male; agonistic/threat behaviour common.

Courtship—behaviour as above often apparently associated with breeding; copulation and birth very rarely observed.

Segregation on migration—immatures and females with yearling calves in van of northward migration, followed by adult males, non-pregnant mature females; pregnant females in the rear. Similarly on southward migration, with cow/calf pairs travelling last.

Fluking utilised in photo-identification—patterned tail fluke underside individually unique, also flank pigmentation, and to lesser extent dorsal fin shape.

Feeding—classified as 'swallowers'. 'Lunge' and 'bubble' feeding described from northern hemisphere, rarely from southern hemisphere; latter involves production of a bubble net formed by exhalation under water, concentrating prey; 'washing machine' feeding behaviour described from southern hemisphere.

9.5 Mortality and pathology

Little information. Stranding uncommon. Calves known to be attacked by sharks and killer whales. Reported to be the most heavily parasitized balaenopterid; animal's slow swimming speed may allow ectoparasites to accumulate, particularly on body areas protected from strong water flow. Whale lice, barnacles and diatoms commonly present. Significant pesticide levels reported in blubber. DDT levels possibly related to annual migrations, with highest levels on feeding grounds, lowest in breeding areas.

9.6 Population abundance and rates of change

Recent point estimates:
Group IV: 3–4000, Group V: 14–1900, cf unexploited state (pre-1935)—Group IV: 12–17 000, Group V: 10 000; 1949—Group IV: 10 000, Group V: 10 000; 1963—Group IV: 570, Group V: ca 500. Current increase rates ca 10% respectively. Re-analysis currently under way may increase Group V unexploited size considerably.

10. Threats

10.1 Past

- As with all other humpback populations, greatly reduced by commercial exploitation, in some cases in several phases. Most recently since 1949, with whaling on the two Australian populations both from the coast and in the Antarctic, resulting in reduction to
  5–6% of initial size by 1963. Despite international protection since then, recovery seems to have been delayed until mid-1970s, possibly mainly through continued illegal catches until about 1970.

10.2 Current

- Direct disturbance possible, on migration path and in breeding areas, by:
  - whale watching and research vessels/aircraft, pleasure craft, swimmers and divers
  - coastal seismic operations
  - defence operations
  - collision with large vessels
  - entanglement in fishing gear/shark nets
  - pollution, including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea, leading to bio-accumulation of toxic substances in body tissues, though less serious for species rarely feeding in low latitudes.

10.3 Potential

- As 10.2, and likely to increase with increased whale watching pressure, petroleum and mineral exploration, particularly as humpback numbers themselves increase. Any take will retard recovery at this point in the population's growth.

11. Conservation objectives

11.1 Research

- Monitor extent of current and future increase of each population, to determine the population's ability to recover from very low levels.
- Refine knowledge of each population's basic biology, distribution and movements, for comparison with other recovering populations and to provide information on localities where special protection may be required.
- Assess effects of possible disturbance in key areas, e.g. from whale watching, oil and mineral exploration and exploitation, essential in developing measures to alleviate or prevent such effects.

11.2 Management

- Maintain viable populations in Australian waters, including protection against harassment and industrial interference, to permit recovery to a (defined) proportion of initial stock size.

12. Conservation actions already initiated

12.1 Research

- Investigate migration path width: off Queensland—M Bryden et al., University of Sydney; off Western Australia—Woodside Petroleum; C Jenner and
  M-N Jenner, Centre for Whale Research.
- Establish breeding area locations: off north-west Western Australia—P Gill, Oceanic Research Foundation/W Dawbin, c/- Australian Museum; C Jenner & M-N Jenner.
- Determine rates of recovery: Group IV—J Bannister, c/- WA Museum; Group V—M Bryden et al., R Paterson, Queensland Museum.
- Determine population size: Group IV, J Bannister, C Jenner and M-N Jenner; Group V as above.

- Assess relationships with other populations, particularly in southern hemisphere but also worldwide, through genetics: C Baker, Auckland University, NZ; M Bryden et al.; P Hale, University of Queensland.
- Photo-identification of individuals: AWCS, Brisbane; C Burton, c/- WA Museum; M Bryden et al.; D Coughran, CALM, WA; P Gill; C Jenner and M-N Jenner; Pacific Whale Foundation, Kihei, Hawaii.
- Monitor population recovery and obtain behavioural information, Group V—AWCS, Brisbane.
- Assess whale watching impact: Hervey Bay, Queensland.
- Assess abundance and distribution in Southern Ocean and Antarctic: IWC collaborative sightings cruises.
- 'Song' studies: W Dawbin c/- Australian Museum, New South Wales; E Eyre, Taronga Zoo; D Cato, Defence Department.
- Investigate behaviour in Antarctic: P Gill.

12.2 Management

- International protection through IWC, including Indian Ocean Sanctuary and Southern Ocean Sanctuary.
- Legal protection of all cetaceans within Australian EEZ, with corresponding provisions under state Acts.
- Establishment of marine parks.
- Education programs at Commonwealth and state level, including release of guidelines for activities near whales.
- Funding assistance for research programs leading to information important for management.
- Encouragement of and assistance to public/private organisations interested in cetacean welfare.

13. Conservation actions required

13.1 Research

- Maintain all initiatives under 12.1, including review of west coast results to 1994 , especially methodology and frequency required to estimate population numbers and trend.
- Re-examine data to recalculate original population size.
- Investigate short- and long-term effects of whale watching on individual whales.
- Investigate effects of industrial development, including acoustic disturbance, particularly on migration patterns and behaviour.
- Using telemetry, determine migration routes, locate breeding grounds and extent of any non-migratory dispersal in warm waters in summer.
- Survey and quantify environmental/geographic parameters of breeding grounds.
- Conduct research into alternatives to shark nets and/or devices to alert animals to the presence of nets.
- Obtain information from strandings, including genetics.

13.2 Management

- Provide funding assistance and support to organisations/individuals conducting required research.
- Through legislation, prohibit/minimise detrimental impacts and protect key habitat areas.
- Ensure action within IWC and other international forums (e.g. CITES, CMS) to maintain protection or other appropriate measures to ensure population viability.

- Expand education and public awareness programs and encourage public/private sector in species' conservation.
- Promote whale watching subject to appropriate research and management.
- Ensure specimens available for appropriate scientific museums.

14. Organisations responsible for conservation of species

14.1 International: ***CITES, CMS, IWC***

14.2 National: ***ANCA***
(Australian EEZ = 200 n miles)

14.3 State: ***government wildlife agencies (state waters = 3 n miles)***

15. Other organisations and individuals involved
See 12.1 and 14. Research funding has come mainly from government and university sources, with some commercial and private support.

16. Can research and management be carried out with existing resources? If no, what is required?

16.1 Research
No, requires:
- Current funding levels permit some monitoring, e.g. off Queensland and Western Australia, and photo-identification. Some projects, mainly short-term and specific, funded by non-government bodies. Long-term population monitoring, assessment and life history studies require dedicated funding over valid time frames. Particular current need for ongoing funding to maintain population assessment and monitoring, and photo-identification studies.

17. Remarks
Both Australian populations were the subject of intensive research in the period 1949–63, in the context of the Australian whaling industry.

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5. Conclusions and Recommendations

5.1 Actions arising from conservation status

The Consultancy Agreement required development of a list of extinct, endangered, vulnerable and potentially vulnerable cetaceans, identification of key habitats for endangered or vulnerable taxa, identification of threatening processes—especially for endangered or vulnerable species—review of current research and management action for such species, and recommendations on future priorities (Consultancy Agreement, Scope, Items 2.2–2.5, reproduced here as Appendix 1, Items 2–4).

The species synopses developed in Item 4 of this report cover all the above, for all Australian cetaceans, including those in all the categories adopted, as determined in Item 3. While we could here restrict ourselves solely to those cetaceans in the ‘endangered’ and ‘vulnerable’ categories, we believe that, given their potential vulnerability, those in the ‘insufficiently known’ category should also be included for priority action.

As a result of the above, there are nine species for priority action, as follows.

Category 1—Endangered

One subspecies:

Balaenoptera musculus musculus, blue whale (nominate or ‘true’ form)

Category 2—Vulnerable

Four species:

Eubalaena australis, southern right whale

Megaptera novaeangliae, humpback whale

Balaenoptera borealis, sei whale

Balaenoptera physalus, fin whale

Category 3—Insufficiently known

Four species:

Sousa chinensis, Indo-Pacific humpbacked dolphin

Orcaella brevirostris, Irrawaddy dolphin

Stenella longirostris, spinner dolphin

Physeter macrocephalus, sperm whale

However, it should be noted here that not all nine species are equally amenable to research and management within Australian waters. Two of the vulnerable species, sei and fin whales, and to a lesser extent the endangered 'true' blue whale require research and management actions extending well beyond the limits of Australian jurisdiction, into international waters. They will be covered by proposals for such actions within the recently established Southern Ocean Sanctuary (see Item 5.4.6). The latter are under separate consideration by ANCA for recommendation to the Australian Government.

The other six species are more appropriately targeted within the EEZ adjacent to the Australian continent. Consequently we have considered priority for actions relevant to their individual circumstances that can be undertaken within those waters as well as, where practicable, for the 'true' blue, sei and fin whales. We **recommend** accordingly as below. Categories are listed in priority, as are species and actions within them.

Category 1—Endangered

Balaenoptera musculus musculus—blue whale (nominate or 'true' form)

Research

(a) objectives

- investigate identity, distribution, abundance, to provide information on current status, particularly cf the pygmy blue whale

(b) actions required

- investigate feasibility of undertaking acoustic and shipboard / aircraft surveys for distribution / abundance in Australian waters, particularly where either subspecies is known to occur, e.g. off Eden, NSW, south-western Western Australia, in the eastern Great Australian Bight and Bass Strait
- ensure continued cooperation with other national and international agencies, e.g. Japan, IWC, conducting research in relevant Southern Ocean areas, in the context of Australian Government initiatives for research in the Southern Ocean Sanctuary

- ensure regular collation of strandings and sightings data, including morphological and genetic analysis

(c) resources required

- feasibility study for Australian waters' acoustic and other surveys, $10 000
- specimen collection within Australian waters, $10 000 per year
- collation and analysis of sightings data from existing sources, e.g. navy / air force / coast watch / commercial shipping, $10 000 per year

(Total $30 000 first year)

Management

(a) objectives

- minimise possible detrimental effects on population(s) in Australian waters, to permit recovery if possible

(b) actions required

- ensure action within IWC and other international forums (e.g. CITES, CMS) to maintain protection or other appropriate measures to ensure population viability

Category 2—Vulnerable (in order of priority)

Eubalaena australis—southern right whale

Research

(a) objectives

- monitor extent of current and future population increase, to determine ability of population(s) to recover from very low levels
- refine knowledge of population size (original and current), basic biology, genetic structure, distribution and movements, and resource requirements, e.g. critical habitat, for comparison with other recovering populations and to provide information on localities where special protection may be required
- assess effects of possible disturbance in key areas, e.g. from whale watching, pollution, oil and mineral exploration and exploitation, essential in developing measures to alleviate or prevent such effects

(b) actions required

- continue monitoring population status off Western Australia, South Australia, Victoria, Tasmania, and northwards into New South Wales, through aerial survey
- continue photo-identification of individuals off Western Australia, South Australia, Victoria, Tasmania, and northwards into New South Wales and compare individuals within and between areas, also any from waters south of Australia, e.g. from Japanese research expeditions, and from New Zealand
- continue behavioural and ecological studies, and photo-identify individuals, at preferred sites, e.g. Head of the Bight, SA, Doubtful Island Bay, WA

- obtain and analyse tissue samples from 'Australian' individuals, particularly to determine population structure and extent of homozygosity in a population increasing from very low levels, and to assist in delineating southern populations
- using telemetry, investigate extent and range of coastal movements, determine migration routes, locate summer feeding grounds
- survey and quantify environmental / geographic parameters of preferred calving locations
- investigate short- and long-term effects of whale watching on individual whales
- investigate effects of industrial development, including acoustic disturbance, particularly on migration patterns and behaviour
- obtain information from stranded specimens, including morphology and genetics

(c) Resources required

- population monitoring $100 000 per year, for at least six years to cover two three-year calving periods
- photo-identification, $50 000 per year
- behavioural / ecological studies, $100 000 per year
- population structure studies, $10 000 per year
- telemetry, $100 000
- calving location studies, $10 000
- whale watching studies, $40 000
- industrial development studies, $40 000
- strandings, $5000 per year

(Total per full year $455 000)

Management

(a) objectives

- ensure population potential for recovery to a (defined) proportion of initial stock size, including by:
  - minimising human impacts on individual whales and the population
  - preserving key habitats

(b) actions required

- provide funding assistance and support to organisations / individuals conducting required research, including through levies on commercial whale watching
- continue to seek cooperation from industry to implement research programs through legislation, prohibit / minimise detrimental impacts and protect preferred habitat, e.g. calving and nursery areas, on basis of present knowledge, particularly to provide Marine Protected Areas and prepare oil spill plans
- increase surveillance at key sites during the calving season (May–October); increase consultation with users of such habitats, e.g. fishers, recreational groups, industry and developers
- ensure action within IWC and other international forums (e.g. CITES, CMS) to maintain protection or other appropriate measures to ensure population viability

- expand education and public awareness programs and encourage public / private sector involvement in species' conservation
- promote whale watching subject to appropriate research and management
- ensure specimens available for appropriate scientific museums

Megaptera novaeangliae—humpback whale

Research

(a) objectives

- monitor extent of current and future increase of each population, to determine the population's ability to recover from very low levels
- refine knowledge of each population's basic biology, distribution and movements, for comparison with other recovering populations and to provide information on localities where special protection may be required
- assess effects of possible disturbance in key areas, e.g. from whale watching, oil and mineral exploration and exploitation, essential in developing measures to alleviate or prevent such effects

(b) actions required

- maintain all current initiatives under Item 4, species synopses, heading 12.1, including for west coast, review survey results to 1994, especially methodology and frequency required to estimate population numbers and trend
- re-examine data to recalculate original population size
- investigate short- and long-term effects of whale watching on individual whales
- investigate effects of industrial development, including acoustic disturbance, particularly on migration patterns and behaviour
- using telemetry, determine migration routes, locate breeding grounds and extent of any non-migratory dispersal in warm waters in summer
- survey and quantify environmental / geographic parameters of breeding grounds
- conduct research into alternatives to shark nets and / or devices to alert animals to the presence of nets
- obtain information from strandings, including genetics

(c) resources required

- maintain current research initiatives (Item 4, heading 12.1), $165 000
- re-examine data for original population size, $10 000
- whale watching studies, $40 000
- industrial development studies, $40 000
- telemetry, $100 000
- breeding ground studies, $10 000
- shark net studies, $40 000
- strandings, $5000

(Total per full year $410 000)

Management

(a) objectives

- maintain viable populations in Australian waters, including protection against harassment and disturbance by industrial and other activities, to permit recovery to a (defined) proportion of initial stock size

(b) action required

- provide funding assistance and support to organisations / individuals conducting required research, including through levies on whale watching
- seek cooperation from industry to implement research programs
- through legislation, prohibit / minimise detrimental impacts and protect key habitat areas, on basis of present knowledge
- ensure action within IWC and other international forums (e.g. CITES, CMS) to maintain protection or other appropriate measures to ensure population viability
- expand education and public awareness programs and encourage public / private sector in species' conservation.
- promote whale watching subject to appropriate research and management
- ensure specimens available for appropriate scientific museums

Balaenoptera borealis—sei whale

Balaenoptera physalus—fin whale

As stated above, most activities on these two species will occur in the context of proposals for the Southern Ocean Sanctuary, but data on either should be included in any strandings or sightings programs or analyses. Given recent reported sightings of sei whales south of Tasmania and in the eastern Great Australian Bight, attempts should be made to obtain further information particularly on that species in those areas as opportunities arise.

Category 3—Insufficiently known (in order of priority)

Sousa chinensis—Indo-Pacific humpbacked dolphin

Research

(a) objectives

- determine biological parameters, population trends and size, genetic status, pollutant levels and habitat requirements, to monitor impacts and their effects

(b) actions required

- by aerial survey, identify areas of highest density, estimate minimum Australian population size
- establish population size and monitor trends in key areas, using photo-identification mark–recapture; derive relationship between aerial survey and photo-identification estimate
- determine population pollutant levels in key areas
- determine level of genetic interchange between local populations

- determine habitat requirements
- determine causes of death of stranded animals, relate pollutant levels to those in key areas
- improve reporting of deaths in inshore shark nets, identify animals to species, salvage carcasses
- establish life history parameters, from carcass salvage and long-term studies of naturally-marked animals

(c) resources required

- aerial surveys, $100 000
- photo-identification, $35 000
- genetic studies, $75 000
- habitat studies, $115 000
- strandings studies, $55 000

(Total per full year $380 000)

Management

(a) objectives

- prevent population decline
- protect habitat and ensure appropriate water quality
- maintain prey stocks

(b) actions required

- establish working group on inshore dolphins, to:
  - influence watershed management to control inputs of sediments and pollutants into *Sousa* habitats
  - seek cooperation in fisheries management to allow for *Sousa* requirements
  - minimise incidental captures
  - initiate education programs on status of inshore dolphins
- ensure specimens available for appropriate scientific museums

Orcaella brevirostris—Irrawaddy dolphin

Research

(a) objectives

- determine biological parameters, population trends and size, genetic status, pollutant levels and habitat requirements, to monitor impacts and their effects

(b) actions required

- identify areas of highest density, estimate minimum Australian population size
- monitor population trends by aerial survey
- determine population pollutant levels in key areas
- determine level of genetic interchange between local populations

- determine habitat requirements
- determine causes of death of stranded animals
- relate pollutant levels to those in key areas
- improve reporting of deaths in inshore shark nets, identify animals to species, salvage carcasses
- establish life history parameters from carcass salvage

(c) resources required

- as for *Sousa*, apart from photo-identification

(Total per full year $345 000)

Management

(a) objectives

- prevent population decline
- protect habitat and ensure appropriate water quality
- maintain prey stocks

(b) actions required

- establish working group on inshore dolphins, to:
  - influence watershed management to control input of sediments and pollutants into *Orcaella* habitat
  - seek cooperation in fisheries management to allow for *Orcaella* requirements
  - minimise incidental captures
  - initiate education programs on status of inshore dolphins
- ensure specimens available for appropriate scientific museums

Stenella longirostris—spinner dolphin

Research

(a) objectives

- determine distribution, abundance, diet, and taxonomic relationships, to assess possible impact of threats

(b) actions required

- undertake sightings and monitoring program in northern waters
- obtain basic biological information, including diet and pollutants, from incidentally-caught and stranded specimens, especially from Arafura and Timor seas
- continue taxonomic comparisons (morphologic and genetic) between Australian, Indo-Pacific and Indian Ocean specimens

(c) resources required

- to undertake dedicated survey on *RV Franklin*, four observers for six weeks, $55 000 per year, for minimum three years
- to operate sightings program from existing platforms of opportunity:

  - minimum, two observers on appropriate vessels for one year, possibly linked with above, $100 000
- to obtain basic biological information from incidental catch:
  - minimum, one biologist on fishing vessels for one year, $50 000
- to analyse pollutants, genetics and diet, $65 000

(Total per full year $270 000)

Management

(a) objectives

- minimise possible detrimental effects on population(s), e.g. from fishing activities

(b) actions required

- ensure adequate protection of population(s) and resources in Australian and adjacent waters
- require reporting and salvage of specimens incidentally caught or stranded
- initiate education programs on concerns associated with incidental capture
- ensure specimens available for appropriate scientific museums

Physeter macrocephalus—sperm whale

Research

(a) objectives

- establish current status of population in Albany, WA, area for comparison with that at end of whaling in 1978, to determine extent if any of recovery since then
- assess possible effects of fishing on food resources there and in other deep water areas of likely fisheries importance within EEZ, e.g. off Kangaroo Island and Eyre Peninsula, SA, western and southern Tasmania, south-eastern New South Wales

(b) actions required

- carry out recommended program for monitoring population status off Albany, WA
- review existing information on distribution and abundance, e.g. off South Australia, Tasmania and southern New South Wales
- ensure regular collation of strandings and sightings data, including genetics and pollutants analysis
- ensure continued cooperation with other national and international agencies, e.g. Japan, IWC, conducting research in relevant neighbouring ocean areas, in the context of Australian Government initiatives for research in the Southern Ocean Sanctuary
- undertake yacht-based studies, including telemetry, of behaviour and ecology in suitable areas possibly off southern New South Wales, south-east Queensland

(c) resources required

- monitoring off Albany, WA $150 000 for one year's survey, to be repeated at least once, at five-year intervals
- analyse existing sightings information from fisheries sources, $65 000

- collect and analyse strandings and pollutant data, $30 000
- yacht-based behavioural and ecological studies, $50 000

(Total per full year $295 000)

Management

(a) objectives

- minimise possible detrimental effects on population(s), e.g. from fishing operations
- ensure international regulation to maintain stocks at an acceptable level

(b) actions required

- continue action within IWC and other international forums (e.g. CITES, CMS) to maintain protection or other appropriate measures to ensure population viability
- seek Commonwealth agencies' support to develop a working group to address fishing impacts, particularly on this but including other cetacean species
- ensure specimens available for appropriate scientific museums

5.2 Habitats

Effective conservation measures for most Australian cetaceans are likely to involve conservation of appropriate habitats and the resources found within them. Identification of key habitats for Australian cetaceans is therefore an important element in developing strategies for their conservation. However, with some exceptions (e.g. breeding localities for southern right whales and migration routes for humpbacks) there has been inadequate knowledge of most species' requirements to pinpoint resources or localities essential to them, except on a very broad scale (see Table 2, p. 40). Also, none of the species found in Australian waters is exclusively Australian and individuals and populations may move in and out of our waters, thus making it difficult to control adverse effects over the whole of their range.

Cetacean habitats in Australia are protected in reserves only by coincidence, except in two instances where reserves have been specially set aside: Hervey Bay, Queensland (for migrating humpbacks), Monkey Mia, WA (for resident bottlenose dolphins). A third proposal, for a marine park at Head of the Bight, SA (for calving southern right whales) has only partially been implemented. More coastal reserves which specifically protect cetacean resources are needed because of the already high, or increasing, human impact on much of the inshore region. Despite the lack of detailed knowledge already referred to, knowledge of at least the distribution requirements of several species is adequate for a number of additional areas to be considered. Some examples are:

- coastal areas for inshore species
  - Moreton Bay, Queensland, for *Tursiops truncatus* and *Sousa chinensis*
  - Jervis Bay, NSW, for *Tursiops truncatus*
  - part of Port River, Adelaide, for a resident population of *Tursiops* cf. *aduncus*

Following identification of key areas in the distribution of *Sousa chinensis* and *Orcaella brevirostris*, several coastal locations in northern Australia could be nominated.

- coastal calving areas for southern right whales
  - Head of Bight, SA, the densest congregation of calving southern right whales
  - Doubtful Island Bay, WA (including Point Anne and Point Charles), a major calving area
  - Warrnambool, Victoria, the only consistently used calving area in eastern Australia
- near-coastal migration routes of humpback whales
  - north of Rottnest Island, WA, a staging area for south-bound humpbacks, increasingly used as a whale watching area, close to Perth
  - between Bernier Island and Carnarvon, Shark Bay, WA, increasingly being used as a staging area for migrating whales
  - off Stradbroke Island, Queensland, a concentrated migration route for humpbacks.

In addition, some areas, such as off Stradbroke Island, Queensland, could be nominated on the basis of their importance for long-term monitoring studies and their vulnerability to development.

We **recommend**:

- that urgent consideration be given (perhaps by the advisory body recommended in Item 5.7) to nomination of such areas, and others, as referred to above. Protection of such areas should also, where necessary, include maintenance of water quality and adjacent watershed management.

Offshore areas of high productivity occur in Australian waters. The following are known to be important locations for cetaceans:

- upwelling areas of high productivity such as off south-eastern South Australia, south and west of Kangaroo Island, and on the North-West Shelf, WA
- along the continental slope off southern Australia such as off Albany, WA, south-west of Kangaroo Island, SA, and west of Tasmania; these are important habitats for sperm whales, pygmy and dwarf sperm whales, beaked whales, Risso's dolphins, false killer whales and pilot whales
- waters in the vicinity of the Antarctic Convergence, especially around Heard and Macdonald Islands and Macquarie Island; the latter area is especially important for killer whales
- the Arafura and Timor seas; both include productive fishing habitats and contain populations of *Stenella longirostris* and several other shelf-dwelling, tropical cetacean species (see Table 2).

We recognise the considerable difficulties involved in considering such areas for effective management, not only because of the large extent and remoteness of some, but also through competing interests, e.g. from existing commercial fisheries. However, they are areas where an ecosystem management approach to marine environment conservation, including cetaceans, could be focused.

5.3 Disturbance and harassment

5.3.1 Acoustic effects

Most, if not all, cetaceans rely on a highly developed acoustic sense to relate to their environment, to communicate and to find and catch prey. Consequently very loud sounds and certain frequencies produced by human activities can be disturbing or stressful and even cause injury, whereas otherwise relatively harmless and widespread activities on and within the sea, such as shipping, contribute substantially to background 'noise' within marine environments. High levels of background noise may be detrimental to cetaceans by drowning out medium distance communication, e.g. of interacting humpbacks 'singing' in Hervey Bay, and by interfering with long-distance (1000+ km) communication between individuals of sparse populations, e.g. of the greatly reduced 'true' blue whale. However, the latter are very low frequency sounds and less likely to be interfered with.

The extent and nature of the impacts of sounds from human sources on cetaceans is little known, but they will increase as humans more extensively and intensively utilise the world's oceans and manipulate the marine environment for anthropocentric ends.

We **recommend**:

- that responsible Commonwealth, state and territory authorities be asked to hold discussions with relevant agencies involved with activities such as harbour works, seismic survey and military operations in or adjacent to important cetacean habitats, to introduce measures to avoid or ameliorate possible detrimental acoustic effects
- that, in conjunction with the above, there should be a cooperative approach to obtaining and assessing quantitative information on sounds associated with human activities, and the extent of their impacts on cetaceans.

5.3.2 Whale and dolphin watching

Commercial whale and dolphin watching is now an established industry in Australia, operating mainly from motor-powered vessels and some aircraft at locations in all states, but not in the Northern Territory as yet. The industry's rapid expansion reflects wide public interest in cetaceans and it provides an ideal vehicle to educate the community in regard to cetacean natural history, the marine environment and related conservation issues.

At the same time there is a growing incidence of recreational whale watching, which can on occasions compete with the commercial industry for access to opportunities.

Two of the targeted species of whale—humpback and southern right whale—are still at an early stage of recovery after gross depletion in numbers by whaling and both are categorised by us as vulnerable (Item 3.2). A third species, the sperm whale, was also harvested locally but was not reduced to the same extent. As its current status in relation to its former abundance is uncertain, it is categorised as 'insufficiently known', the third category of threat recognised by us. Bottlenose dolphins are also a prime and accessible species for observation from vessels, but because of their small size and propensity to

approach and investigate they are also exploited in interactive situations such as dolphin swims and hand feeding from shore-based facilities.

All these species are predictably accessible where they are resident or congregate at particularly favoured or key sites, when on traditional migration paths or where they feed, mate, calve or rear their young.

We recognise that management requirements are likely to differ between species and from area to area even for the same species—e.g. on migration, or on breeding grounds. Nevertheless, generalisations can be made. Aspects of whale watching which require regulation include manoeuvring and nearness of approach by vessels and aircraft, and any activities which generate excessive levels of sound above and especially under the water, to prevent harassment resulting from crowding and acoustic disturbance. Repeated disturbance and harassment at calving and nursery sites could lead to temporary abandonment and increased mortality of the young.

Feeding of dead fish is undesirable, because of possible health risks to the animals and habituating them to an unnatural source of food. This practice is banned in Commonwealth waters, in Victoria and Queensland, and in Western Australia except in relation to the controlled feeding of dolphins at Monkey Mia, Shark Bay.

We **recommend**:

- that Commonwealth and state agencies regulate the expanding whale / dolphin watching industry in Australia in regard to
  - permitted sites
  - licensing and limiting the number of commercial operators
  - conduct and practices, to avoid detrimental impacts on targeted species
- that whale / dolphin watching licences be non-transferable
- that, where relevant, whale watching guidelines be converted to enforceable regulations and that they be uniform throughout Commonwealth, state and territory waters (see also Item 5.5)
- that licensing authorities should
  - from time to time review regulations and any supporting codes of conduct in relation to accumulated evidence of benign and detrimental impacts, regional and / or local circumstances and issues, and in consultation with the industry
  - require and assist licensed operators to provide high quality interpretive materials to patrons to enhance the experience of viewing wild cetaceans and maximise the opportunity for education, especially of students and school groups
  - require licensed operators to assist with monitoring and research by providing, at least, details for each trip of encounters with cetaceans and the number of patrons carried
- that the practice of hand feeding or burleying with dead fish to attract or habituate cetaceans be reviewed, with a view to closer regulation or total prohibition
- that licensing authorities impose a levy on licensed operators, calculated as a proportion of the fee charged to patrons, and that this revenue be used to
  - investigate impacts of whale watching, and of the impacts of helicopters in particular

  - undertake field studies on the behaviour and ecology of cetacean species currently or likely to be targeted by the whale watching industry
  - defray a proportion of the costs (not to exceed a stated percentage of fund receipts) of supervising commercial and non-commercial whale watching activities
- that the possible conflict between commercial and recreational users of the resource be assessed
- that local governments and business associations in whale watching areas be provided with assistance in developing controls and promotional material.

5.4 Research

In considering the specific recommendations for research action in the species synopses, a number of topics common to several species have arisen. Here we have attempted to draw together conclusions and recommendations on those general topics we believe should be given priority.

5.4.1 Strandings

Strandings play a vital role in the study of cetaceans.

For many species, strandings are a source of information on aspects of their biology that cannot be obtained in any other way, given the practical difficulties of field collecting (compared with terrestrial mammals) and which in any case would not be supported by the Australian community. It is therefore essential to maximise data and samples collected from dead stranded animals which provide distribution records, standardised measurements, information on sex/age classes and an uncontentious source of materials to investigate taxonomic and genetic relationships, organ systems and diet, pathology, including internal parasites, and levels of pollutants in body tissues. Thorough post-mortem examination requires the presence of both a cetologist and a veterinary pathologist.

Major logistical and financial difficulties often beset the process when large cadavers are involved. Special arrangements must be made, including extra staff, for treatment on-site or removal and transport for treatment elsewhere, disposal of unwanted parts, preparation of skeletal parts and their subsequent curation in a suitably equipped museum.

Live strandings provide equally unique opportunities to obtain, non-invasively, field data on active physiological processes and responses, and to undertake benign sampling of blood, exudates, faeces and external parasites. Appropriate veterinary expertise is essential to collect these data and samples, which should be part of the assessment of animals prepared for release to the sea. Rescued animals should be marked for subsequent recognition in the event of restranding and ideally should be fitted with a radio tag for direct or satellite tracking to monitor their progress.

Manuals and stranding contingency plans have been prepared by several responsible authorities, but there is need for greater coordination and standardisation. A National Cetacean Strandings Contingency Plan was published in 1982 and several state plans have since been prepared. These plans provide guidelines for operational responses by the

responsible authorities, treatment and rescue of live animals, and obtaining scientific data from live and dead animals. Having cetological and veterinary expertise on-site is essential, to ensure competent assessment and treatment of live animals and that appropriate scientific data are obtained.

We **recommend**:

- that state and territory authorities be encouraged to prepare/update operational planning for stranding contingencies, to ensure scientific and animal welfare objectives are fully realised
- that Commonwealth, state and territory wildlife agencies convene two national workshops
  - one to review scientific and veterinary aspects of dealing with strandings/entanglements, the other on operational aspects and rescue techniques
  - both involving biologists, veterinarians, museum curators and representatives of the responsible agencies and NGOs
  - to be held consecutively to allow cross-participation.
- that the agenda for the scientific/veterinary workshop on strandings/entanglements include
  - the need for a coordinated national program of investigation of cetacean strandings
  - estimates of funds required for such a national program
  - the need for strengthening legislation where necessary, to ensure that all stranded specimens remain under the control of the responsible authority and that scientifically important material is made available to the relevant federal/state/territory museums
  - review of priorities, objectives and techniques of investigation, including use and accessibility of databanks
  - establishment of a tissue bank in an appropriate institution/s, to store tissue samples for future analyses and investigations of, for example, pollutant levels, pathology and genetic relationships
- that the agenda for the workshop on operational aspects and rescue techniques include
  - evaluation of recent experience and techniques of first-aid, rescue, rehabilitation and release of stranded cetaceans
  - review of contingency plans and planning, to assess the need for greater cooperation and coordination of resources to deal with mass strandings and strandings of large single animals
  - evaluation of techniques for subsequent identification of released animals, e.g. by tag or cryothermic brand (in the event of restranding) and for tracking to monitor survival, e.g. by radio, preferably satellite-linked.

5.4.2 Incidental take

In Australia, it is not illegal to catch cetaceans accidentally in licensed fishing operations (see 2.3). The *Whale Protection Act 1980* requires reporting of by-catch in waters under Commonwealth jurisdiction. Reported catches are very low, although there is a question over whether this reflects the true picture or a lack of reporting and of the low resources applied. In some state waters, e.g. Victoria, there is a requirement to report such catches. Inshore netting and aquaculture are potentially serious problems for coastal species such

as *Tursiops truncatus*, as well as for two categorised by us as insufficiently known—*Sousa chinensis* and *Orcaella brevirostris*. A number of catches of these species are reported each year but the true number taken is not known.

The problem of incidental take is complex because it involves first establishing what the true incidence is for the different operations, then researching ways of reducing it. Both involve education, in that to be successful they require the cooperation of commercial and recreational fishermen, and in the case of international waters, agreements between neighbouring countries such as Indonesia, Papua New Guinea and Australia. There should be positive reinforcement that reporting and collecting specimens are beneficial, possibly through a reward system and financial assistance for collecting specimens for further study. Funds are also required to enable research workers and museums to study, prepare and curate incidentally-caught cetaceans.

At present, there is very little pooling of reported data on incidental catch. As a first step, all known sources (e.g. the ANCA Strandings Database, state department files, fishing industry information, IWC reports) should be reviewed. Particular areas or specific fishing activities should then be targeted, based on the findings. At the same time, selected species, for example the flagship taxa recommended in Item 6, could be promoted in education programs on such problems as net entanglement on migration routes (humpbacks and southern right whales), and the effects of inshore netting and aquaculture in causing mortality on resident inshore populations (bottlenose dolphins, Irrawaddy dolphins, possibly also Indo-Pacific humpbacked dolphins). The spinner dolphin, although not one of our recommended flagship taxa, could be used as an example of the need for international cooperation in ensuring minimal incidental catches. Serious concerns exist in the scientific community over the level of incidental captures in Arafura and Timor Sea shark fisheries, which, although outside Australian waters, are likely to involve the same populations as those in the Australian EEZ; the fisheries are lucrative and likely to increase in the future. The aim of the education program should be to foster cooperation between the fishing industry and conservationists, rather than recrimination.

The second step should be to establish a state/Commonwealth working group to plan a reporting and collecting program in targeted areas/industries. This could involve a trained observer program for offshore fisheries operations, and be linked with already-existing observer programs (e.g. the Southeast Australian Trawl Fishery Observer Program run by AFMA). AFMA and ANCA should take joint responsibility for financing offshore studies. While inshore waters are the responsibility of state government wildlife and fisheries agencies and fishing industry councils, their activities should be overseen by the working group.

We **recommend**:

- that the responsible Commonwealth, state and territory authorities establish a Fisheries Incidental Take Working Group, whose agenda would include
  - re-examining current legislative requirements for reporting incidental take, including endangered species and fisheries legislation, and relevant international obligations
  - consideration of the practicality and merits of utilising trained observers
  - consideration of an education program targeting relevant fisheries and fishing areas
  - establishing a database on incidental captures, possibly as a subset of the National Strandings Database

– assessing the need to introduce measures to reduce the incidence of incidental takes
- assessing the level of funding required to offset the costs of obtaining, treating and analysing material derived.

5.4.3 Distribution and abundance

While strandings can provide biological information not otherwise available for many species (see Item 5.4.1), they have limitations as sources of information on distribution. Their discovery may depend on chance, and reflect concentrations of people rather than cetaceans. The animals themselves may have stranded because they are out of their normal range. Dedicated sightings surveys from ships or aircraft are necessary to provide statistically valid information, but two other valuable sources are now becoming more readily available. The three sources of information are discussed below.

5.4.3.1 Sightings surveys

Compared with the amount of information available for terrestrial fauna, there is a dearth of information on cetacean distribution and abundance in Australian waters. Such studies are generally in their infancy in Australia. Collating and pooling the existing information on distribution would provide a basis for much-needed surveys. Two types of survey can be considered: 1) platforms of opportunity, where trained observers are placed on naval and fisheries patrol vessels, government geological survey and other research vessels, including those of the Antarctic Division, and aerial surveys such as coastwatch; 2) dedicated synoptic surveys designed to sample areas systematically using vessels specifically for the purpose. Platforms of opportunity are much less expensive but provide information only on distribution, and the results have to be interpreted with caution. Nevertheless, information from such sources as the National Sightings Database (coordinated by ANCA from sources such as naval vessels but with little exposure in the past four to five years) can provide the starting point for more systematic investigations, such as humpback calving areas off the east coast. Dedicated surveys are very expensive but provide reliable information both on distribution and abundance.

Ideally, in the long term, a national program should be developed which systematically surveys the Australian EEZ. A number of government and industry groups, e.g. the petroleum and fishing industries, would be interested in access to such information; they should be encouraged to cooperate in the development of such a program. In the short term, advantage could be taken of, and encouragement given, both at Commonwealth and state level, to existing observer networks already available, mainly in coastal waters, in states such as Tasmania and South Australia.

We **recommend**:

- that ANCA fund the publication of a comprehensive field guide on Australian cetaceans, to include distribution maps and recording protocols
- that ANCA convene, possibly through the advisory body recommended in Item 5.7, a workshop of representatives of the Commonwealth and state governments, industry and the research community to examine the potential for and costs of dedicated and platform-of-opportunity surveys, including the emphasis to be given to, and funding implications of, a National Sightings Database

- that consideration be given to the provision of a cetacean biologist on current CSIRO / Japanese tuna surveys along the continental slope off South Australia as a test case to determine the reliability of using such already existing surveys for obtaining cetacean distribution and abundance data
- that the relevant state agencies be encouraged to provide financial support for observer programs within coastal waters.

5.4.3.2 Acoustic studies

International interest has been raised recently over the potential of acoustic methods for investigating behaviour, seasonal movement and distribution of cetaceans, particularly the great whales, over large ocean areas.

A program using existing US Navy passive hydrophone arrays in the North Atlantic in 1993 proved very successful in detecting individuals and tracking them over considerable distances, providing information on seasonal distribution, movement and behaviour for three species—blue, fin and minke whales. More acoustic material was acquired in one year than exists in all the cetacean sound libraries combined, worldwide. Given concerns expressed over the difficulty of estimating the abundance of blue whales in the southern hemisphere, the International Whaling Commission's Scientific Committee has strongly recommended that the potential of such methods, both for identifying areas of blue whale concentrations and for assessing their abundance, be determined. The potential of towed arrays to achieve similar ends is also to be investigated.

No such comprehensively oceanic passive systems exist in the southern hemisphere, but passive hydrophone facilities have been established in some places on the Australian coast and are potentially powerful sources of information on at least local movements and distribution of inshore species. At the same time there is the potential for obtaining important information over wider areas from towed arrays, particularly for the relatively inaccessible oceanic rorquals such as blue, fin and sei whales.

We **recommend**:

- that the potential for obtaining information on whale distribution, movements and behaviour be investigated, possibly by the advisory body recommended in Item 5.7, both from existing passive hydrophone arrays in Australian waters, and from towed arrays deployed, for example, from navy or Antarctic Division vessels operating both within Australian waters and the Southern Ocean, particularly in relation to research to be proposed in the context of the Southern Ocean Sanctuary (see Item 5.4.6). Investigations should include assessments of
  - current naval and CSIRO acoustic capacity and material
  - the need for acquisition or development of equipment for deployment on suitable vessels
  - provision of trained observers on naval, Antarctic supply and national oceanographic and fisheries research vessels
  - the applicability and reliability of obtaining estimates or indices of abundance from acoustic data, comparable to those already developed in sightings theory.

5.4.3.3 Telemetry

Several species synopses refer to telemetry as a required conservation research action. Although telemetry has been used successfully in research on Australian dugongs and seals, there are, as far as we know, no examples of its successful use with cetaceans in Australian waters. A proposal for satellite-tracking of humpback whales off Western Australia did not receive funding support, but a pilot project on southern right whales was funded to take place near Israelite Bay, WA, in September 1994. Telemetry has been proposed as a research tool in determining movement patterns, including migration routes, in locating breeding grounds (humpbacks) and summer feeding grounds (southern right whales). It could also be important in behavioural, physiological and ecological studies of inshore and offshore delphinids and species favouring the continental slope, such as Risso's dolphins and possibly pilot whales. While generally proposed for use on animals at sea, there have been proposals for its use with healthy animals released after stranding (long-finned pilot whales, false killer whales).

Rapid technical development of transmitters has yet to be matched by prolonged success in attachment techniques. So far, the number of cetacean species involved has been small—around six to eight—and the maximum successful operating time some two to three months. Most success has been with the smaller whales, such as beluga in the Arctic, although there have been some encouraging results recently on two great whales, bowheads and northern right whales. Effort generally is now being put into producing smaller, more efficient and sophisticated transmitting packages, and into improving attachment techniques.

Satellite systems have a major advantage over those using VHF radio, given their relatively worldwide applicability and greater power, but the transmitters are considerably more expensive (US$ 2–5000 cf $300–1000 for the basic unit). Radio tags are, however, much more costly per day because of the need normally to track by vessel or aircraft (US$1000+ per day cf only $15 for satellite time).

The most pressing technical need is for investigation of more efficient attachment techniques, particularly for transmitters on the larger species. The rejection rate, where the transmitter is treated by the whale's immune system as a foreign body, is currently unacceptable, particularly given the high costs of the units and/or tracking time. The answer may lie in development of biocompatible materials, as are currently used in human implants.

We **recommend**:

- that greater emphasis be given to telemetry studies in Australian waters, particularly for investigating breeding areas of humpback whales, coastal and migration movements of southern right whales, behaviour/ecology of inshore and offshore delphinids—including those of the continental slope, as well as the survival of animals following rescue from mass strandings
- that in any proposed telemetry projects emphasis should be given to the development of improved transmitter attachment methods, particularly for the larger whales.

5.4.4 Ecosystem context in relation to the exploitation of marine resources

Marine and terrestrial environments are intimately interconnected by the cyclic movement of water (via evaporation and rain) and of gases (especially O_2 and CO_2), and by global climate systems (especially deriving from seasonal fluctuations of the South Polar Ice Cap and Antarctic ice sheet). Land-based urban, industrial and agricultural activities inevitably and increasingly have an impact on marine ecosystems via these cycles and in other ways. Management to protect or to enhance cetacean populations must fundamentally be directed at the integrity and productivity of the ecosystems which sustain them.

Many cetaceans and especially the larger odontocetes are predators at relatively high trophic levels within complex food webs. The large Southern Ocean mysticetes depend on and are major consumers of invertebrates (euphausiid and copepod crustaceans) at a low trophic level in a restricted and relatively uncomplicated food web.

Cetaceans are particularly vulnerable to perturbations within marine ecosystems which have major impacts on species important in their diet, e.g. extensive, intensive and expanding fisheries on keystone species such as Antarctic krill, *Euphausia superba*, in the Southern Ocean, and trawl and purse-seine fisheries for clupeoids (e.g. anchovy and pilchard), other fish and squid in state, Northern Territory and Commonwealth waters.

Poor knowledge of the status and biology of most cetaceans prejudices understanding and appropriate recognition of their role within marine ecosystems, and does not allow for their requirements in the face of increasing human impacts on the resources on which they depend. This concern is particularly pertinent to Australian fisheries, which are currently undergoing a phase of expansion in the variety of stocks targeted and in the development of harvesting techniques and technology. The impact on cetaceans of present and future competition for food resources is unknown. The dearth of specific information on the diet and population status of cetaceans inhabiting Australian waters has meant that their resource needs are rarely, if ever, taken into account when fishery catch limits are determined. On the other hand, general information is available for many species and can be used as a first approximation.

The possibility cannot be ruled out of legislated changes to fisheries management policy in Australia, whereby governments opt to sell marine fish resources into medium- to long-term private ownership via an instrument of title or exclusive licence. The *Native Titles Act 1993* also has potential implications in relation to new arrangements for managing fisheries operations in areas subject to sea claims by Aboriginal communities.

Where governments overseas have relinquished direct management of fishery resources to private operators, whose motivations are competition and profit, there has been increased potential for over-exploitation and environmental degradation.

We **recommend**:

- that the expanding exploitation of living marine resources (harvesting of fish, crustaceans, squid and other molluscs, seaweeds, etc) be planned and regulated with a view to ecological relationships, and with special reference to the identification and protection or conservative management of keystone species within marine ecosystems

- that where management plans are prepared (e.g. under the Commonwealth Fisheries Management Act) for fisheries targeting particular marine species or stocks, responsible Commonwealth, state and territory agencies take into account the impacts of that exploitation on other species and other trophic levels within the ecosystem sustaining those targeted species or stocks
- that in the design of research into stocks of fish (and of other marine organisms) and the calculation of catch quotas, fishery biologists and managers
  - consider the role and food requirements of cetaceans in the food webs that include the targeted commercial species
  - seek relevant advice from cetacean biologists, possibly via the proposed advisory body (see Item 5.7)
- that relevant authorities be encouraged to
  - regulate the use of agricultural biocides and the disposal of industrial and urban wastes to prevent or allow their entry into aquatic environments only within safe levels
  - monitor the levels of pollutants in aquatic environments regularly at strategic sites, to assess water quality in relation to accumulation of toxic substances at different trophic levels within the biota
  - develop improved methods of disposal of industrial and urban wastes and of monitoring to ensure the effectiveness of regulatory systems
- that relevant authorities consult with extractive industries (oil, gas, minerals) and ancillary industries (e.g. bulk tanker shipping) which operate within marine environments to ensure that exploration, extraction and transport of their products is conducted according to the highest levels of awareness and safety, and of preparedness for dealing with accidents and disasters (e.g. oil spills) that could have a detrimental impact on cetaceans and their habitats.

5.4.5 Photo-identification catalogues

The use of photo-identification as a major benign research tool is now well-established. In Australia it has been employed mainly in studies of southern right and humpback whales, and bottlenose dolphins, but it has potential for other species such as blue and minke whales and humpbacked dolphins—as demonstrated already in other parts of the world.

Concerns have been expressed to us over questions of harassment involved in obtaining, for example, humpback tail fluke photographs, both in respect of its short- and long-term effects. There is also concern over the effort required to obtain statistically meaningful population estimates from samples of photo-identified animals, particularly where a population may be increasing rapidly and there are practical limits to the amount of effort that can be applied.

Here we deal mainly with the question of photo-identification catalogues and their application Australia-wide. This is not to deny the effectiveness of photo-identification in obtaining information on such biologically important matters as distribution, local movements, residence times and rates of travel, migration paths and patterns, and calving intervals.

In the case of humpbacks and right whales, a number of separate research groups are involved in Australia, each developing its own catalogue of identifying photographs. For right whales, for example, there are catalogues being developed at the WA Museum, at the SA Museum, at the University of Sydney and through at least one private consultancy.

Attempts have been made to institute a national catalogue for both right whales and humpbacks, through ANCA, where funding from that body is made available for that research. It is a condition of the relevant Consultancy Agreement that identifying photographs obtained be provided to ANCA for the catalogue.

The question has been raised in the course of this consultancy, as on earlier occasions, as to the nature and usefulness of such a national catalogue. While in theory there seems to be a self-evident case for its existence, in practice there has not been a great deal of activity in assembling it.

For humpbacks, a catalogue has recently been published by the Pacific Whale Foundation. While it includes photographs from both the east and west Australian coasts, i.e. from both 'Australian' populations, it is not totally comprehensive. Like all such publications, it is also a static document, and cannot be readily augmented.

At a right whale photo-identification workshop in Perth in early 1994, attended by representatives of all the Australian research groups currently active, the question of a national catalogue for right whale identifying photographs was discussed. From subsequent discussions with scientists involved in humpback studies, it seems that similar conclusions might apply as were reached in the case of right whales. Those conclusions were:

- the main current need is for photographs to be centrally archived for posterity. This is based on the premise that regular opportunities can currently, or in the foreseeable future, be found for relevant workers to exchange photographs, and/or to meet to share information and undertake 'matching' between existing catalogues
- assuming such an archive is established, relevant questions to be addressed would include
  - who would have responsibility for its creation, day-to-day control and expansion
  - what format should be adopted for entries
  - under what conditions would photographs and associated information be provided to interested persons
  - what resources would be available to establish and operate it, both in the short- and long-term and from what source
- successful 'central' catalogues/archives depend very much upon the initiative and energy of a single person, uncommitted to any particular study or region (such as would be expected of a good librarian/archivist). Such a person would preferably be centred on, and administered by, a central agency such as ANCA.

We **recommend**:

- that ANCA commission a review of photo-identification as applied to cetaceans in Australian waters, to cover the following
  - the need for, administration, resource implications and other aspects of national catalogues of identifying photographs

- the short- and long-term effects of field methods employed to obtain photographs, e.g. low-flying over right whales, prolonged chasing of humpbacks
- the numbers of photographs required for a given presumed population size, and the effort required to obtain them, from which to obtain statistically valid estimates of population size using mark–recapture methods.

5.4.6 The Southern Ocean Sanctuary

At its 46th meeting in Mexico, May 1994, the International Whaling Commission adopted an amendment to the schedule to the International Whaling Convention, establishing a sanctuary in the Southern Ocean. Essentially this provides for a prohibition on commercial whaling in southern hemisphere waters south of 40°S, except near South America, where the prohibition operates only south of 60°S, and in the Indian Ocean, where the existing Indian Ocean Sanctuary—adopted by the commission in 1979—already extends to 55°S (see Figure 8). The prohibition applies whatever the status of individual whale stocks, but is to be reviewed after 10 years and at successive 10 year intervals.

For waters of special interest to Australia, and specifically covered by this report, this means that commercial whaling is prohibited in the Indian Ocean bordering Western Australia, including the area south of that state eastwards to 130°E, and thence south of 40°S eastwards into the Tasman Sea.

Strongly implicit in the adoption of the resolution establishing the Southern Ocean Sanctuary was that its establishment would not reduce the research effort already under way to establish the status of southern hemisphere whales that use the area, now protected, as their main feeding ground, in particular the greatly depleted baleen whales such as blue, fin, sei and humpback. Indeed there was the understanding that it would lead to an increase in that effort. To that end, proposals have been developed by ANCA, in conjunction with other relevant agencies, to mount a major research effort aimed particularly at those populations of direct interest to Australia.

That initiative provides the immediate framework for an integrated program of research on those great whales which we would otherwise have been recommending largely on a species by species basis. It also provides the framework for a research program in areas relatively remote from the Australian coastline on animals that, because of their current conservation status, should be given priority. That then allows us to continue to recommend action on those smaller and generally coastal species that, because of their conservation status, should also be given priority, such as *Sousa* and *Orcaella*. That was taken into account in our recommendations in Item 5.1.

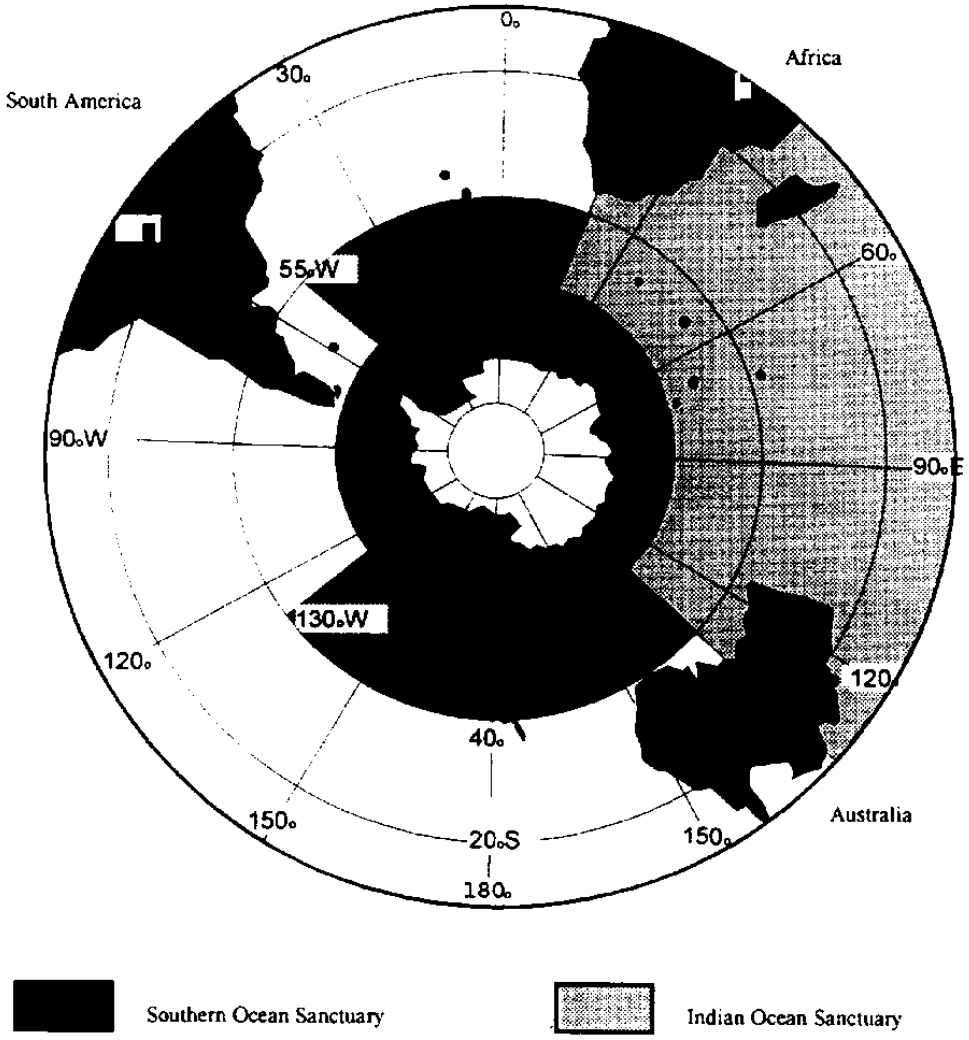

Figure 8: The Southern Ocean Sanctuary and Indian Ocean Sanctuary

5.5 Legislation

Item 2.3 reviews Australia's legislative activities and responsibilities at the international, regional and national level. Elsewhere (for example, Community involvement, 2.4; Whale watching, 5.3.2; Incidental take, 5.4.2) there are specific references to relevant responsibilities, actions and needs.

At a national and state level, there is need for clarification of the roles of those agencies whose responsibilities and activities do, or are likely to, relate to cetaceans. In this context, at the Commonwealth Government level, relevant agencies, in addition to ANCA, include the Commonwealth Environment Protection Agency (CEPA), Department

of Primary Industries and Energy (DPIE) Fisheries Policy Branch and Petroleum Minerals Section, and the Department of Defence. Towards the conclusion of our work, we were made aware that the Australian Government, through the Australian Antarctic Foundation, has prepared a draft conservation strategy for the Australian Antarctic Territory which as well as covering the terrestrial environment extends into adjacent waters, and inter alia supports the Southern Ocean Sanctuary.

A summary of the legislative position as it concerns the states is given in Item 2.3. There are three major concerns:

(i) there is a lack of uniformity, or at least complementarity, in legislation across Australia

(ii) scientific institutions with the legislative responsibility to maintain collections in perpetuity—mainly the state museums—do not necessarily have first choice at obtaining parts of stranded or incidentally-caught cetaceans

(iii) the requirement to report incidental captures needs to be enforced.

At the same time there are major concerns about the existing capacity, resources, funding and infrastructure in state and Commonwealth management agencies. As humpback and southern right numbers increase, and commercial and recreational operations broaden their extent, management and development of, for example, the whale watching industry will become increasingly important both locally, regionally and nationally. Consideration needs to be given toward resourcing:

(i) support for major programs under the Act, including the National Strandings Contingency Plan. Needed, for example, are development of national tissue salvage and analysis priorities, refinement of rescue techniques, cooperation with the states in developing response capacity for mass strandings

(ii) long-term monitoring programs and specific management-related research

(iii) development of regulations under Commonwealth legislation—with priority for recreational and commercial whale watching.

To supplement provision of such resources by government agencies, there is a strong need to ensure contributions from industries and organisations towards research into problems related to their activities, although we recognise that some organisations, such as BHPP, have already given, and continue to give, substantial support in this area.

We **recommend**:

- that state and Commonwealth agencies be encouraged to work towards providing uniform or complementary legislation relating to cetaceans across Australia, in concert with the *Whale Protection Act 1980*
- that all state legislation should require and enforce the reporting of strandings and incidental captures
- that all such legislation should require that specimens so obtained be first offered to a scientific institution for study, preferably where there is legislative provision to retain specimens in perpetuity, e.g. in state museums
- that a review be undertaken—perhaps by the advisory body recommended in 5.7—of existing resources allocated to cetacean conservation by Commonwealth and state management agencies

- that the review include the role to be played by industry and other organisations in supplementing such resources.

5.6 Education

The current wide community interest in cetaceans is self-evident. This interest includes active participation in limited consumptive uses, such as the captive display of dolphins and small whales, and in a wide variety of non-consumptive uses, such as whale watching and related tourist facilities, museum displays, literature and art.

The non-Aboriginal community is generally unaware of the wide diversity of cultural relationships with cetaceans that exist in Aboriginal and Torres Strait Islander communities in many parts of Australia, or of the very long history of these relationships. Aboriginal knowledge, stories and art relating to cetaceans can contribute to a wider understanding of these animals in the Australian context.

There is wide community concern for the welfare and protection of cetaceans, which is espoused and fostered by many non-government organisations and groups. Disparate views are held within the community in relation to events and issues affecting cetaceans, leading to conflicting interpretations and controversy. Controversies tend to escalate as a result of oversimplification and inaccurate reporting by the media of events and issues affecting cetaceans.

Misconceptions and inaccuracies are to be found in many general texts and other reference materials on the biology, status and use of cetaceans.

Information on Australian cetaceans is expanding, as a result of increasing research. Early studies were mainly concerned with strandings, the history of whaling and aspects of biology and trends in populations of exploited species. Post-whaling research has tended to concentrate on strandings, monitoring the recovery of exploited populations, and the behaviour and biology of widespread and locally accessible species such as bottlenose dolphin. The results of past research are not easily accessible to the community in general, although some have contributed to general accounts given in several recent books. The purpose of much of the current work and its relevance to conservation and management is not generally well-publicised by scientists.

As recognised in our discussion of sightings surveys (Item 5.4.3.1), there is particular need for a comprehensive and authoritative field guide to all Australian cetaceans, specifically designed for the identification of species in the wild.

We **recommend**:

- that institutions and scientists involved in the study of cetaceans be strongly encouraged, by their funding agencies where appropriate, to
  - publicise and explain the objectives and methods of their research, particularly in relation to animal welfare concerns
  - in addition to publishing the results in scientific journals, seek opportunities to interpret and disseminate the information for the benefit of the wider community
- that education programs within schools dealing with

  - biology, geography and environmental issues, include topics concerning cetaceans, marine science and marine environmental issues
  - historical aspects of whales and whaling in Australia, or of current attitudes and roles within the community in relation to cetaceans

  include relevant material on Aboriginal contributions, perspectives and aspirations
- that publications and other educational materials sponsored, prepared or used by schools and government agencies relating to cetaceans and cetacean conservation issues are balanced and scientifically accurate
- that the whale watching industry be encouraged to produce promotional and educational materials to high standards of factual accuracy and presentation
- that an authoritative and comprehensive field guide be prepared, incorporating the latest information, including aids to identification of species at sea (see also our first recommendation under Item 5.4.3.1).

5.7 Advisory body

Throughout this project we have been aware of, and had our attention drawn to, major gaps in knowledge in almost every aspect of cetacean taxonomy, biology, and environment, and the limitations this ignorance places on defining and achieving realistic conservation and management objectives. This is the situation despite the dedicated efforts of a relatively small number of scientists and considerable activity in a number of government and non-government organisations, and the development of widespread public interest and concern for the welfare of cetaceans.

It is clear that over the next few years the pressures on cetaceans are likely to continue and increase, on individual animals in certain circumstances, and on their populations. Those pressures are most likely to be exerted through impacts on cetacean habitats, but other factors are likely to contribute, such as increases in interactions with fisheries, and even as a result of such relatively benign activities as whale watching and dolphin–human interactions.

Control of these pressures, including preventative measures, is a responsibility of government, acting on the best available advice.

Currently, the Commonwealth Government receives its advice from a number of independent sources. Those sources include the results of research, some of which, but by no means all, is government-funded. They include the results of studies such as this one, which although originally designed to address threatened taxa has inevitably, in dealing with such a relatively little known group, been broadened to include all cetaceans known from Australian waters. An influential public source is public opinion. In the case of cetaceans in particular, this has in some circumstances been formed, and has been greatly influenced by, the considerable efforts of a variety of politically active non-government organisations concerned for the animals' welfare (see Item 2.4 and Appendix 3). Such organisations include animal welfare groups (IFAW, AFA, ANZFAS, for example) and those with a more ecological base for their concerns (for example AWCS, ORRCA, Project Jonah). The sources of advice also include government bodies other than those specifically concerned with fauna conservation.

Two main issues need to be addressed. The first involves the assessment of national priorities for action, including research funding. The second concerns the development and implementation of policies and action relating to regional and international cetacean conservation and management. At present the main forum for exchange of views is through meetings held by ANCA with NGOs at which issues directly relating to the International Whaling Commission are addressed; other marine mammal matters may also be discussed. As well as ANCA and the NGOs, others present have included members of the Australian delegation to IWC and Australian scientists on the IWC Scientific Committee. Participation has recently been broadened with ecotourism and ATSIC representatives. However, no similar forum exists at which the views of the active research and conservation movement can be gained.

We believe there is a need for the provision of independent, credible and broadly-based advice to government, drawing on a wide variety of sources. Similar needs have already been met, for example, in the case of kangaroos (the Kangaroo Advisory Body) and Antarctic science (the Antarctic Science Advisory Committee).

We therefore **recommend**:

- establishment of a cetacean advisory body with at least the following functions
  - continue review of existing and potential threats to cetaceans
  - advise on national priorities for action, including
    - management and legislative needs to meet perceived threats
    - research necessary to provide objective data against which to measure the impacts of such threats, and the resources, including funding levels, required
    - education programs, to include a continuing source of authoritative information to the wider community on current advances in knowledge and research programs under way
    - the need for national long-term facilities such as tissue storage banks, a pollutant analysis facility, and well-curated museum collections
  - advise on regional and international policies and action, particularly in relation to the IWC
  - provide a continuing forum for exchange of views between government, non-government bodies and the scientific community.

The advisory body should provide its advice direct to the Chief Executive Officer, ANCA, and be serviced and resourced by that agency. Its composition should be drawn from a wide representation of organisations and individuals, to provide a balance between them, and include Commonwealth and state agencies, NGOs, industry, and the research community.

6. Flagship Taxa

In the Consultancy Agreement, Item 2.6, Scope of the Consultancy Services (reproduced as Appendix 1, Item 5), requires us to identify two or more flagship taxa for public education programs and provide resource materials on those taxa.

In our early consideration of threatened taxa, leading to the decision to prepare species synopses on all Australian cetaceans, we believed we might consider those relatively few species likely to fall into the endangered or vulnerable categories as possible candidates under this section. In the event, five taxa have been classified in the two categories—*Balaenoptera musculus musculus*, *Eubalaena, Megaptera*, *B. borealis* and *B. physalus.* A further four—*Sousa*, *Orcaella*, *Stenella longirostris* and *Physeter*—we have classified as insufficiently known and therefore possibly under threat.

At the Canberra workshop and subsequently we have received a number of suggestions of species for inclusion here, particularly some of the smaller ones and those less frequently in the public eye. The latter have included *Delphinus delphis*, *Globicephala melas*, *Orcaella brevirostris, Sousa chinensis, Orcinus orca*, and a beaked whale.

Taking the above into account, we conclude as follows.

- Three species stand out as candidates—*Eubalaena australis*, *Megaptera novaeangliae*, and *Tursiops truncatus*—although the latter does not fall into the endangered, vulnerable or insufficiently known categories. We agree that two others, *Sousa* and *Orcaella*, deserve serious consideration in addition to *Eubalaena* and *Megaptera.* They are little known biologically, are, or are potentially, subject to a variety of threats associated with restricted inshore habitats, and are virtually unknown to the community at large.
- *Eubalaena*, *Megaptera* and *Tursiops* all have special significance in the Australian context.
- The two whales are each very distinctive and recognisable and are ‘great whale’ symbols. They are majestic, distant and mysterious, appearing from and disappearing to the deep oceans. The rhythm of their lives, though predictable, thus appears ‘other-worldly’ and remote from our frenetic ones.
- *Tursiops* is one of the best known cetaceans, and is ‘the’ dolphin. It provides a useful and strong contrast through its small size, which engenders a more intimate reaction in people—enhanced because it is non-threatening, is apparently innocently friendly, and actively seeks and permits contact. It occurs year-round in all states and in coastal habitats where development effects are and will be most felt.
- All are primary subjects of expanding whale / dolphin watching industries—a benign, non-consumptive use.
- In addition to the above, we would add *Orcaella.* An attractive tropical inshore dolphin, little is known of its biology, yet it is suspected of being under threat from coastal development, water pollution and inshore netting. It is under threat in other parts of its range. It is less well-known than *Sousa,* and in the broad conservation sense would benefit from deliberate exposure to a wider public by inclusion here.

We therefore **recommend** the following as flagship taxa:

- the southern right whale, *Eubalaena australis*
- the humpback whale, *Megaptera novaeangliae*
- the bottlenose dolphin, *Tursiops truncatus*
- the Irrawaddy dolphin, *Orcaella brevirostris.*