NSW SCIENTIFIC COMMITTEE

Review of the Conservation Status Of Marine Mammal Species In New South Wales

Report to the
NSW Scientific Committee
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May 2001

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This report should be cited as follows:

Smith, P.J (2001). Review of the Conservation Status of Marine Mammal Species in NSW.
A report to the NSW Scientific Committee. NSW National Parks and Wildlife Service. Hurstville NSW.

ISBN 0 7313 6398 1

FOREWORD

The NSW Scientific Committee was established in 1996 following the enactment of the Threatened Species Conservation Act, 1995 (TSC Act). The Committee is independent and consists of 10 Scientists appointed by the Minister for the Environment.

The functions of the Committee include the assessment of nominations to list endangered and vulnerable species, endangered populations, endangered ecological communities and key threatening processes in the Schedules of the TSC Act. The Committee is also required to keep the Schedules under review. Following the publication by the Commonwealth Government of two Action Plans concerning marine mammals, the Scientific Committee undertook to reassess the conservation status of marine mammals in NSW by engaging Dr Peter Smith to carry out a review. Reviews have also been undertaken on marine reptiles and albatrosses within NSW waters.

These reviews have highlighted the difficulty in assessing the conservation status of marine species that are recorded only rarely in NSW waters. Assessment under the Threatened Species Conservation Act (1995) is prescribed by the artificial boundaries of the NSW borders and to 3 nautical miles out to sea. So when considering a species status within NSW the Scientific Committee does not need to consider the viability of populations across the entire range of the species but tries to make an ecologically valid assessment based on the NSW populations, the threats that are impacting on them and the contribution they can make to neighbouring populations. The Committee is of the view that for a mobile species with an extensive range to be listed there needs to be a population all or part of which uses NSW waters in some way to maintain its viability. This could include species that visit NSW waters to calve (e.g. Southern Right Whale), inshore passage migrants (e.g. Humpback Whale), and other species that visit NSW waters on a regular or frequent basis (e.g. Blue Whale). This is especially important when considering the status of marine species that are rarely recorded in NSW because they are vagrants, seasonal strays or dispersing young animals at the edge of their range.

Marine animals can be difficult to identify under most circumstances and recent taxonomic revisions of the albatross group and some of the whale species have made this even more difficult for field researchers. The Scientific Committee is of the view that for a species to be considered for listing under the Threatened Species Conservation Act there must be a reliable record of its occurrence in NSW, preferably backed by a voucher specimen such as a skull or DNA from a tissue sample. Species which cannot be confirmed as occurring in NSW waters will be removed from the Schedules.

The Scientific Committee commends Peter Smith for the review he has carried out and the detailed information he has included in the individual species accounts. This information will be invaluable for the preparation of Recovery Plans for the listed species and the ongoing review of status for this interesting group of animals.

Dr Chris Dickman
Chairperson
Scientific Committee

Summary

Forty species of marine mammals have been reliably recorded in NSW waters, comprising 32 cetaceans (whales and dolphins), seven pinnipeds (seals and sea-lions) and one sirenian (the Dugong). There have also been unconfirmed records of three additional species of cetaceans, and another cetacean species has been reliably recorded just outside NSW waters. Profiles of all 44 species are provided in this review, and an account of the known and potential threatening processes that affect them. Conservation priority scores for each species have been calculated using the methods of Millsap *et al.* (1990).

The review has indicated a number of changes to the current listings of marine mammal species in the Threatened Species Conservation Act that warrant consideration by the NSW Scientific Committee:

- ***Blue Whale.*** Only subspecies *musculus* is currently listed in the Act, but listing of the Blue Whale as an endangered species is warranted, not just subspecies *musculus*.

- ***Fin Whale and Sei Whale.*** Both are currently listed as vulnerable species, but there have been no confirmed records of either in NSW. If they do occur it would only be as occasional vagrants. As neither unconfirmed species nor vagrant species are eligible for listing, both species should be delisted.

- ***Indo-Pacific Humpbacked Dolphin and Spinner Dolphin.*** Both are currently listed as vulnerable species, but only occur in NSW as rare vagrants and should be delisted.

- ***Australian Fur-seal and New Zealand Fur-seal*****.** Not considered threatened at national level, but the small NSW populations of both species warrant listing as vulnerable in NSW.

- ***Dugong.*** Warrants listing as a vulnerable species in NSW because NSW waters play an occasional role as a temporary refuge area for the vulnerable Queensland population.

A variety of potential threatening processes have been identified for marine mammals in NSW and adjacent Australian waters: deliberate killing; incidental catches (bycatch); reduction of prey populations by fisheries; entanglement and ingestion of marine debris; harassment from whale, dolphin and seal watching; collisions with vessels; oil spills; toxic pollutants; acoustic disturbance; and habitat degradation. Not enough information is available to make a proper assessment of the impact of these threats. None is sufficiently well documented to warrant a nomination for listing as a key threatening process in the Threatened Species Conservation Act at this stage. However, they are matters of concern and require further investigation. A particular concern is the unknown level of marine mammal bycatch in fisheries operating in NSW and adjacent Australian waters.

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Tables

1. Introduction

1.1 Objectives

The marine mammals of New South Wales include a variety of cetaceans (whales and dolphins) and pinnipeds (seals and sea-lions), and one sirenian (the Dugong). This review was commissioned by the NSW Scientific Committee to document the status of all marine mammal species occurring in NSW, and to identify the known and potential threatening processes that affect them. The NSW Scientific Committee is an independent body whose functions include the consideration and recommendation for listing (or delisting) of threatened species and populations in the Threatened Species Conservation Act. Eight marine mammal species are currently listed in the Act (Table 1). This review provides information to assist in assessing whether these species warrant their listings and whether any additional species or populations warrant listing.

The specific objectives of the review were to:

- Identify the marine mammal species that have been reliably recorded in NSW waters (up to three nautical miles offshore).

- Summarise the available information on the distribution, abundance, seasonal patterns of occurrence, and ecological requirements of each species in NSW.

- Summarise the available information on population size and historical and recent population trends for each species in NSW, and in other parts of their distribution where appropriate.

- Identify the known and potential threatening processes that affect marine mammals in NSW waters, and in other parts of their distribution where appropriate.

- Rank the species in terms of need for conservation effort following the methods of Millsap *et al*. (1990).

- Identify the species, subspecies or populations that warrant listing, changed listing or delisting under the Threatened Species Conservation Act. Where these differ from the current listings under the Act, appropriate nominations are to be prepared for consideration by the NSW Scientific Committee.

One issue for the review has been the status of species that are vagrants to NSW. The NSW Scientific Committee has been considering this issue in relation to other groups such as marine reptiles and marine birds, and is trying to bring a consistency to the listing of wide-ranging, highly mobile species. The Committee is of the view that for a mobile species to be listed there needs to be a population all or part of which uses NSW waters in some way to maintain its viability. This could include species that visit NSW waters to calve (e.g. Southern Right Whale), inshore passage migrants (e.g. Humpback Whale), and other species that visit NSW waters on a regular or frequent basis (e.g. Blue Whale). Species that occur in NSW waters only

as occasional vagrants outside their normal distribution and habitat are not considered eligible for listing.

Another issue has been the status of species whose occurrence in NSW has not been confirmed. The Committee is of the view that for a species to be considered for listing under the Threatened Species Conservation Act there must be a reliable record of its occurrence in NSW, preferably backed by a voucher specimen.

Table 1. Marine mammal species currently listed in the Threatened Species Conservation Act (January 2001)

Scientific name	Common name	Listing
Balaenoptera musculus musculus	Blue Whale	Endangered
Balaenoptera borealis	Sei Whale	Vulnerable
Balaenoptera physalus	Fin Whale	Vulnerable
Eubalaena australis	Southern Right Whale	Vulnerable
Megaptera novaeangliae	Humpback Whale	Vulnerable
Physeter macrocephalus	Sperm Whale	Vulnerable
Sousa chinensis	Indo-Pacific Humpbacked Dolphin	Vulnerable
Stenella longirostris	Spinner Dolphin	Vulnerable

1.2 Sources of Marine Mammal Records

Records of marine mammals in NSW were obtained from the following sources:

- The NSW National Parks and Wildlife Service's 'Atlas of NSW Wildlife' database (records entered up to December 2000). Includes records from the Environment Australia cetacean strandings database (Nicol 1990).

- Cetacean records for 1983-1998 compiled by Environment Australia for its annual reports to the International Whaling Commission (including many records not published in the *Reports of the International Whaling Commission*).

- Cetacean records for 1999-2000 compiled by the NSW National Parks and Wildlife Service's Coordinator Wildlife Management.

- The Environment Australia cetacean sightings database (records entered up to March 1999).

- Sapphire Coast whale watch reports for 1996-2000 (http://www.sapphirecoast.com.au/whales)

- Marine mammal records published in the *ORRCA Newsletter*, Autumn 1993 to Summer 2000.

- Other records from the literature, including records from Dawbin (1964), Dixon (1980), Robinson (1984), Baker (1990), Pavey (1992) and Garbett (1996).

Details of many marine mammal records for NSW that have not been listed in the Atlas of NSW Wildlife, especially stranding records, are provided in Appendix 2.

1.3 Conservation Status Categories

The species profiles below include their current conservation status listings at international, national and state levels. The categories are briefly defined as follows.

IUCN Red List of Threatened Animals (IUCN Species Survival Commission 2000):

Critically endangered: Facing an extremely high risk of extinction in the wild in the immediate future, as defined by a set of specific criteria.

Endangered: Facing a very high risk of extinction in the wild in the near future, as defined by a set of specific criteria.

Vulnerable: Facing a high risk of extinction in the wild in the medium-term future, as defined by a set of specific criteria.

Lower risk, conservation dependent: Does not satisfy the criteria for the above categories. Taxon-specific or habitat-specific conservation programs are being carried out, the cessation of which would result in the taxon qualifying for one of the above categories within a period of five years.

Lower risk, near threatened: Does not qualify for conservation dependent, but close to qualifying for vulnerable.

Lower risk, least concern: Does not qualify for conservation dependent or near threatened.

Data deficient: There is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES Secretariat 2000):

Appendix I: Species threatened with extinction that are or may be affected by trade.

Appendix II: Species that may become threatened with extinction unless trade is subject to strict regulation.

Convention on the Conservation of Migratory Species of Wild Animals (UNEP/CMS Secretariat 2000):

Appendix I: Migratory species that are endangered.

Appendix II: Migratory species that require or would benefit significantly from international agreements for their conservation and management.

Commonwealth Environment Protection and Biodiversity Conservation Act (January 2001):

Critically endangered/endangered/vulnerable/conservation dependent: Defined as in IUCN Red List, but with different criteria and only applied to the status of each species in Australia, not at a global scale.

Migratory species: Listed in the Convention on Migratory Species.

Marine species: Actions that kill, take, injure, trade, keep or move a member of a listed marine species in or from a Commonwealth area can occur only in

limited circumstances.

Action Plan for Australian Cetaceans (Bannister et al. 1996):

Endangered: In danger of extinction. Survival of the taxon is unlikely if the causal factors continue operating.

Vulnerable: Likely to move into the endangered category in the near future if the causal factors continue operating.

Insufficiently known: Suspected, but not definitely known, to be endangered or vulnerable.

No category assigned because of insufficient information: Differs from the previous category in that there is no firm basis on which to infer a significant threat, past or present.

No category assigned but possibly secure: No firm basis on which to infer a significant threat, past or present, and there are general indications of wide distribution and abundance.

No category assigned but probably secure: No firm basis on which to infer a significant threat, past or present, and a reasonably objective assessment exists of numbers in the wild.

Secure: Current population numbers are such that the taxon is in no danger, except perhaps if uncontrolled commercial whaling resumes.

Action Plan for Australian Seals (Shaughnessy 1999):

Categories defined as in IUCN Red List, but only applied to the status of each species in Australia, not at a global scale.

NSW Threatened Species Conservation Act (January 2001):

Endangered: Likely to become extinct in nature in NSW unless the circumstances and factors threatening its survival or evolutionary development cease to operate; or its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction; or it might already be extinct, but is not presumed extinct.

Vulnerable: Likely to become endangered unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

1.4 Legislation Protecting Marine Mammals in NSW

The NSW Threatened Species Conservation Act provides for the identification and listing of species that are endangered or vulnerable in NSW, and for the identification of endangered populations and endangered ecological communities. The Act also allows for the identification of the key threatening processes that are causing their decline, and the identification of critical habitat for endangered species, populations and communities. Listing of marine mammal species or populations in the Act affords increased legal protection for them. It triggers an assessment and approval process for any actions that are likely to have an adverse impact, placing specific responsibilities on proponents, consent and determining authorities, and the NSW National Parks and Wildlife Service in the fields of environmental planning and development control. It also triggers the preparation and implementation of recovery plans to promote the recovery of the listed species or population to a position of

viability in nature. In addition, the Act provides for the preparation and implementation of threat abatement plants for key threatening processes.

In addition to the Threatened Species Conservation Act, other legislation that protects marine mammals in NSW waters includes the NSW National Parks and Wildlife Act and the Commonwealth Environment Protection and Biodiversity Conservation Act.

All marine mammals are protected fauna in NSW under the National Parks and Wildlife Act. The Act prohibits unauthorised people from harming protected fauna. The definition of 'harm' includes hunt, shoot, poison, net, snare, spear, pursue, capture, trap, injure or kill, but does not include harm by changing the habitat of the animal. Marine mammals are also protected by the special provisions of section 112 of the Act. This section prohibits unauthorised people from approaching marine mammals closer than the distances prescribed by the regulations or interfering with them. The minimum approach distances apply to all marine mammals in NSW except the Bottlenose Dolphin and Common Dolphin. The distances are set out in section 16 of the National Parks and Wildlife (Fauna Protection) Regulation and vary depending on the method of approach. Section 112 of the Act also provides for the preparation and implementation of plans of management for populations of marine mammals.

The recent introduction of the Commonwealth Environment Protection and Biodiversity Conservation Act has introduced a new assessment and approvals system for actions that are likely to have a significant impact on 'matters of national environmental significance', which includes nationally listed threatened species and ecological communities, and nationally listed migratory species. This now applies generally in NSW, not just for actions on Commonwealth territory or by Commonwealth agencies, as in the previous Commonwealth Endangered Species Protection Act. The Act currently lists five marine mammal species as threatened species, and eight additional species as migratory species.

2. Species Profiles

2.1 Species List

Forty species of marine mammals have been reliably recorded in NSW, comprising 32 cetaceans, seven pinnipeds and one sirenian (Table 2). There have also been unconfirmed records of three additional species of cetaceans, and another cetacean species has been reliably recorded just outside NSW waters. All 44 species are profiled below. The nomenclature and order of the species follow Bannister *et al*. (1996) for cetaceans, and Shaughnessy (1999) for pinnipeds.

Table 2. Marine mammal species recorded in NSW waters (up to 5 km offshore)
u = unconfirmed records, + = recorded just outside NSW waters

Scientific name	Common name
Order Cetacea	**Whales, dolphins and porpoises**
Suborder Odontoceti	**Toothed whales**
Family Delphinidae	
Steno bredanensis	Rough-toothed Dolphin
Sousa chinensis	Indo-Pacific Humpbacked Dolphin
Lagenorhynchus obscurus (u)	Dusky Dolphin
Grampus griseus	Risso's Dolphin
Tursiops truncatus	Bottlenose Dolphin
Stenella attenuata	Pantropical Spotted Dolphin
Stenella longirostris	Spinner Dolphin
Stenella coeruleoalba	Striped Dolphin
Delphinus delphis	Common Dolphin
Lagenodelphis hosei	Fraser's Dolphin
Lissodelphis peronii	Southern Right Whale Dolphin
Peponocephala electra	Melon-headed Whale
Feresa attenuata	Pygmy Killer Whale
Pseudorca crassidens	False Killer Whale
Orcinus orca	Killer Whale
Globicephala melas	Long-finned Pilot Whale
Globicephala macrorhynchus	Short-finned Pilot Whale
Family Ziphiidae	
Berardius arnuxii (+)	Arnoux's Beaked Whale
Mesoplodon densirostris	Blainville's Beaked Whale
Mesoplodon layardii	Strap-toothed Beaked Whale
Mesoplodon grayi	Gray's Beaked Whale
Mesoplodon bowdoini	Andrew's Beaked Whale
Mesoplodon ginkgodens	Ginkgo-toothed Beaked Whale
Ziphius cavirostris	Cuvier's Beaked Whale
Hyperoodon planifrons	Southern Bottlenose Whale
Family Physeteridae	
Physeter macrocephalus	Sperm Whale

Table 2 (contd)

Scientific name	Common name
Family Kogiidae	
Kogia breviceps	Pygmy Sperm Whale
Kogia simus	Dwarf Sperm Whale
Suborder Mysticeti	**Baleen whales**
Family Balaenidae	
Eubalaena australis	Southern Right Whale
Family Neobalaenidae	
Caperea marginata	Pygmy Right Whale
Family Balaenopteridae	
Balaenoptera acutorostrata	Minke Whale
Balaenoptera borealis (u)	Sei Whale
Balaenoptera edeni	Bryde's Whale
Balaenoptera musculus	Blue Whale
Balaenoptera physalus (u)	Fin Whale
Megaptera novaeangliae	Humpback Whale
Order Carnivora	**Carnivores**
Suborder Pinnipedia	**Seals and sea lions**
Family Otariidae	
Neophoca cinerea	Australian Sea-lion
Arctocephalus forsteri	New Zealand Fur-seal
Arctocephalus pusillus	Australian Fur-seal
Arctocephalus tropicalis	Subantarctic Fur-seal
Family Phocidae	
Mirounga leonina	Southern Elephant Seal
Hydrurga leptonyx	Leopard Seal
Lobodon carcinophagus	Crab-eater Seal
Order Sirenia	**Sea cows**
Family Dugongidae	
Dugong dugon	Dugong

2.2 Rough-toothed Dolphin *Steno bredanensis*

Conservation Status

International

IUCN Red List of Threatened Species: data deficient
Convention on International Trade in Endangered Species: Appendix II
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: not listed
Cetacean Action Plan: no category assigned because of insufficient information

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Rough-toothed Dolphin occurs in tropical and subtropical waters around the world, rarely ranging north of 40^{o}N or south of 35^{o}S (Jefferson *et al*. 1993, Miyazaki and Perrin 1994). It is usually seen in deep water far offshore (Leatherwood and Reeves 1983). Animals recorded inshore or in colder waters are often considered to be vagrants. However, the species is frequently observed in inshore waters in Brazil (Flore and Ximenez 1997). The diet includes fish and cephalopods (Miyazaki and Perrin 1994). No major migratory patterns are known. In Australia, it has been recorded from Western Australia, Northern Territory, Queensland and New South Wales (Bannister *et al*. 1996).

Subspecies and Stocks

No subspecies are recognised. Separate stocks have been suggested for the Atlantic and Indo-Pacific because of differences in rostrum lengths, but the data are not conclusive (Leatherwood and Reeves 1983).

Occurrence in NSW

There have been only two records of the Rough-toothed Dolphin in NSW: an undated specimen at the Australian Museum from Wollongong; and an animal found trapped in a tidal pool at Urunga in September 1970 and returned to the sea (Atlas of NSW Wildlife).

Population Size

The size of the population in the eastern tropical Pacific was estimated at 145 900 (c.v. 0.320) in the late 1980s (Wade and Gerrodette 1993). No population estimates are available for Australian waters.

Population Trends

Little is known about population trends in Australian waters or elsewhere. No major conservation problems are known at present (Klinowska 1991, Reeves and Leatherwood 1994, Bannister *et al*. 1996).

2.3 Indo-Pacific Humpbacked Dolphin *Sousa chinensis*

Conservation Status

International

IUCN Red List of Threatened Species: data deficient
Convention on International Trade in Endangered Species: Appendix I
Convention on Migratory Species: Appendix II

Australia

Environment Protection and Biodiversity Conservation Act: migratory species
Cetacean Action Plan: insufficiently known

NSW

Threatened Species Conservation Act: vulnerable

Distribution, Habitat and Movements

There is some uncertainty over species limits in the genus *Sousa*. Conventionally, two species have been distinguished: the Indo-Pacific Humpbacked Dolphin (*Sousa chinensis*) in the Pacific and Indian Oceans, and the Atlantic Humpbacked Dolphin (*S. teuszii*) on the west coast of Africa (Leatherwood and Reeves 1983, Klinowska 1991, Reeves and Leatherwood 1994, Baillie and Groombridge 1996). Zhou *et al*. (1980) and Ross (1984) presented evidence suggesting that a third species, *S. plumbea* (northern and western Indian Ocean), should be distinguished from *S. chinensis* (western Pacific and eastern Indian Oceans). This treatment was followed by Ross *et al*. (1994), Bannister *et al*. (1996) and Rice (1998). However, Ross *et al*. (1995, 1996) have suggested that the genus should be considered to consist of just one species, *S. chinensis*, with possibly three or more subspecies.

Following the conventional treatment of the genus, the Indo-Pacific Humpbacked Dolphin is distributed around the Indian Ocean coasts of Africa, Asia and north-western Australia, and from southern China through the Indo-Malay Archipelago to north-eastern Australia (Ross *et al*. 1994, Jefferson and Karczmarski 2001). In Australia, it occurs in coastal northern waters from the NSW/Queensland border to Exmouth Gulf (Corkeron *et al*. 1997). Within this range, it is mostly confined to shallow waters close to the coast or in embayments. It also occurs in the Great Barrier Reef region, where it stays close to reefs or islands. Elsewhere in the world, it is known to venture several kilometres up rivers, particularly in China, but is chiefly a species of coasts, bays and estuaries (Ross *et al*. 1994). In South Africa, Karczmarski *et al*. (2000) found that it remains mostly within 400 m of the shore in water less than 15 m deep, concentrating around rocky reefs, which are the primary feeding grounds. The species feeds mainly on fish, especially littoral, estuarine and reef species (Ross *et al.* 1994). Populations are sedentary or undertake only local movements (Ross *et al.* 1994, Parsons 1998). The population in Moreton Bay apparently stays within the bay (Corkeron 1990).

Subspecies and Stocks

In view of the species' sedentary, inshore habits, the Australian population may be considered as a separate entity, although some interchange is possible with populations outside Australia.

Occurrence in NSW

The Indo-Pacific Humpbacked Dolphin is resident all along the Queensland coast (Corkeron *et al*. 1997), south to Moreton Bay (Corkeron 1990) and the Gold Coast (Bryden 1978). However, there have been no reports, recent or historical, of any resident populations south of the border in northern NSW. There have been only three records in NSW: strandings at Tweed Heads in 1962 (specimen at Australian Museum) and in the Port Macquarie area in 1976 (Atlas of NSW Wildlife), and a skull in the Cambridge Museum, UK, that was collected last century at Wollongong (Baker 1990). The species apparently occurs in NSW only as an occasional vagrant from

Queensland.

Population Size

No estimate of the overall population size in Australia can be made from the available data (Corkeron *et al*. 1997). The size of the Moreton Bay subpopulation has been estimated in the order of 120-160, or about one per 10 km^2.

Population Trends

Population declines have been reported in Thailand and southern China, and are likely to have occurred in other areas as well (Reeves and Leatherwood 1994, Jefferson and Karczmarski 2001). Information on population trends in Australia is scarce, but there are indications that the species may be declining in Australian waters (Corkeron *et al*. 1997).

2.4 Dusky Dolphin *Lagenorhynchus obscurus*

Conservation Status

International

IUCN Red List of Threatened Species: data deficient
Convention on International Trade in Endangered Species: Appendix II
Convention on Migratory Species: Appendix II

Australia

Environment Protection and Biodiversity Conservation Act: migratory species
Cetacean Action Plan: no category assigned because of insufficient information

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Dusky Dolphin is restricted to the Southern Hemisphere, where it occurs around New Zealand, off south-western Africa, off parts of South America, and around oceanic islands in the South Atlantic, southern Indian Ocean and western South Pacific (International Whaling Commission 1997b, Brownell and Cipriano 1999). These populations are discontinuous, although occasional interchange may be possible. Dusky Dolphins have been recorded occasionally in southern Australian waters, particularly around Tasmania, but also Victoria, South Australia and an unconfirmed record from southern Western Australia (Gill *et al*. 2000). These are unlikely to be resident animals, more likely visitors from the New Zealand population.

Dusky Dolphins inhabit continental shelf and slope waters, generally moving into water deeper than 2000 m only in areas where there are steep drop-offs near continental or island coasts (International Whaling Commission 1997b, Brownell and Cipriano 1999). No major migratory movements are known. Off Argentina, they seem to follow closely the movements of their primary prey, Southern Anchovies (*Engraulis anchoita*), coming inshore in spring and early summer, then moving offshore into deeper water in late summer and autumn (Wursig and Wursig 1980). Off New

Zealand, they seem to feed mainly on deep-water prey such as lantern fish (Myctophidae) and cephalopods, taken largely at night, with the dolphins moving inshore during the day to rest, socialise and avoid predators (Wursig *et al*. 1997). Mothers and newborn young are found in particularly shallow waters. The daily pattern of inshore/offshore movements is less pronounced in winter, when Dusky Dolphins in New Zealand are generally found further offshore than during summer.

Subspecies and Stocks

No subspecies are currently recognised. However, an analysis of variation in skulls and body size has indicated differences warranting recognition at the subspecific level (at least) between the populations from western South America, New Zealand and south-western Africa (Van Waerebeek 1993). Subsequent genetic analyses have confirmed the discreteness of these populations and indicated that the differences may warrant recognition at the species level. Dusky Dolphins in New Zealand and Peru are about as genetically distant from each other as either of them is from the Pacific White-sided Dolphin *Lagenorhynchus obliquidens* (International Whaling Commission 1997b, Wursig *et al*. 1997).

Occurrence in NSW

The occurrence of the Dusky Dolphin in NSW is unconfirmed. There is a record in the Atlas of NSW Wildlife of an animal that stranded and died at Mona Vale in November 1977 while a pod of about 20 remained offshore. However, there is no specimen at the Australian Museum to substantiate the record (S. Ingleby, pers. comm.).

Population Size

The only population estimate available is for the waters off Argentina between 43^{o}S and 47^{o}S in 1995, when the number of animals was conservatively estimated at 7252 (95% confidence limits 4435 to 11 858) (International Whaling Commission 1997b). No population estimates are available for the New Zealand population, but the species is common there and schools can number well over 1000 animals (Wursig *et al*. 1997).

Population Trends

Large numbers (up to 17 500 per year) have been taken in gillnets and by harpooning in Peru since the early 1980s (International Whaling Commission 1997b). Although directed takes have now been banned, there is still concern over the level of incidental takes in gillnet fisheries off Peru. Substantial bycatches of Dusky Dolphins (up to 560 per year) have also occurred in shrimp trawls off Patagonia. Unlike the situation in Peru, the New Zealand Dusky Dolphin population does not appear to be threatened at present, although bycatch in gillnets is a potential threat, with an estimated 50-150 killed each year between 1984-88 (Wursig *et al*. 1997).

2.5 Risso's Dolphin *Grampus griseus*

Conservation Status

International

IUCN Red List of Threatened Species: data deficient

Convention on International Trade in Endangered Species: Appendix II

Convention on Migratory Species: Appendix II (North and Baltic Sea populations)

Australia

Environment Protection and Biodiversity Conservation Act: not listed

Cetacean Action Plan: no category assigned because of insufficient information

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

Risso's Dolphin is widely distributed in all oceans between about 60^{o}N to 60^{o}S, where surface water temperature is over about 10^{o}C (Kruse *et al.* 1999). It inhabits deep oceanic and continental slope waters, sometimes continental shelf waters, of tropical, subtropical and temperate regions, favouring warmer waters. It occasionally extends its range into higher latitudes, probably in response to protracted or unseasonal warm water events (Leatherwood *et al*. 1980). Seasonal patterns of distribution and abundance may also be associated with changing sea surface temperatures: increasing numbers and a shoreward shift in distribution occurring during periods of warm water (Kruse *et al.* 1999). In Australia, it has been recorded from south-western Western Australia, South Australia, Victoria, NSW and Queensland (Bannister *et al*. 1996). It preys chiefly on cephalopods of various types (Kruse *et al*. 1999).

Subspecies and Stocks

No subspecies are currently recognised. Ross (1984) has reported regional differences in body lengths in samples from the north-eastern Atlantic, the Mediterranean and South Africa. Mizue and Yashido (1962) have suggested that different 'races' of Risso's dolphin occur off Japan. However, the data are limited and the question of population differences remains unresolved (Kruse *et al*. 1999).

Occurrence in NSW

Risso's Dolphin has been recorded in NSW from 15 strandings between Brooms Head and Eurobodalla National Park, the most recent in March 2000 (Atlas of NSW Wildlife, ORRCA Newsletters). Of the 11 records for which the month is given, all are between December and June, except for two records from September 1972. One of the latter was a mass stranding of eight animals at Jervis Bay.

Population Size

Wade and Gerrodette (1993) estimated the size of the Risso's Dolphin population in the eastern tropical Pacific as 175 800 (c.v. 0.381). Barlow *et al*. (1997) estimated the size of the population in the waters off the west coast of the United States as 32 376

(c.v. 0.46). Miyashita (1993) estimated that there were about 83 000 Risso's Dolphins in the waters off the Pacific coast of Japan. No population estimates are available for Australian waters.

Population Trends

Little is known about population trends in Australian waters or elsewhere. No major conservation problems are known at present in the Australian region (Bannister *et al*. 1996), although there has been concern over the effects of direct or incidental catches in some other regions, especially in regard to the high numbers taken incidentally in Sri Lankan gillnet fisheries (Klinowska 1991, Reeves and Leatherwood 1994).

2.6 Bottlenose Dolphin *Tursiops truncatus*

Conservation Status

International

IUCN Red List of Threatened Species: data deficient

Convention on International Trade in Endangered Species: Appendix II

Convention on Migratory Species: Appendix II (Arafura/Timor Sea *T. aduncus* populations, North and Baltic Sea *T. truncatus* populations, western Mediterranean *T. truncatus* population, Black Sea *T. truncatus* population)

Australia

Environment Protection and Biodiversity Conservation Act: migratory species (Arafura/Timor Sea *T. aduncus* populations)

Cetacean Action Plan: no category assigned because of insufficient information

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Bottlenose Dolphin is a cosmopolitan species that is found in tropical, subtropical and temperate waters throughout the world, mainly between latitudes 60^{o}N and 50^{o}S (Leatherwood and Reeves 1983, Wells and Scott 1999). At the northern limit of its range in the North Atlantic it is seasonally migratory, with a more southerly distribution in winter. In Australia it occurs in all states and the Northern Territory (Bannister *et al*. 1996). Separate inshore and offshore forms occur in many regions. Inshore forms typically occur as resident groups with a limited home range in very shallow water close to the coast, often entering bays, estuaries and coastal lagoons, sometimes venturing well up river, although generally avoiding freshwater reaches (Leatherwood and Reeves 1983, Wells and Scott 1999). Offshore forms may occur in continental shelf and slope waters or well beyond, where individuals range widely and may undertake regular seasonal migrations, apparently following the movements of their prey (Walker 1981). The diet consists chiefly of fish and cephalopods, with a typically wide variety of species being taken (Wells and Scott 1999). Differences have been found in the diets of inshore and offshore forms consistent with their different habitats (Walker 1981, Ross 1984).

Subspecies and Stocks

The taxonomy of the genus *Tursiops* is confused and remains unresolved. The conventional treatment has been to consider the genus to be represented by a single widespread and polymorphic species, but a number of different forms probably warrant recognition as separate species or subspecies. In South African waters, Ross (1977) equated the offshore form of the Bottlenose Dolphin to *Tursiops truncatus*, and the inshore form to *T. aduncus*. The same two forms have been distinguished in Australia, and both forms occur widely in NSW waters (Ross and Cockcroft 1990, Hale *et al*. 2000, Möller and Beheregaray 2001). The two forms differ morphologically as well as in habitat preferences. However, there are arguments for and against their recognition as separate species (Hale *et al*. 2000).

Occurrence in NSW

Bottlenose Dolphins are regularly observed all along the NSW coast, usually close to shore and often in bays, estuaries and the lower reaches of rivers. There are resident, breeding populations at Port Stephens, Jervis Bay, Twofold Bay and many other sites. Most observations are groups of 1-50 animals. Unusually large numbers (300-2000) were reported close to the coast between Merimbula and Narooma in May 1992 (Atlas of NSW Wildlife). Schools of over 200 were reported in Twofold Bay in June-August 1996 (Sapphire Coast whale watch reports). The Bottlenose Dolphin is the most frequent cetacean species to strand in NSW (81 stranding and netting records in the Atlas of NSW Wildlife and Appendix 2). Mass strandings have occurred elsehere in Australia, but have not been recorded in NSW.

Population Size

Wade and Gerrodette (1993) estimated the size of the Bottlenose Dolphin population in the eastern tropical Pacific as 243 500 (c.v. 0.286), but coastal dolphin populations were not well covered in their surveys. Miyashita (1993) estimated that there were about 37 000 Bottlenose Dolphins in the waters off the Pacific coast of Japan. No population estimates are available for Australian waters, except at a local scale. Photo-identification studies have provided minimum population estimates for several local populations: 334 in Moreton Bay; 321 in inshore waters off North Stradbroke Island; over 300 in south-eastern Shark Bay; at least 150 in Cockburn Sound; and at least 140 at Adelaide (Bannister *et al*. 1996). In NSW, the size of the resident population in Jervis Bay has been estimated at about 47 individuals (Mandelc 1995).

Population Trends

Populations of Bottlenose Dolphins, particularly of inshore forms, are vulnerable to a range of threats such as habitat degradation, pollution, excessive disturbance, boat strikes, incidental catches and, in some areas, direct catches. Conflicts between Bottlenose Dolphins and human activities occur in many areas around the world, and there are a number of examples of local population declines (Klinowska 1991, Reeves and Leatherwood 1994, Wells and Scott 1999). In Australia, there has been particular concern over high levels of bycatch in a gillnet fishery by Taiwanese vessels in northern Australian waters in the 1970s and 1980s. The total cetacean bycatch for the period June 1981 to December 1985 was in the order of 14 000

animals, of which about 60% were the *aduncus* form of the Bottlenose Dolphins (Harwood *et al*. 1984, Harwood and Hembree 1987). The use of pelagic driftnets greater than 2.5 km was banned in 1986, which led to the cessation of operations in Australian waters (Evans 1998). However, the fishery still operates just outside Australian waters and the bycatch remains high (Bannister *et al*. 1996). Because of this, the Arafura/Timor Sea populations of *Tursiops aduncus* have recently been listed on Appendix II of the Convention on Migratory Species.

2.7 Pantropical Spotted Dolphin *Stenella attenuata*

Conservation Status

International

IUCN Red List of Threatened Species: lower risk, conservation dependent
Convention on International Trade in Endangered Species: Appendix II
Convention on Migratory Species: Appendix II (eastern tropical Pacific population, Southeast Asian populations,)

Australia

Environment Protection and Biodiversity Conservation Act: migratory species (eastern tropical Pacific population, Southeast Asian populations)
Cetacean Action Plan: no category assigned because of insufficient information

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Pantropical Spotted Dolphin has been redescribed and distinguished from the Atlantic Spotted Dolphin (*Stenella frontalis*), resolving the previous taxonomic confusion (Perrin *et al*. 1987). It is distributed around the world in all oceans between latitudes 40^{o}N and 40^{o}S, but is most abundant in the tropical parts of its range (Jefferson *et al.* 1993, Perrin and Hohn 1994). In Australia, it has been recorded in Western Australia, the Northern Territory, Queensland and NSW (Bannister *et al*. 1996). A reported record for Victoria (Dixon 1989) has been reidentified as a Common Dolphin (Perrin and Hohn 1994). The Pantropical Spotted Dolphin occurs both in the open ocean and in coastal waters. Its prey consists chiefly of small epipelagic fish, cephalopods and crustaceans, with some take of mesopelagic animals. Seasonal inshore/offshore movements have been reported in both the eastern tropical Pacific and Japan (Perrin and Hohn 1994).

Subspecies and Stocks

In the eastern tropical Pacific, a large-bodied coastal form of the Pantropical Spotted Dolphin has been separated as subspecies *grafmani*, and two other stocks have been distinguished in offshore waters (Dizon *et al*. 1994). Pantropical Spotted Dolphins around Hawaii have been identified as another stock that is distinct from those in the eastern tropical Pacific (Perrin 1975). No information is available on stocks in the western Pacific or in the Indian and Atlantic Oceans.

Occurrence in NSW

The Pantropical Spotted Dolphin has been recorded in NSW from six strandings, the most recent in February 1998 (Atlas of NSW Wildlife and ORRCA Newsletters). There have also been two unconfirmed sightings (Atlas of NSW Wildlife). The records are from locations between Coffs Harbour and Sydney, in the months of January, February, March, June and September.

Population Size

In the eastern tropical Pacific, Wade and Gerrodette (1993) have estimated the population sizes of the various stocks as 1 298 400 (c.v. 0.150) for the western/southern offshore stock, 730 900 (c.v. 0.142) for the north-eastern offshore stock, and 29 800 (c.v. 0.346) for the coastal subspecies *grafmani*. No population estimates are available for Australian waters.

Population Trends

The species' habit of schooling with tuna has caused major bycatch problems in the tuna purse-seine fishery in the eastern tropical Pacific, where nets are set around dolphin schools because they indicate the presence of tuna. As many as seven million dolphins have been killed in this fishery, of which 62% were from the north-eastern offshore stock of the Pantropical Spotted Dolphin (International Whaling Commission 1992). The population of this stock was estimated to have declined by 1990 to less than a quarter of its size in 1959, when the fishery began (Wade 1993a). The dolphin mortality in this fishery has now been drastically reduced to levels that are no longer considered a threat to dolphin populations (Scott 1995, Hall and Lennert 1997). Bycatch of dolphins has been much less of a problem in tuna fisheries in the western Pacific, where nets are not usually set around dolphin schools (Bailey *et al*. 1996). However, Pantropical Spotted Dolphins have been subject to substantial direct and incidental catches in other fisheries in the western Pacific (Klinowska 1991, Reeves and Leatherwood 1994). There was a significant bycatch of small cetaceans in a gillnet fishery by Taiwanese vessels in northern Australian waters in the 1970s and 1980s. The total cetacean bycatch for the period June 1981 to December 1985 was in the order of 14 000 animals, of which about 5% were Pantropical Spotted Dolphins (Harwood and Hembree 1987). The fishery no longer operates in Australian waters (Evans 1998), but it still operates nearby, and the bycatch remains high (Bannister *et al*. 1996).

2.8 Spinner Dolphin *Stenella longirostris*

Conservation Status

International

IUCN Red List of Threatened Species: lower risk, conservation dependent
Convention on International Trade in Endangered Species: Appendix II
Convention on Migratory Species: Appendix II (eastern tropical Pacific populations, Southeast Asian populations,)

Australia

Environment Protection and Biodiversity Conservation Act: migratory species (eastern tropical Pacific populations, Southeast Asian populations)

Cetacean Action Plan: insufficiently known

NSW

Threatened Species Conservation Act: vulnerable

Distribution, Habitat and Movements

The Spinner Dolphin is distributed around the world in all oceans between latitudes 40^{o}N and 40^{o}S, but is most abundant in the tropical parts of its range (Perrin and Gilpatrick 1994, Perrin 1998). It is often associated with inshore waters, islands and banks, but also occurs in the open ocean many hundreds of kilometres from the nearest land. Pelagic and shallow-water forms have been distinguished in the western Pacific. The pelagic form (subspecies *longirostris*) feeds primarily on small mesopelagic fish and squid, while the shallow-water form (subspecies *roseiventris*) feeds mainly on benthic and coral reef fish and invertebrates (Perrin *et al*. 1989, 1999). In Hawaii, Spinner Dolphins usually spend the daytime hours resting in shallow bays near deep water, moving offshore at dusk to feed (Norris *et al*. 1994). The species has been recorded in Australia from Western Australia, the Northern Territory, Queensland and NSW (Bannister *et al*. 1996).

Subspecies and Stocks

Perrin *et al*. (1999) distinguished two subspecies of Spinner Dolphin in the western Pacific: a large pelagic form, subspecies *longirostris*, which is widespread in the Pacific, Indian and Atlantic Oceans; and a smaller form associated with shallow waters in the Gulf of Thailand, the Timor and Arafura Seas, and probably throughout Indonesia and Malaysia, subspecies *roseiventris*. In the eastern Pacific, Perrin (1990) distinguished three subspecies: *longirostris* and two subspecies endemic to the region, *orientalis* and *centroamericana*.

Occurrence in NSW

The Spinner Dolphin is only a vagrant to NSW. It has been recorded from six strandings between Byron Bay and Urunga: one in June 1984, one in November 1989, and a spate of four in July and August 1991 (Atlas of NSW Wildlife).

Population Size

In the eastern tropical Pacific, Wade and Gerrodette (1993) have estimated the population size of the Eastern Spinner Dolphin (subspecies *orientalis*) as 631 800 (c.v. 0.238), and the population size of the Whitebelly Spinner Dolphin (an apparently hybrid population of subspecies *longirostris* and *orientalis*) as 1 019 300 (c.v. 0.187). No population estimates are available for Australian waters.

Population Trends

The species' habit of schooling with tuna has caused major bycatch problems in the tuna purse-seine fishery in the eastern tropical Pacific, where nets are set around

dolphin schools because they indicate the presence of tuna. As many as seven million dolphins have been killed in this fishery, of which 22% were Eastern Spinner Dolphins (International Whaling Commission 1992). The population of this subspecies was estimated by Wade (1993b) to have declined by 1990 to about 44% of its size in 1959, when the fishery began. The dolphin mortality in this fishery has now been drastically reduced to levels that are no longer considered a threat to dolphin populations (Scott 1995, Hall and Lennert 1997). Bycatch of dolphins has been much less of a problem in tuna fisheries in the western Pacific, where nets are not usually set around dolphin schools (Bailey *et al*. 1996). However, Spinner Dolphins have been subject to substantial direct and incidental catches in various other fisheries around the world (Klinowska 1991, Reeves and Leatherwood 1994). There was a significant bycatch of small cetaceans in a gillnet fishery by Taiwanese vessels in northern Australian waters in the 1970s and 1980s. The total cetacean bycatch for the period June 1981 to December 1985 was in the order of 14 000 animals, of which about 35% were Spinner Dolphins (Harwood and Hembree 1987). The use of pelagic driftnets greater than 2.5 km was banned in 1986, which led to the cessation of operations in Australian waters (Evans 1998). However, the fishery still operates just outside Australian waters and its continuing impact on Spinner Dolphins is a matter of some concern (Bannister *et al*. 1996).

2.9 Striped Dolphin *Stenella coeruleoalba*

Conservation Status

International

IUCN Red List of Threatened Species: lower risk, conservation dependent
Convention on International Trade in Endangered Species: Appendix II
Convention on Migratory Species: Appendix II (eastern tropical Pacific population, western Mediterranean population)

Australia

Environment Protection and Biodiversity Conservation Act: not listed
Cetacean Action Plan: no category assigned because of insufficient information

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Striped Dolphin is distributed around the world in all oceans between latitudes 50^{o}N and 50^{o}S, but is most abundant in the tropical and subtropical parts of its range (Perrin *et al*. 1994, Archer and Perrin 1999). In the eastern tropical Pacific, Striped Dolphins (and Common Dolphins) tend to be more frequent in areas where the more strictly tropical Spinner Dolphin and Pantropical Spotted Dolphin are less frequent, although there is great overlap in distribution (Au and Perryman 1985). The Striped Dolphin is usually found in deep waters beyond the continental shelf. In some areas, the chief prey has been recorded as cephalopods, while in other areas it is myctophid fish (Perrin *et al.* 1994). The Striped Dolphin is present throughout the year in some regions, but in other areas it appears to be associated with the fronts of warm oceanic currents that move seasonally and produce sporadic warm-water intrusions (Perrin *et al*. 1994). In Australia, it has been recorded from Western Australia,

Queensland and NSW (Bannister *et al*. 1996).

Subspecies and Stocks

No subspecies are currently recognised. Three migratory stocks are provisionally recognised in the western North Pacific (Kishiro and Kasuya 1993), but all Striped Dolphins in the eastern Pacific are provisionally considered to belong to a single stock (Dizon *et al*. 1994).

Occurrence in NSW

Striped Dolphins have been recorded in NSW from 13 strandings between Byron Bay and Sussex Inlet, the most recent in May 2000 (Atlas of NSW Wildlife, ORRCA Newsletters). There have been records in every month except April and June.

Population Size

Wade and Gerrodette (1993) have estimated the size of the Striped Dolphin population in the eastern tropical Pacific as 1 918 000 (c.v. 0.112). Miyashita (1993) has estimated the size of the population in the waters off the Pacific coast of Japan as about 821 000. No population estimates are available for Australian waters.

Population Trends

Although Striped Dolphins remain abundant overall, some populations have been heavily exploited and show signs of serious decline. Striped Dolphins in the eastern tropical Pacific have been affected by bycatches in the tuna purse-seine fishery, but only to a minor degree, especially in comparison with the other dolphin species affected (International Whaling Commission 1992). Of greater concern are populations in the western North Pacific and the Mediterranean (Reeves and Leatherwood 1994). The Striped Dolphin has been a major target of a directed fishery for small cetaceans in Japanese waters, where catches sometimes exceeded 20 000 in earlier years (International Whaling Commission 1992). This population has declined markedly since the 1950s and was estimated to have been reduced by 50% or more by the late 1970s. In the Mediterranean, the chief threats are pollution and incidental capture in purse seines and pelagic drift gillnets (International Whaling Commission 1992). A major die-off of Striped Dolphins occurred in the western Mediterranean in 1990-92. Although the immediate cause was a disease syndrome linked to a morbillivirus infection, high body levels of organochlorines are suspected of contributing substantially to the severity of the problem through impairment of immune function (Aguilar and Borrell 1994). No major conservation problems are known at present for Striped Dolphins in Australian waters (Bannister *et al*. 1996).

2.10 Common Dolphin *Delphinus delphis*

Conservation Status

International

IUCN Red List of Threatened Species: not listed

Convention on International Trade in Endangered Species: Appendix II
Convention on Migratory Species: Appendix II (North and Baltic Sea populations, western Mediterranean population, Black Sea population, eastern tropical Pacific population)

Australia

Environment Protection and Biodiversity Conservation Act: not listed
Cetacean Action Plan: no category assigned but possibly secure

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Common Dolphin has been recorded widely in all tropical, subtropical and temperate waters of the world, both inshore and offshore (Evans 1994). In Australia, the species has been recorded in all states and the Northern Territory (Bannister *et al*. 1996). It appears to be an opportunistic feeder, its diet varying with location and season, the main dietary items being fish and cephalopods (Klinowska 1991, Evans 1994). Seasonal movements have been reported in different parts of the species' range, apparently in response to water temperature changes or prey species migrations (Klinowska 1991). Large herds, some estimated at over 10 000, have been observed at times in south-eastern Australian waters, moving purposely parallel to the coast (Warneke 1996). The nature of these movements is unknown.

Subspecies and Stocks

Two species of Common Dolphin have recently been distinguished in the eastern North Pacific, differing in colour pattern and morphometrics: the Short-beaked Common Dolphin (*D. delphis*), which is found both inshore and offshore; and the Long-beaked Common Dolphin (*D. capensis*), which is a less common species of inshore waters (Heyning and Perrin 1994). The Short-beaked Common Dolphin is known to occur in Australian waters and there is unconfirmed evidence that the Long-beaked Common Dolphin may also be present (Bannister *et al*. 1996). In the eastern tropical Pacific, four stocks of Common Dolphins have been distinguished: the Baja neritic stock (Long-beaked Common Dolphin), and three stocks of the Short-beaked Common Dolphin, the northern, central and southern stocks (Perrin *et al*. 1985, Wade and Gerrodette 1993). Similar complexity is evident elsewhere in the Common Dolphin's world range and requires further investigation. It is uncertain how many forms occur in Australian waters and what their relationships are to populations of Common Dolphins outside Australia.

Occurrence in NSW

The Common Dolphin is often observed along the NSW coast (e.g. Robinson 1984, Sapphire Coast whale watch reports), although generally not as close to shore as the Bottlenose Dolphin. It is one of the most frequent species to strand, with 48 stranding or netting records for NSW (Atlas of NSW Wildlife, Appendix 2). These include two mass strandings: 15 stranded at Seal Rocks in the early 1960s (Dawbin 1964), and about 40 stranded in Twofold Bay in January 1971 (Warneke 1996). Common Dolphins have been recorded all along the coast, from Tweed Heads to Nadgee Nature Reserve, and in every month, with no obvious seasonal changes in

frequency. Large groups (100+ animals) have been reported at times on the far south coast (Sapphire Coast whale watch reports). However, most NSW sightings records in the Atlas of NSW Wildlife and the Environment Australia cetacean sightings database are of much smaller groups.

Population Size

In the eastern tropical Pacific, Wade and Gerrodette (1993) estimated the population sizes of Common Dolphins as 2 210 900 (c.v. 0.217) for the southern stock, 406 100 (c.v. 0.383) for the central stock, and 476 300 (c.v. 0.367) for the northern and Baja neritic stocks combined. For the waters off the west coast of the United States, Barlow *et al*. (1997) estimated the size of the Short-beaked Common Dolphin population as 305 694 (c.v. 0.34), and the size of the Long-beaked Common Dolphin population as 8980 (c.v. 0.64). The Common Dolphin is abundant in Australian waters, but no population estimates are available (Bannister *et al*. 1996).

Population Trends

Common Dolphins are widely distributed and abundant worldwide, but some populations have been heavily exploited and have declined as a result. The stock in the Black Sea has been seriously depleted by overhunting (International Whaling Commission 1992). In the eastern tropical Pacific, Common Dolphins are one of the species that associate with tuna and have been subject to large bycatches in the tuna purse-seine fishery. The numbers caught have been considerably less than for Pantropical Spotted Dolphins and Spinner Dolphins, but Common Dolphin populations in the region have still declined significantly (International Whaling Commission 1992). The dolphin mortality in this fishery has now been drastically reduced to levels that are no longer considered a threat to dolphin populations (Scott 1995, Hall and Lennert 1997). Bycatch of dolphins has been much less of a problem in tuna fisheries in the western Pacific, where nets are not usually set around dolphin schools (Bailey *et al*. 1996). No major conservation problems are known at present for Common Dolphins in Australian waters (Bannister *et al*. 1996).

2.11 Fraser's Dolphin *Lagenodelphis hosei*

Conservation Status

International

IUCN Red List of Threatened Species: data deficient

Convention on International Trade in Endangered Species: Appendix II

Convention on Migratory Species: Appendix II (Southeast Asian populations)

Australia

Environment Protection and Biodiversity Conservation Act: migratory species (Southeast Asian populations)

Cetacean Action Plan: no category assigned because of insufficient information

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

Until the early 1970s, Fraser's Dolphin was known only from the type specimen collected in Sarawak, but there have now been many records from widely scattered localities. It occurs in tropical and subtropical waters of the Pacific, Indian and Atlantic Oceans (Perrin *et al*. 1994, Jefferson and Leatherwood 1994). The majority of records are from latitudes between 30^{o}N and 30^{o}S. Records outside these latitudes appear to be vagrants. Fraser's Dolphin is an oceanic species and avoids shallow inshore waters, although it may be seen close to the shores of islands surrounded by deep water. It feeds mainly on mesopelagic fish and cephalopods, but also takes crustaceans and some benthic fish (Perrin *et al*. 1994, Jefferson and Leatherwood 1994). In Australia, it has been recorded in Western Australia, Queensland, NSW and Victoria (Bannister *et al*. 1996).

Subspecies and Stocks

No subspecies or stocks have been distinguished.

Occurrence in NSW

Fraser's Dolphin has been recorded in NSW from six strandings between Byron Bay and Coffs Harbour, the most recent in June 1999 (Atlas of NSW Wildlife and Appendix 2). All the strandings occurred between March and September.

Population Size

Wade and Gerrodette (1993) estimated the size of the population in the eastern tropical Pacific as 289 300 (c.v. 0.335). There are no population estimates for Australian waters.

Population Trends

Fraser's Dolphin is exploited in various fisheries for small cetaceans, but it is not known to be taken regularly or on a large scale except in the Philippines (Dolar *et al*. 1994). The situation in the Philippines requires further investigation, but no serious conservation problems are known elsewhere (Klinowska 1991, Reeves and Leatherwood 1994, Bannister *et al*. 1996).

2.12 Southern Right Whale Dolphin *Lissodelphis peronii*

Conservation Status

International

IUCN Red List of Threatened Species: data deficient
Convention on International Trade in Endangered Species: Appendix II
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: not listed
Cetacean Action Plan: no category assigned because of insufficient information

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Southern Right Whale Dolphin is restricted to the Southern Hemisphere, where it has a circumpolar distribution, mainly in subantarctic waters between the Subtropical and Antarctic Convergences (Jefferson *et al*. 1994, Newcomer *et al*. 1996). Most records are between 35^{o}S and 62^{o}S, although it extends further north along the west coasts of South America and southern Africa in association with cold currents. It is primarily an oceanic, deep water species, but also occurs in highly productive continental shelf waters. It feeds chiefly on cephalopods and fish (Jefferson *et al*. 1994, Newcomer *et al*. 1996). No major migratory movements are known. In Australia, the Southern Right Whale Dolphin has been recorded from strandings in Tasmania and NSW, and from sightings south and south-west of Tasmania, off south-western Australia and in the Great Australian Bight (Bannister *et al*. 1996).

Subspecies and Stocks

No subspecies or stocks have been distinguished. A closely related species, the Northern Right Whale Dolphin (*Lissodelphis borealis*), occurs in the North Pacific.

Occurrence in NSW

The Southern Right Whale Dolphin has been recorded in NSW from strandings at Bendalong in September 1986, and Norah Head in July 1993 (Atlas of NSW Wildlife).

Population Size

No population estimates are available for Australian waters or elsewhere. The species appears to be reasonably common, and herds of over 1000 animals have been reported (Gaskin 1972).

Population Trends

Little is known about population trends in Australian waters or elsewhere. No major conservation problems are known at present (Klinowska 1991, Reeves and Leatherwood 1994, Bannister *et al*. 1996).

2.13 Melon-headed Whale *Peponocephala electra*

Conservation Status

International

IUCN Red List of Threatened Species: not listed

Convention on International Trade in Endangered Species: Appendix II

Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: not listed

Cetacean Action Plan: no category assigned because of insufficient information

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Melon-headed Whale is found in tropical and subtropical waters of the Pacific, Indian and Atlantic Oceans (Perryman *et al*. 1994, Jefferson and Barros 1997). Most records are between 20^{o}N and 20^{o}S, although there have also been records north to about 50^{o}N, and south to about 35^{o}S. It is a species of deep oceanic waters, seldom seen close to shore except where water depth drops off very quickly. It preys on mesopelagic fish and cephalopods, occasionally crustaceans (Perryman *et al*. 1994, Jefferson and Barros 1997). Seasonal movements have not been studied, although Melon-headed Whales appear to be present in most areas of their range throughout the year. In Australia, they have been recorded in Western Australia, Queensland and NSW (Bannister *et al*. 1996).

Subspecies and Stocks

No subspecies or stocks have been distinguished.

Occurrence in NSW

The Melon-headed Whale has been recorded in NSW from 19 strandings, the most recent in September 1998 (Atlas of NSW Wildlife and Appendix 2). Strandings have occurred from Tweed Heads south to Sydney, and in every month except March, May, June and October. There have been three mass strandings: 150-250 at Crowdy Head in August 1958 (Dawbin *et al*. 1970), three at Wooli in July 1988 (Atlas of NSW Wildlife), and about 15 at Point Plomer in January 1996 (Anon. 1996).

Population Size

Wade and Gerrodette (1993) estimated the size of the population in the eastern tropical Pacific as 45 400 (c.v. 0.467). There have been no population estimates for Australian waters.

Population Trends

Little is known about population trends in Australian waters or elsewhere. No major conservation problems are known at present (Klinowska 1991, Reeves and Leatherwood 1994, Bannister *et al*. 1996).

2.14 Pygmy Killer Whale *Feresa attenuata*

Conservation Status

International

IUCN Red List of Threatened Species: data deficient

Convention on International Trade in Endangered Species: Appendix II

Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: not listed

Cetacean Action Plan: no category assigned because of insufficient information

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Pygmy Killer Whale has a circumpolar distribution in tropical and subtropical waters between about 35^{o}N and 35^{o}S (Ross and Leatherwood 1994). In the eastern tropical Pacific, it tends to be found closer to the coast than the False Killer Whale (Wade and Gerrodette 1993). Little is known of its habits. Its diet includes cephalopods and fish, but records are scanty. Migratory movements have not been reported. In Australia, the species has been recorded from strandings in Western Australia and NSW (Bannister *et al*. 1996).

Subspecies and Stocks

No subspecies or stocks have been distinguished.

Occurrence in NSW

The Pygmy Killer Whale has been recorded in NSW from eight strandings, the most recent in November 1999, from Kingscliff south to Sydney (Bryden 1976, Atlas of NSW Wildlife, Appendix 2). Strandings have occurred in every month from December to March, and in June and August.

Population Size

Wade and Gerrodette (1993) have estimated the size of the Pygmy Killer Whale population in the eastern tropical Pacific as 38 900 (c.v. 0.305). No population estimates are available for Australian waters.

Population Trends

Little is known about population trends in Australian waters or elsewhere. No major conservation problems are known at present (Klinowska 1991, Reeves and Leatherwood 1994, Bannister *et al*. 1996).

2.15 False Killer Whale *Pseudorca crassidens*

Conservation Status

International

IUCN Red List of Threatened Species: not listed

Convention on International Trade in Endangered Species: Appendix II

Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: not listed

Cetacean Action Plan: no category assigned but possibly secure

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The False Killer Whale is found in tropical and temperate waters worldwide, between about 60^{o}N and 50^{o}S, but more commonly in warmer waters (Stacey *et al*. 1994, Odell and McClune 1999). It is found primarily in deep water and offshore areas, rarely approaching land except around oceanic islands and near coasts with deep water nearby. In Australia, it has been recorded in all states and the Northern Territory (Bannister *et al*. 1996). Mass strandings of False Killer Whales occur relatively frequently on Australian coasts, on average one per 2.5 years since 1970. Single strandings occur in all months, but the majority of mass strandings occur from May to September on the southern and south-eastern coasts, suggesting a seasonal movement inshore or along the continental shelf. False Killer Whales prey mainly on squid and large fish (Stacey *et al*. 1994, Odell and McClune 1999).

Subspecies and Stocks

No subspecies or stocks are currently recognised.

Occurrence in NSW

Fourteen strandings have been recorded in NSW, the most recent in May 1997 (Atlas of NSW Wildlife and Appendix 2). Strandings have occurred from Tweed Heads south to Jervis Bay, in every month between May and January, except September. The records include three mass strandings: 66 at Seal Rocks in July 1980; 62 at Crowdy Head in June 1985; and 50 at Seal Rocks in July 1992. In addition to the strandings, there is also a report of a pod of about 50 seen swimming close to shore off Coffs Harbour in October 1991 (Atlas of NSW Wildlife).

Population Size

Wade and Gerrodette (1993) have estimated the size of the False Killer Whale population in the eastern tropical Pacific as 39 800 (c.v. 0.636). Miyashita (1993) has estimated the population in the waters off the Pacific coast of Japan as about 16 600. No population estimates are available for Australian waters.

Population Trends

Little is known about population trends in Australian waters or elsewhere. No major conservation problems are known at present, except possibly in Japanese waters, where the species is exploited on a moderate scale and has been culled in large numbers for interfering with tuna fisheries (Klinowska 1991, Reeves and Leatherwood 1994, Bannister *et al*. 1996).

2.16 Killer Whale *Orcinus orca*

Conservation Status

International

IUCN Red List of Threatened Species: lower risk, conservation dependent
Convention on International Trade in Endangered Species: Appendix II
Convention on Migratory Species: Appendix II (eastern North Atlantic population, eastern North Pacific population)

Australia

Environment Protection and Biodiversity Conservation Act: not listed
Cetacean Action Plan: no category assigned but probably secure

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Killer Whale is a cosmopolitan species found throughout the oceans of the world, from the edge of the pack ice to the equator (Heyning and Dahlheim 1988, Dahlheim and Heyning 1999). It is most abundant in coastal habitats and high latitudes, but can be encountered anywhere at any time of year. It occurs seasonally in some areas, but is present year-round in other areas. In the Southern Hemisphere, most Killer Whales occur in relatively warm waters in winter, and then migrate into high latitudes as far as the ice edge with the approach of the Antarctic summer (Mikhalev *et al*. 1981). In Australia, Killer Whales have been recorded from all states, but not the Northern Territory (Bannister *et al*. 1996). They are typically seen in Australian waters along the continental slope and over the continental shelf, and often near seal colonies. Killer Whales are opportunistic feeders with diets that differ seasonally and regionally. They take a wide variety of prey, including fish, squid, cetaceans, seals, seabirds (particularly penguins) and marine turtles (Heyning and Dahlheim 1988, Dahlheim and Heyning 1999).

Subspecies and Stocks

Geographical variation in size and colour pattern has been noted, but no widely accepted subspecies are currently recognised. The genus *Orcinus* is considered monotypic by most authorities. Two species described in the early 1980s, *Orcinus nanus* and *O. glacialis*, both seem to refer to the same population of smaller, more yellowish individuals in the Antarctic, and have not gained general acceptance (Heyning and Dahlheim 1988, Dahlheim and Heyning 1999). More substantial data are required to support their recognition. Mikhalev *et al*. (1981), who described the 'dwarf' Killer Whale, *Orcinus nanus*, also suggested that there were six populations of 'normal' Killer Whales in the Southern Hemisphere, based on their winter distributions: one on either side of South America, southern Africa and Australia.

Occurrence in NSW

Killer Whales have been recorded in NSW waters in recent years from both sightings and strandings, from Disaster Bay north to Byron Bay (a total of 24 records from 1984 to 2000 in the Atlas of NSW Wildlife, Sapphire Coast whale watch reports and

Appendix 2). There have been records for every month except February and December, but most records have been between May and November. Most records have come from southern NSW, south of Broken Bay. The species formerly occurred more regularly at Twofold Bay, where a pod of Killer Whales appeared each winter from about 1843 to about 1930 and formed an unusual partnership with the local shore whalers to hunt the Humpback Whales migrating along the coast (Mead 1985). Robinson (1984) reported that Killer Whales had been seen occasionally off the Illawarra coast until about 1958, but had not been recorded since. However, the number of Killer Whales visiting NSW now appears to be increasing again, possibly as a result of the partial recovery of the Humpback Whale population following its decimation by whaling in the 1950s and 1960s.

Population Size

Butterworth *et al*. (1995) have provided the following estimates of the summer Killer Whale population in Antarctic waters south of 60^{o}S: 64 000 (c.v. 0.30) based on 1978-84 survey data, and 53 000 (c.v. 0.30) based on 1985-91 survey data. Wade and Gerrodette (1993) have estimated the size of the Killer Whale population in the eastern tropical Pacific as 8500 (c.v. 0.368). No population estimates are available for Australian waters.

Population Trends

Little information is available on population trends in the Killer Whale. In the Southern Hemisphere, they were subject to commercial catches by Soviet pelagic whalers until the early 1980s. The Soviets, whaling primarily in the Antarctic, took an average of 26 animals annually from 1935 to 1979, but took 916 animals in the 1979/80 Antarctic season (Dahlheim 1981). No major conservation problems are known at present (Klinowska 1991, Reeves and Leatherwood 1994, Bannister *et al*. 1996).

2.17 Long-finned Pilot Whale *Globicephala melas*

Conservation Status

International

IUCN Red List of Threatened Species: not listed
Convention on International Trade in Endangered Species: Appendix II
Convention on Migratory Species: Appendix II (North and Baltic Sea populations)

Australia

Environment Protection and Biodiversity Conservation Act: not listed
Cetacean Action Plan: no category assigned but possibly secure

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Long-finned Pilot Whale is found in temperate and subpolar waters of the North Atlantic Ocean and all Southern Hemisphere oceans (Bernard and Reilly 1999). The

two populations are widely separated and there appears to be no contact between them. Sub-fossil remains have shown that the species also once occurred in the North Pacific, at least until the 10th century (Klinowska 1991). The Long-finned Pilot Whale occurs in deep oceanic waters and in zones of higher productivity along continental slopes, sometimes venturing into the shallower waters of the continental shelf. It has been widely recorded in southern Australian waters, with records from every state, but not the Northern Territory (Bannister *et al*. 1996). Mass strandings have occurred on Australian coasts on average once per year since 1970, mainly in September to March. This suggests a seasonal influx of the species to coastal waters, possibly in pursuit of seasonally abundant prey (Warneke 1995b). Long-finned Pilot Whales prey mainly on squid, taking a variety of species, but apparently preferring larger species and larger individuals (Klinowska 1991, Gales *et al*. 1992c).

Subspecies and Stocks

The Southern Hemisphere population has been distinguished as subspecies *edwardi*, and the North Atlantic population as subspecies *melas*. The two have sometimes been classified as separate species. However, the validity of the distinction, even at subspecific level, is questionable (Bernard and Reilly 1999). It is not yet clear whether any stocks should be distinguished within the Southern Hemisphere (Klinowska 1991).

Occurrence in NSW

There have been two mass strandings of Long-finned Pilot Whales in NSW: 16 stranded at Seal Rocks in August 1962, and 32 at Wreck Bay in October 1963 (Dawbin 1964). Single strandings have been recorded at Thirroul Beach in February 1969, and Newport Beach in July 1975, and there is an undated specimen record from Lord Howe Island (Atlas of NSW Wildlife).

Population Size

Buckland *et al*. (1993) estimated that there were 778 000 (c.v. 0.295) Long-finned Pilot Whales in the north-eastern North Atlantic in 1987-89. Butterworth *et al*. (1995) have provided the following estimates of the summer Long-finned Pilot Whale population in Antarctic waters south of 60^{o}S: 130 000 (c.v. 0.80) based on 1978-84 survey data, and 43 000 (c.v. 1.04) based on 1985-91 survey data. No population estimates are available for Australian waters.

Population Trends

Long-finned Pilot Whales in the North Atlantic have long been exploited in drive fisheries as well as in shore-based and pelagic hunts (Klinowska 1991, Reeves and Leatherwood 1994). There has also been a substantial bycatch in the mackerel fishery off the north-eastern United States (International Whaling Commission 1992). However, Long-finned Pilot Whales in the Southern Hemisphere are not known to have been exploited on a significant scale (Bernard and Reilly 1999), although some large catches may have occurred in Tasmanian waters last century (Bannister *et al*. 1996). No major conservation problems are known at present (Klinowska 1991, Reeves and Leatherwood 1994, Bannister *et al*. 1996).

2.18 Short-finned Pilot Whale *Globicephala macrorhynchus*

Conservation Status

International

IUCN Red List of Threatened Species: lower risk, conservation dependent
Convention on International Trade in Endangered Species: Appendix II
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: not listed
Cetacean Action Plan: no category assigned but possibly secure

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

Short-finned Pilot Whales are found in tropical, subtropical and warm temperate waters around the world, chiefly between 50^{o}N and 40^{o}S (Bernard and Reilly 1999). They are usually found in deep oceanic waters, but seasonal movements inshore have been reported in the North Pacific, coinciding with the appearance of spawning squid (Leatherwood and Reeves 1983). Squid are their main prey (Klinowska 1991). In Australia, the Short-finned Pilot Whale has been recorded from the Northern Territory and all states except Victoria (Bannister *et al*. 1996).

Subspecies and Stocks

No subspecies are currently recognised. Two morphologically distinct populations, northern and southern, have been distinguished off Japan (Kasayu *et al*. 1988). Morphologically distinct northern and southern forms of the species have also been identified in the eastern Pacific Ocean (Barlow *et al*. 1997). Morphological variation has not been investigated in the Australian region.

Occurrence in NSW

The Short-finned Pilot Whale has been recorded in NSW from 11 strandings from Brunswick Heads south to Culburra, the most recent in April 2000 (Atlas of NSW Wildlife and Appendix 2). The records are for the months of January, February, April, June, July and October. They include two mass strandings: about 100 stranded in the Taree area in 1923, and a group of three stranded at Seal Rocks in January 1998. There has also been an unconfirmed sighting of about 200 animals off Port Hacking in October 1993 (Atlas of NSW Wildlife).

Population Size

Wade and Gerrodette (1993) have estimated the size of the pilot whale population in the eastern tropical Pacific as 160 200 (c.v. 0.138). It is likely that these are predominantly Short-finned Pilot Whales. For the waters off the Pacific coast of Japan, Miyashita (1986) has estimated the population size of the northern form of the Short-finned Pilot Whale as 5300 (c.v. 0.43), and the population size of the southern form as 53 000 (c.v. 0.33). No population estimates are available for Australian

waters.

Population Trends

Little information is available on population trends. There are active fisheries for Short-finned Pilot Whales in Japanese waters and in the Carribean which have caused some concern, but no major conservation problems are evident elsewhere in the species' range (Klinowska 1991, Reeves and Leatherwood 1994, Bannister *et al*. 1996).

2.19 Arnoux's Beaked Whale *Berardius arnuxii*

Conservation Status

International

IUCN Red List of Threatened Species: lower risk, conservation dependent
Convention on International Trade in Endangered Species: Appendix I
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: not listed
Cetacean Action Plan: no category assigned but possibly secure

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

Arnoux's Beaked Whale is restricted to the Southern Hemisphere, where it has a circumpolar distribution, occurring from the edge of the Antarctic ice north to 34^{o}S (Balcomb 1989). The majority of strandings and sightings have come from New Zealand and elsewhere in the western South Pacific. Almost nothing is known about the species' life history and ecological requirements (Balcomb 1989). The diet is likely to be similar to that of Baird's Beaked Whale (*Berardius bairdii*), which feeds mainly on fish and cephalopods, but also takes crustaceans and sea cucumbers (Leatherwood and Reeves 1983). The majority of strandings in New Zealand have been in summer, but seasonal shifts in distribution have not been confirmed (International Whaling Commission 1989). In Australia, the species has been recorded from Western Australia, South Australia, Tasmania and NSW, but the total number of records is very small (Bannister *et al*. 1996).

Subspecies and Stocks

No subspecies or stocks have been distinguished.

Occurrence in NSW

There have been no records of Arnoux's Beaked Whale in NSW waters. However, there is a specimen at the Australian Museum (skull and rib) dragged up in a trawl net in May 1997 from just outside NSW waters about 13 km east of Brush Island (S. Ingleby, pers. comm.). Paterson and Parker (1994) have also reported 28 sightings

of large beaked whales, tentatively identified as this species, in Australian waters off southern NSW between 1962 and 1984. The sightings were made between November and February during tuna-spotting flights. With few exceptions, they were made in the relatively narrow area of the continental slope between Eden and Wollongong. Occasional sightings were made in deeper water further out in the Tasman Sea. Groups of up to 16 animals were seen.

Population Size

No population estimates are available for Arnoux's Beaked Whale in Australian waters or elsewhere. Kasamatsu *et al.* (1988) noted that they are much less common than Southern Bottlenose Whales, which have a similar distribution.

Population Trends

Little is known about population trends in Australian waters or elsewhere. The species has never been hunted on a significant scale and no major conservation problems are known at present (International Whaling Commission 1989, Klinowska 1991, Reeves and Leatherwood 1994, Bannister *et al*. 1996).

2.20 Blainville's Beaked Whale *Mesoplodon densirostris*

Conservation Status

International

IUCN Red List of Threatened Species: data deficient
Convention on International Trade in Endangered Species: Appendix II
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: not listed
Cetacean Action Plan: no category assigned because of insufficient information

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

Blainville's Beaked Whale has the widest distribution of all *Mesoplodon* species, occurring in both hemispheres in tropical and temperate waters of the Pacific, Indian and Atlantic Oceans (Mead 1989b). Like other members of the genus, it is an inhabitant of deep oceanic waters. There have been strandings in all Australian states except South Australia and the Northern Territory (Bannister *et al*. 1996). Whales of the genus *Mesoplodon* are believed to feed primarily on pelagic cephalopods, but the limited data available for Blainville's Beaked Whale suggest that its diet may be more varied, including fish as well as cephalopods (Klinowska 1991).

Subspecies and Stocks

No subspecies or stocks have been distinguished.

Occurrence in NSW

Blainville's Beaked Whale has been recorded in NSW from a stranding at Stanwell Park in May 1980 (Robinson 1984). There is also a record of a specimen obtained at sea off Lord Howe Island in January 1869 (Krefft 1870), possibly not in NSW waters.

Population Size

There have been no specific population estimates for this species in Australian waters or elsewhere. However, Wade and Gerrodette (1993) estimated the total *Mesoplodon* population in the eastern tropical Pacific as 25 300 animals (c.v. 0.195). Blainville's Beaked Whale was believed to be the most common species in this count. For the waters off the west coast of the United States, Barlow *et al*. (1997) estimated the *Mesoplodon* population as 1378 (c.v. 0.58) unidentified animals, plus 728 (c.v. 2.03) identified as Blainville's Beaked Whales.

Population Trends

Little is known about population trends in Australian waters or elsewhere. The species has never been hunted on a significant scale and no major conservation problems are known at present (International Whaling Commission 1989, Klinowska 1991, Reeves and Leatherwood 1994, Bannister *et al*. 1996). However, bycatches of *Mesoplodon* in gillnet fisheries off the west coast of the United States have been high enough in recent years to cause some concern (Barlow *et al*. 1997). The identified species of *Mesoplodon* in this bycatch have not included Blainville's Beaked Whale, but many of the animals caught have not been identified to species.

2.21 Strap-toothed Beaked Whale *Mesoplodon layardii*

Conservation Status

International

IUCN Red List of Threatened Species: data deficient
Convention on International Trade in Endangered Species: Appendix II
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: not listed
Cetacean Action Plan: no category assigned but possibly secure

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Strap-toothed Beaked Whale is restricted to the Southern Hemisphere, where it has a circumpolar distribution at latitudes between about 25^{o}S and 60^{o}S (Mead 1989b, Bannister *et al*. 1996). In Australia, there have been strandings in every state, but not in the Northern Territory (Bannister *et al.* 1996). Most of the strandings have been on the southern and eastern coasts. The species has been recorded throughout the year south of 38^{o}S, but occurrences north of 38^{o}S appear to be

seasonal. The majority of strandings in Australia occur between January and April. Like other members of the genus, it apparently prefers deep oceanic waters, although it may feed seasonally in zones of higher productivity adjacent to the continental slope. Whales of the genus *Mesoplodon* are believed to feed primarily on pelagic cephalopods, but the data are meagre (Clarke 1986, Mead 1989b).

Subspecies and Stocks

No subspecies or stocks have been distinguished.

Occurrence in NSW

The Strap-toothed Beaked Whale is the most frequent *Mesoplodon* species to strand in NSW, with 14 records from Byron Bay south to Kioloa, the most recent in December 1992 (Atlas of NSW Wildlife, Dixon 1980). Strandings have occurred in every month from December to July, except January and June.

Population Size

No population estimates are available for the Strap-toothed Beaked Whale in Australian waters or elsewhere. It is the most commonly stranded species of *Mesoplodon* in the Southern Hemisphere (International Whaling Commission 1989).

Population Trends

Little is known about population trends in Australian waters or elsewhere. No major conservation problems are known at present (International Whaling Commission 1989, Klinowska 1991, Reeves and Leatherwood 1994, Bannister *et al*. 1996).

2.22 Gray's Beaked Whale *Mesoplodon grayi*

Conservation Status

International

IUCN Red List of Threatened Species: data deficient
Convention on International Trade in Endangered Species: Appendix II
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: not listed
Cetacean Action Plan: no category assigned but possibly secure

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

Gray's Beaked Whale has a circumpolar distribution in the Southern Hemisphere at latitudes from 25^{o}S to at least 53^{o}S (International Whaling Commission 1989, Mead 1989b, Bannister *et al*. 1996). There is one anomalous record from the Northern Hemisphere, an animal that stranded in the Netherlands, presumably a vagrant as

there has been no other indication of a North Atlantic population. In Australia, there have been strandings from southern Western Australia across to southern NSW, including Tasmania (Bannister *et al*. 1996). Like other members of the genus, Gray's Beaked Whale apparently prefers deep oceanic waters. *Mesoplodon* species are believed to feed primarily on pelagic cephalopods, but the data are meagre (Clarke 1986, Mead 1989b). The majority of strandings occur between December and April, suggesting that there may be a seasonal movement into inshore waters, possibly for calving and mating (Bannister *et al*. 1996).

Subspecies and Stocks

No subspecies or stocks have been distinguished.

Occurrence in NSW

There have been eight strandings of Gray's Beaked Whales recorded in NSW, from Coffs Harbour south to Tura Beach, the most recent in April 1999 (Atlas of NSW Wildlife and Appendix 2). Strandings have occurred in every month from January to July, except May and June.

Population Size

No population estimates are available for Gray's Beaked Whale in Australian waters or elsewhere. It is one of the more frequently stranded species of *Mesoplodon* in the Southern Hemisphere.

Population Trends

Little is known about population trends in Australian waters or elsewhere. No major conservation problems are known at present (International Whaling Commission 1989, Klinowska 1991, Reeves and Leatherwood 1994, Bannister *et al*. 1996).

2.23 Andrew's Beaked Whale *Mesoplodon bowdoini*

Conservation Status

International

IUCN Red List of Threatened Species: data deficient
Convention on International Trade in Endangered Species: Appendix II
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: not listed
Cetacean Action Plan: no category assigned because of insufficient information

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

Andrew's Beaked Whale is a Southern Hemisphere species known only from a small

number of specimens, primarily from strandings in New Zealand and Australia (Mead 1989b, Klinowska 1991). In Australia, strandings have been reported in Western Australia, South Australia, Victoria and NSW (Bannister *et al*. 1996). Like other members of the genus, Andrew's Beaked Whale apparently prefers deep oceanic waters. *Mesoplodon* species are believed to feed primarily on pelagic cephalopods, but the data are meagre (Clarke 1986, Mead 1989b). Most of the stranding records of Andrew's Beaked Whale have been in spring and summer, suggesting that there may be a seasonal movement into inshore waters, possibly for calving and mating (Bannister *et al*. 1996).

Subspecies and Stocks

No subspecies or stocks have been distinguished. Andrew's Beaked Whale is very closely related to Hubbs' Beaked Whale (*Mesoplodon carlhubbsi*), a species that is endemic to the North Pacific. Mead (1989b) has suggested that a good argument can be made, based on cranial and pigmentation similarities, for considering Hubbs' Beaked Whale as a subspecies of Andrew's Beaked Whale.

Occurrence in NSW

Andrew's Beaked Whale is known in NSW only from two strandings in the Illawarra region: single strandings at Windang Beach in December 1977 and Corrimal Beach in April 1978 (Robinson 1984). Two animals that stranded near Bermagui in 1974 were originally identified as this species (Tidemann 1980), but have since been reidentified as Ginkgo-toothed Beaked Whales (Mead 1989b).

Population Size

No population estimates are available for Andrew's Beaked Whale. The scarcity of strandings suggests that it is rare, but this apparent rarity may be due in large part to the species' offshore and inconspicuous mode of life, and the difficulty of identifying it at sea.

Population Trends

Little is known about population trends in Australian waters or elsewhere. No major conservation problems are known at present (International Whaling Commission 1989, Klinowska 1991, Reeves and Leatherwood 1994, Bannister *et al*. 1996).

2.24 Ginkgo-toothed Beaked Whale *Mesoplodon ginkgodens*

Conservation Status

International

IUCN Red List of Threatened Species: data deficient
Convention on International Trade in Endangered Species: Appendix II
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: not listed

Cetacean Action Plan: no category assigned because of insufficient information

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Ginkgo-toothed Beaked Whale is known only from the Pacific and Indian Oceans, where it inhabits tropical and temperate waters on both sides of the equator (Mead 1989b, Klinowska 1991). The southernmost record is from Chatham Island. The species is believed to be more common in the western North Pacific than elsewhere. In Australia, it is only known from three strandings in NSW and one stranding in Victoria (Bannister *et al*. 1996). Like other members of the genus, the Ginkgo-toothed Beaked Whale apparently prefers deep oceanic waters. *Mesoplodon* species are believed to feed primarily on pelagic cephalopods, but the supporting data are meagre (Clarke 1986, Mead 1989b). It is not known whether the species undertakes any seasonal movements.

Subspecies and Stocks

No subspecies or stocks have been distinguished.

Occurrence in NSW

Two animals that stranded at separate locations south of Bermagui in August 1974, originally identified as Andrew's Beaked Whales (Tidemann 1980), have since been reidentified as this species (Mead 1989b). The only other record for NSW is an animal that stranded at Bawley Point in July 1993 (Atlas of NSW Wildlife).

Population Size

No population estimates are available for the Ginkgo-toothed Beaked Whale. The scarcity of strandings throughout the world suggests that the species is rare. However, its apparent rarity may be due in large part to its offshore and inconspicuous mode of life, and the difficulty of identifying it at sea.

Population Trends

Little is known about population trends in Australian waters or elsewhere. No major conservation problems are known at present (International Whaling Commission 1989, Klinowska 1991, Reeves and Leatherwood 1994, Bannister *et al*. 1996).

2.25 Cuvier's Beaked Whale *Ziphius cavirostris*

Conservation Status

International

IUCN Red List of Threatened Species: data deficient

Convention on International Trade in Endangered Species: Appendix II

Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: not listed

Cetacean Action Plan: no category assigned but possibly secure

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

Cuvier's Beaked Whale is a cosmopolitan species, known from strandings along most coasts and many oceanic islands in tropical to subpolar waters in all ocean basins (Heyning 1989). Whaling records off Japan indicate that it is most commonly found in waters deeper than 1000 m (Nishiwaki and Oguro 1972). The diet includes cephalopods, fish and crustaceans. Most of the prey items recorded are either open ocean, mesopelagic or deep-water benthic species, which is consistent with the idea that Cuvier's Beaked Whale is an offshore, deep-diving species (Heyning 1989). Stomach contents from animals caught off Japan varied consistently, with a predominance of cephalopods in animals taken in waters slightly less than 1000 m in depth, while fish were the most common prey item in animals taken in deeper water, suggesting that the species is somewhat opportunistic in its feeding habits (Nishiwaki and Oguro 1972). In Australia, Cuvier's Beaked Whale has been recorded from strandings in every state and the Northern Territory (Bannister *et al*. 1996). Most of the strandings have occurred between January and July.

Subspecies and Stocks

No subspecies or stocks have been distinguished. There is a great deal of morphological variation between specimens from different areas, but no comprehensive study has been undertaken to determine whether any separate stocks exist (International Whaling Commission 1989).

Occurrence in NSW

Cuvier's Beaked Whale has been recorded in NSW from a specimen collected at Sydney before 1885 (Beneden 1885). This record is listed in the cetacean strandings databases of the Smithsonian Institution and Environment Australia. A second NSW record in the latter database, a specimen at the Australian Museum (S935), is an error - the specimen came from Suwarrow Island, not from NSW (S. Ingleby, pers. comm.).

Population Size

The size of the population in the eastern tropical Pacific has been conservatively estimated at 20 000 (c.v. 0.265) by Wade and Gerrodette (1993). For the waters off the west coast of the United States, Barlow *et al*. (1997) conservatively estimated the population at 9163 animals (c.v. 0.52). No population estimates are available for Australian waters.

Population Trends

Little is known about population trends in Australian waters or elsewhere. There has

been some exploitation in the past, mainly off Japan, but there are no systematic direct takes at present and no major conservation problems were identified by the International Whaling Commission (1989), Klinowska (1991), Reeves and Leatherwood (1994) and Bannister *et al*. (1996). However, bycatches of Cuvier's Beaked Whale in gillnet fisheries off the west coast of the United States have been high enough in recent years to cause some concern (Barlow *et al*. 1997).

2.26 Southern Bottlenose Whale *Hyperoodon planifrons*

Conservation Status

International

IUCN Red List of Threatened Species: lower risk, conservation dependent
Convention on International Trade in Endangered Species: Appendix I
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: not listed
Cetacean Action Plan: no category assigned but possibly secure

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Southern Bottlenose Whale is restricted to the Southern Hemisphere, where it occurs throughout the Southern Ocean and north to about 30^{o}S, although the type specimen came from the Dampier Archipelago, Western Australia, at about 20^{o}S (Mead 1989a). There is also a population of unidentified whales in tropical waters of the Pacific, which may be either the Southern Bottlenose Whale or an undescribed species of *Hyperoodon* (International Whaling Commission 1989). South of 60^{o}S, the Southern Bottlenose Whale (and ziphiids in general) is most frequently encountered within 100 km of the ice edge (Kasamatsu *et al*. 1988). The feeding habits of the species are poorly known, but oceanic cephalopods appear to be their main prey (Sekiguchi *et al*. 1993, Slip *et al*. 1995). Although commonly seen at sea in the Southern Ocean, the Southern Bottlenose Whale apparently rarely ventures near land, and strandings are infrequent. In Australia, strandings have been reported from Western Australia, South Australia, Victoria, Tasmania and NSW (Bannister *et al*. 1996). Sightings off South Africa show strong seasonality, with peaks in February and October, suggesting a northward migration out of the Antarctic in late summer, followed by a return there in spring (Sekiguchi *et al*. 1993). However, data on seasonal occurrence in Australian waters are inconclusive (Bannister *et al.* 1996).

Subspecies and Stocks

No subspecies or stocks have been distinguished.

Occurrence in NSW

Recorded in NSW from two animals that stranded at Ulladulla and Bawley Point in November 1988 (Dixon *et al*. 1994). Two groups of Southern Bottlenose Whales had

been sighted at sea earlier that year, in February 1988, about 29 km ENE of Wollongong, outside NSW waters (Lewis 1988). The two groups were in close proximity to each other, one group consisting of two adults and a calf, the other group containing eight animals.

Population Size

No population estimates are available for the Southern Bottlenose Whale. However, they are known to be abundant and widely distributed in Antarctic waters in summer (International Whaling Commission 1995a).

Population Trends

Little is known about population trends in Australian waters or elsewhere. No major conservation problems are known at present (International Whaling Commission 1989, Klinowska 1991, Reeves and Leatherwood 1994, Bannister *et al*. 1996). The species has been recorded as a bycatch in pelagic driftnet fishing operations in the Tasman Sea, but no estimates of the annual take are available (Klinowska 1991).

2.27 Sperm Whale *Physeter macrocephalus*

Conservation Status

International

IUCN Red List of Threatened Species: vulnerable
Convention on International Trade in Endangered Species: Appendix I
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: not listed
Cetacean Action Plan: insufficiently known

NSW

Threatened Species Conservation Act: vulnerable

Distribution, Habitat and Movements

Sperm Whales are found throughout all oceans of the world from the equator to the edge of the Antarctic and Arctic pack ice, although it is only the larger, older males that range into higher latitudes (Rice 1989). In the Southern Hemisphere, females and younger, smaller males seldom venture south of the Subtropical Convergence (about 45^{o}S). There is a general movement of the population southward in summer and northward in winter. In mid-winter they are rarely seen south of 30^{o}S. They prefer deep water beyond the continental shelf (i.e. over 200 m deep), but tend to concentrate near steep continental slopes, sea mounts and oceanic islands, where upwellings occur and prey may be more abundant (Bannister *et al*. 1996). They are specialist feeders, preying chiefly on deep-sea cephalopods, and are capable of long, deep dives, which may last over two hours and reach depths of over 3000 m (Rice 1989). Within each major ocean basin, concentrations of Sperm Whales occur in particular areas, corresponding to the whaling grounds identified by the 19th century American pelagic whalers. There were two major whaling grounds near Australia: the

'Middle Ground' between south-eastern Australia and New Zealand, and the 'Coast of New Holland Ground' off western and south-western Australia (Townsend 1935). The species has been recorded from every Australian state and the Northern Territory (Bannister *et al*. 1996).

Subspecies and Stocks

Some authors have divided the species into Northern and Southern Hemisphere subspecies, but the morphological differences are minor and are not generally considered sufficient to warrant taxonomic recognition (Rice 1989). The Northern and Southern Hemisphere populations are effectively isolated from each other by the six-month difference in their reproductive cycles, which would seem to offer little opportunity for gene exchange. In the Southern Hemisphere, nine stocks of Sperm Whales have been distinguished by the International Whaling Commission and are defined by longitudinal boundaries. Sperm Whales off eastern Australia belong to the Division 6 stock (130^{o}E to 160^{o}E), while those off Western Australia belong to the Division 5 stock (90^{o}E to 130^{o}E). However, the stock structure of Sperm Whales in the Southern Hemisphere is not well understood (Donovan 1991, Dufault and Whitehead 1995).

Occurrence in NSW

Historically, concentrations of Sperm Whales occurred in the waters between NSW and New Zealand, which was an important whaling ground for pelagic whalers last century. Whaling on this ground took place chiefly from December to March (Townsend 1935). Sperm Whales are still frequently observed here and Bannister *et al*. (1996) list these waters as one of the key localities for Sperm Whales in Australia. The Environment Australia cetacean sightings database lists 169 sightings off NSW out to the edge of the Australian Exclusive Economic Zone, including a sighting near Lord Howe Island. The sightings were of single animals (27%), pairs (19%) and groups of 3-15 (54%). The majority (94%) were at latitudes south of Sydney. Sightings have been reported from August to April, with peaks in October to December and, to a lesser extent, in March. It should be noted, however, that many of the sightings were made by tuna spotters (Paterson 1982b) and hence there is a bias in the data for records off southern NSW during the tuna season (October to April).

Although frequent in Australian waters off NSW, Sperm Whales are rarely observed close to shore within the 5 km limit of NSW waters. There are two such records in the Atlas of NSW Wildlife: a group of four seen off Twofold Bay in November 1989, and a group of three seen off Broken Bay in November 1998. However, most of the records for NSW are strandings, of which there have been 22 reports, the most recent in March 2000 (Atlas of NSW Wildlife and Appendix 2). Sperm Whales are well known for their mass strandings, but all the NSW records have been single strandings. A high proportion were calves (at least 10 of the 22 records). Strandings have been reported from Merimbula north to Ballina. Most records (84%) have been for the period from January to June, although strandings have also occurred in August, October and November.

Population Size

Butterworth *et al*. (1995) estimated the size of the Sperm Whale population in the Southern Hemisphere south of 30^{o}S in summer as 290 000 (c.v. 0.46), based on sightings data from 1965-91. There are no reliable estimates for the 'Australian' population, but it is likely to number in the tens of thousands (Bannister *et al*. 1996).

Population Trends

Sperm Whales were hunted extensively throughout the 19th century by American pelagic whalers, and to a lesser extent by whalers from other nations. Between 1804 and 1876, American whalers killed an estimated 225 521 Sperm Whales worldwide (Rice 1989). The industry declined at the end of the century for economic reasons. Modern whaling during the present century was based initially on rorquals, although some Sperm Whales were taken. Before 1939 the annual world catch of Sperm Whales was of the order of 2-3000 animals. After the war, however, new uses for sperm oil increased demand and catches increased to a world peak of 29 255 in 1964. From 1971, increasingly restrictive catch limits were set by the International Whaling Commission, and in 1979 pelagic catches of Sperm Whales were banned. Commercial whaling of Sperm Whales was banned everywhere in 1982 except in the western North Pacific, where catches from Japanese land stations continued until 1988. Rice (1989) estimated that the world population of Sperm Whales had been reduced by about 31% by modern-style whaling, with males reduced by about 45% and females by about 17%. Sperm Whales were the target of an Australian whaling industry operating from a land station at Albany, Western Australia, mainly from 1955 until 1978, when it was finally closed down. Kirkwood *et al*. (1980) estimated that by 1979 the exploitable population of Sperm Whales in this region (which was also subject to pelagic whaling) had been reduced by 35% compared to its size in 1947, with males reduced by 91% and females by 26%. There had also been a significant decline in the pregnancy rate among mature females, which is likely to be a result of the disproportionately low numbers of males in the population.

2.28 Pygmy Sperm Whale *Kogia breviceps*

Conservation Status

International

IUCN Red List of Threatened Species: not listed
Convention on International Trade in Endangered Species: Appendix II
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: not listed
Cetacean Action Plan: no category assigned because of insufficient information

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The genus *Kogia* has been separated into two species comparatively recently

(Handley 1966). They are rarely identified at sea (and then usually not to species), and the distribution of the Pygmy Sperm Whale remains poorly known. Most of the information on the species has come from strandings, which are surprisingly frequent, particularly in some regions. It appears to be a cosmopolitan species of tropical, subtropical and temperate waters, avoiding polar and subpolar waters (Caldwell and Caldwell 1989). Strandings have been reported most frequently from south-eastern Australia, New Zealand, South Africa and the south-eastern United States (Handley 1966). In Australia, there have been strandings in every state, but not the Northern Territory (Bannister *et al*. 1996). Ross (1979) concluded from an analysis of stomach contents that the Pygmy Sperm Whale lives in oceanic waters beyond the edge of the continental shelf. Madsen and Herman (1980) have compiled data that suggest that it feeds chiefly on cephalopods from the disphotic zone (below about 100 m). Analyses of stranding dates do not indicate any major migratory movements or seasonal changes in distribution (Caldwell and Caldwell 1989).

Subspecies and Stocks

No subspecies or stocks have been distinguished.

Occurrence in NSW

The Pygmy Sperm Whale is one of the most frequent species to strand in NSW, with 48 strandings reported, the most recent in July 1999 (Atlas of NSW Wildlife and Appendix 2). Strandings have occurred from Byron Bay south to Twofold Bay, with similar numbers in northern and southern NSW. There have been strandings in every month, although more frequently in October to March (72% of records).

Population Size

No population estimates are available for the Pygmy Sperm Whale in Australian waters or elsewhere, largely because of the infrequency of sightings at sea. This lack of sightings appears to be due to the species' unobtrusive behaviour rather than actual rarity. The animals spend a large proportion of their time submerged and are very difficult to detect at the surface unless seas are calm (Barlow *et al*. 1997). The frequency of strandings indicates that the species is much more common than the scarcity of sightings would indicate (Caldwell and Caldwell 1989).

Population Trends

Little is known about population trends in Australian waters or elsewhere. No major conservation problems are known at present (Klinowska 1991, Reeves and Leatherwood 1994, Bannister *et al*. 1996).

2.29 Dwarf Sperm Whale *Kogia simus*

Conservation Status

International

IUCN Red List of Threatened Species: not listed

Convention on International Trade in Endangered Species: Appendix II
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: not listed
Cetacean Action Plan: no category assigned because of insufficient information

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The genus *Kogia* has been separated into two species comparatively recently (Handley 1966). They are rarely identified at sea (and then usually not to species), and the distribution of the Dwarf Sperm Whale remains poorly known. Most of the information on the species has come from strandings, which are surprisingly frequent. It appears to be a cosmopolitan species of tropical, subtropical and temperate waters, avoiding polar and subpolar waters. It apparently occurs more often in warmer waters than the Pygmy Sperm Whale, although both species are found over a wide latitudinal range (Caldwell and Caldwell 1989). Ross (1979) concluded from an analysis of stomach contents that the Dwarf Sperm Whale lives over or near the edge of the continental shelf, whereas the Pygmy Sperm Whale lives in oceanic waters beyond the edge. Ross (1984) later modified this interpretation to suggest that juvenile and immature Dwarf Sperm Whales live over the outer part of the continental shelf and upper part of the slope, while the adults live further out in deeper water. The diet consists primarily of cephalopods, although fish and crustaceans are also eaten (Nagorsen 1985). Analyses of stranding dates do not seem to indicate any major migratory movements or seasonal changes in distribution (Caldwell and Caldwell 1989).

Subspecies and Stocks

No subspecies or stocks have been distinguished.

Occurrence in NSW

The Dwarf Sperm Whale strands much less frequently in NSW than the Pygmy Sperm Whale. There have been only four records: Coffs Harbour in March 1977 and again in August 1991; Royal National Park in December 1994; and Hawks Nest in May 1996 (Atlas of NSW Wildlife and Appendix 2).

Population Size

The size of the population in the eastern tropical Pacific has been conservatively estimated at 11 200 (c.v. 0.294) by Wade and Gerrodette (1993). No population estimates are available for Australian waters.

Population Trends

Little is known about population trends in Australian waters or elsewhere. No major conservation problems are known at present (Klinowska 1991, Reeves and Leatherwood 1994, Bannister *et al*. 1996).

2.30 Southern Right Whale *Eubalaena australis*

Conservation Status

International

IUCN Red List of Threatened Species: lower risk, conservation dependent
Convention on International Trade in Endangered Species: Appendix I
Convention on Migratory Species: Appendix I

Australia

Environment Protection and Biodiversity Conservation Act: endangered, and also listed as a migratory species
Cetacean Action Plan: vulnerable

NSW

Threatened Species Conservation Act: vulnerable

Distribution, Habitat and Movements

The Southern Right Whale is restricted to the Southern Hemisphere, where it has a circumpolar distribution. It occurs mainly between 20^{o}S and 55^{o}S, although it has also been observed as far south as 63^{o}S (Jefferson *et al*. 1993). It summers mainly between the Subtropical and Antarctic Convergences (i.e. between about 45^{o}S and 55^{o}S), moving to lower latitudes with the onset of winter (Miyashita *et al*. 1995). It inhabits offshore waters during summer, when feeding, but moves into inshore waters during winter to breed. Breeding occurs on the coasts of South Africa, South America, Australia, New Zealand and certain islands (International Whaling Commission 1986). The Southern Right Whale is a winter-spring visitor to Australian waters, occurring around the southern coastline from about Perth to Sydney, including Tasmania. Its range may currently be extending in Australia, with recent sightings north of Sydney to Byron Bay, and north of Perth to Shark Bay and North West Cape (Bannister *et al*. 1996). Southern Right Whales are believed to feed mainly in waters south of about 40^{o}S, taking advantage of the pelagic crustaceans that are abundant in the surface waters of the Southern Ocean during summer. They feed on copepods, Antarctic krill (*Euphausia superba*) and the decapod *Munida gregaria* (Cummings 1985b, Kawamura 1994). They are not known to feed at all while at their breeding grounds around Australia over winter, probably because of the low densities of suitable prey (Warneke 1995d).

Subspecies and Stocks

The Southern Right Whale (*Eubalaena australis*) is closely related to the Northern Right Whale (*E. glacialis*) of the Northern Hemisphere, and the two are sometimes treated as subspecies rather than as separate species. Recent studies by Rosenbaum *et al*. (2000) have indicated that there are, in fact, three genetic lineages within *Eubalaena*, with North Pacific *E. glacialis* being more closely related to *E. australis* than to North Atlantic *E. glacialis*. No subspecies are currently recognised within *E. australis*. The whales that breed in Australian waters appear to be a separate population from those that breed around other southern continents and islands (Klinowska 1991). Within Australia, the International Whaling Commission (1986) has made an arbitrary division of the population into two stocks, the Southeast Australia Stock and the Southwest Australia Stock, with longitude 135^{o}E selected as

the boundary between them. The division is useful for analysis purposes, but it was recognised that there is no discontinuity in distribution or other evidence to suggest that they are truly separate populations. Movements between the two regions have been recorded both between years and within years (Kemper *et al*. 1997).

Occurrence in NSW

There have been only two recorded strandings of Southern Right Whales in NSW: Long Reef in August 1989 and Norah Head in July 1993 (Atlas of NSW Wildlife and Appendix 2). However, the species has been observed many times close to shore along the NSW coast, with a total of 133 sightings reported since 1970 (Atlas of NSW Wildlife, Environment Australia cetacean sightings database, Sapphire Coast whale watch reports and Appendix 2). The northernmost record was at Byron Bay, but most records (94%) are for southern and central NSW (south of Newcastle). The same distribution pattern was evident during the nineteenth century, with few records north of Sydney (Dawbin 1986). Twofold Bay and adjacent waters are one of 12 recognised aggregation areas for the Southern Right Whale in Australia (Environment Australia 2001). Southern Right Whales have been recorded in NSW waters in every month from May to November, and there are also a couple of January records, but the majority of records (84%) are for July to September. There have been many records of new-born calves in NSW waters, including a sighting of a calf as far north as Woolgoolga. Calving takes place in sheltered waters very close to shore. American pelagic whalers last century took many Southern Right Whales in the Tasman Sea between NSW and New Zealand (Townsend 1935). The whales were taken there mainly between September and November, particularly in the latter month. This suggests a movement of the population offshore after calving in NSW waters, before migrating to more southerly waters in summer.

Population Size

No reliable estimates are available of the world population of Southern Right Whales. The Australian population is thought to number about 600-800 (Bannister *et al*. 1996). Only part of this population visits the coastline each year. Several studies (Bannister 1990, Best 1990, Payne *et al*. 1990) have shown that females return to their breeding grounds to give birth once every three years, on average. Bannister (1994) estimated the number of females with calves visiting the western half of Australia over a three-year period to be at least 189, extrapolating from the results of an aerial survey in 1993. Southern Right Whales are much less numerous in eastern Australia, where aerial surveys in 1991-93 recorded only 22 individual females with calves, or 10% (22/211) of the combined total for all of southern Australia (Kemper *et al*. 1997). However, it is likely that the actual number of females with calves in eastern Australia over the three years was higher than this because of limited survey effort in NSW and Tasmania. The number of Southern Right Whales that visit NSW in any one year is probably less than ten (Warneke 1996).

Population Trends

Because they were relatively easy to kill and did not sink when dead, the Southern Right Whale was the 'right' whale for pursuit by the early coastal and pelagic whalers. It was hunted from the late 1700s. Most catches took place before about 1850, by

which time all the Southern Hemisphere stocks had been drastically reduced (Klinowska 1991). In Australia, Southern Right Whales were first hunted by shore-based whalers in the Derwent River estuary in 1805 (Dakin 1934). Other whaling stations were set up in Tasmania and on the southern coast of the mainland. The number of whaling stations peaked at about 50 in the late 1830s. The whale population dwindled rapidly and in the mid-1840s the local right whale industry collapsed, although catches continued to be made until the 1930s by whalers whose chief targets were other species. At least 26 000 Southern Right Whales were taken off south-eastern Australia and New Zealand between 1827 and 1930, of which nearly 75% were taken in the single decade from 1835 to 1844 (Dawbin 1986). The species was given full protection by the International Whaling Commission in 1937. However, it is now known that Russian pelagic whalers continued to take the species illegally until 1972, and that at least 5423 were taken during this period (Zemsky *et al*. 1995, 1996, Mikhalev 1997). It was not until the 1970s that the first signs of recovery were observed in Southern Right Whale populations (Klinowska 1991). Since then, there has been a pronounced trend of recovery of populations in southern Africa, South America and Australia (Best 1993). In Australia, there were very few records of Southern Right Whales this century before 1960. However, since 1970, and particularly since 1975, there has been a marked increase in the number of reports (Bannister 1986, Kemper *et al*. 1997). The current rate of increase of the Australian population has been estimated at about 8-10% per annum (Bannister 1994). Although steadily increasing, the size of the Australian population remains small compared with its likely size before exploitation, judging by the large numbers taken in the early 1800s.

2.31 Pygmy Right Whale *Caperea marginata*

Conservation Status

International

IUCN Red List of Threatened Species: not listed
Convention on International Trade in Endangered Species: Appendix I
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: not listed
Cetacean Action Plan: no category assigned but possibly secure

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Pygmy Right Whale is restricted to the Southern Hemisphere, where it has a circumpolar distribution mainly at latitudes between 31^{o}S and 52^{o}S, corresponding to the region between the 20^{o}C summer sea surface isotherm and the 5^{o}C winter isotherm (Baker 1985). The species is rarely reported at sea, probably because of its inconspicuous behaviour and the likelihood of confusion with Minke Whales. Little is known of its life history. Most records have come from strandings in southern Australia, New Zealand and South Africa. Strandings have occurred in all months throughout the species' range. There is some suggestion of an inshore movement in

South African waters in spring and summer, perhaps of juveniles (Ross *et al*. 1975), but the data are too limited to indicate a definite migratory pattern (Baker 1985). Sightings of the species far offshore indicate that it is certainly not confined to inshore waters. Little information is available on its diet and feeding habits, but it appears to be primarily a copepod-feeder (Sekiguchi *et al*. 1992). In Australia, it has been recorded from southern Western Australia, South Australia, Victoria, Tasmania and southern NSW, from Fremantle around to Nowra (Pavey 1992). In Tasmania, it is the most frequent species of cetacean to strand, although sightings at sea off Tasmania are very rare (Nicol and Croome 1988). Strandings occur in Tasmania throughout the year and the animals that strand are predominantly adults. By contrast, mainland strandings are more frequent between August and January, and include more juveniles than adults (Pavey 1992).

Subspecies and Stocks

No subspecies or stocks have been distinguished.

Occurrence in NSW

The Pygmy Right Whale has been recorded in NSW from an undated specimen from Twofold Bay (Pavey 1992), and from strandings at Culburra Beach in June 1986, Haycock Point in October 1989, and Batemans Bay in February 1992 (Atlas of NSW Wildlife). There has also been an unconfirmed sighting of three animals near Montagu Island in June 1992 (Environment Australia cetacean sightings database).

Population Size

There are no population estimates available for the Pygmy Right Whale. Judging by the frequency of strandings (about two or three per year), it is probably not rare in the waters around southern Australia (Bannister *et al*. 1996).

Population Trends

Little is known about population trends in Australian waters or elsewhere. No major conservation problems are known at present (Klinowska 1991, Reeves and Leatherwood 1994, Bannister *et al*. 1996).

2.32 Minke Whale *Balaenoptera acutorostrata*

Conservation Status

International

IUCN Red List of Threatened Species: lower risk, near threatened
Convention on International Trade in Endangered Species: Appendix I
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: not listed
Cetacean Action Plan: dark-shoulder form secure; diminutive form no category assigned because of insufficient information

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Minke Whale is a cosmopolitan species, widely distributed in the tropical, temperate and polar waters of both hemispheres (Stewart and Leatherwood 1985, Horwood 1990, Klinowska 1991). In general, it migrates between summer feeding grounds in polar waters and winter breeding grounds in warmer waters, although it is less predictable than most other rorquals, and appears to be widely distributed in all seasons. Some North Pacific populations appear to remain in the one area throughout the year. In the Southern Hemisphere, the Minke Whale is most common from December to March in waters south of 60^{o}S, especially near the Antarctic ice-edge (Kasamatsu *et al*. 1996). However, it is also found during summer in the 40^{o}-60^{o}S zone, and even the 20^{o}-40^{o}S zone (Kasamatsu and Miyashita 1983). In autumn there is a general movement northwards to temperate and tropical waters. Southern Hemisphere animals feed predominantly on Antarctic krill (*Euphausia superba*), but Northern Hemisphere animals have a more varied diet in which fish are a major component (Stewart and Leatherwood 1985, Kawamura 1994). Minke Whales occur both offshore and inshore. They are often sighted close to shore and sometimes enter coastal rivers and lagoons. The species has been recorded from all Australian states, but not the Northern Territory (Bannister *et al*. 1996).

Subspecies and Stocks

The taxonomy of the Minke Whale is confused, but three subspecies have been distinguished: *B. a. acutorostrata* in the North Atlantic, *B. a. davidsoni* in the North Pacific, and *B. a. bonaerensis* in the Southern Hemisphere (Stewart and Leatherwood 1985, Horwood 1990). Some authors recognise the last as a separate species, the Southern Minke Whale *B. bonaerensis*. In addition, a 'diminutive form' (also known as the 'dwarf Minke Whale') has been described from the Southern Hemisphere, which may warrant recognition as a separate subspecies when more information is available (Best 1985, Arnold *et al.* 1987). The typical form of the Southern Minke Whale is called the 'dark-shoulder form'. The diminutive form has been recorded from South Africa, Australia, New Zealand and Brazil (Arnold *et al*. 1987). In Australia, it has been recorded north to about 12^{o}S on the east coast and about 20^{o}S on the west coast. It has been recorded in Australian waters from May to December (Arnold *et al*. 1987, Arnold 1997). It has been recorded in subantarctic and Antarctic waters to 65^{o}S (Kasamatsu *et al*. 1993), but it seems generally not to migrate as far south as the dark-shoulder form, and may not be as dependent on krill (Bannister *et al*. 1996). Conversely, the dark-shoulder form may not migrate as far north as the diminutive form in Australian waters: off eastern Australia the most northerly record of the dark-shoulder form is about 21^{o}S, even though it occurs near the equator off Brazil.

Minke Whales in the Southern Hemisphere have traditionally been divided by the International Whaling Commission into six stocks defined by longitudinal boundaries. Minke Whales off eastern Australia are part of the Area V stock (130^{o}E to 170^{o}W), while those off Western Australia are part of the Area IV stock (70^{o}E to 130^{o}E). These stock divisions were developed primarily for administrative purposes and had little biological basis. However, recent genetic studies have indicated that two separate stocks of the dark-shoulder form do, in fact, occur in Antarctic waters in

Areas IV and V. A 'core' stock is present during summer in Area V, the eastern part of Area IV, and in the western part of Area IV during a late period of the feeding season, while a genetically differentiated 'western' stock is present in the western part of Area IV during the early period of the feeding season (Pastene *et al*. 1996).

Occurrence in NSW

There have been seven reported strandings of Minke Whales in NSW, the most recent in September 1989 (Atlas of NSW Wildlife). The species has also been observed close to shore along the NSW coast on a number of occasions (12 records in the Atlas of NSW Wildlife and 11 records in Sapphire Coast whale watch reports, the most recent in October 2000). The stranding and sighting records span the area from Twofold Bay north to Minnie Water, in every month from June to November, but none at other times of year. Both forms of Southern Minke Whale, the dark-shoulder form and the diminutive form, occur off NSW (Arnold *et al*. 1987).

Population Size

The size of the Minke Whale population in the Southern Hemisphere south of 60^{o}S in summer has been estimated as 500 000 to 700 000 animals (International Whaling Commission 1995b). Estimates for each area are: Area I - 52 888 (c.v. 0.17) in 1989/90; Area II - 122 156 (c.v. 0.190) in 1986/87; Area III - 88 735 (c.v. 0.273) in 1987/88; Area IV - 74 692 (c.v. 0.257) in 1988/89; Area V - 294 610 (c.v. 0.138) in 1985/86, but 92 709 (c.v. 0.202) in 1991/92; Area VI - 55 985 (c.v. 0.30) in 1990/91. It should be noted, however, that many animals occur north of 60^{o}S in summer (Kasamatsu and Miyashita 1983), probably including almost the entire population of the diminutive form. These animals are not included in the above estimates. No estimate of population size is available for the diminutive form.

Population Trends

Minke Whales did not become a major target for whalers until the 1930s in the Northern Hemisphere and the 1970s in the Southern Hemisphere, following the depletion of the larger species (Stewart and Leatherwood 1985, Horwood 1990). The larger species came under increasing protection, so that by 1980 the Minke Whale was the most important whaling species. Commercial pelagic whaling continued in the Antarctic until the 1986/87 season. Since then, the Japanese pelagic fleet has caught about 300 per year in areas IV and V under a special permit for scientific purposes. The total catch of Minke Whales in the Southern Hemisphere to 1990 was 114 138, of which 15 165 were taken in Area V and 34 586 in Area IV (International Whaling Commission 1995b). Some stocks in the Northern Hemisphere have been heavily depleted by modern whaling since the 1930s (Klinowska 1991). In the Southern Hemisphere, despite the direct impact of whaling, it has been suggested that the Minke Whale population may have actually increased since the 1950s, together with the populations of certain other krill predators, such as Crab-eater Seals and Antarctic Fur Seals, in response to the increased availability of krill following the decimation of the larger krill-eating whale species by whaling (Bryden 1993). However, important evidence for an increase in Minke Whale numbers (Masaki 1979) has been discredited (Cooke 1985), and it is now uncertain whether or not there has been an increase (Klinowska 1991).

2.33 Sei Whale *Balaenoptera borealis*

Conservation Status

International

IUCN Red List of Threatened Species: endangered
Convention on International Trade in Endangered Species: Appendix I
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: vulnerable
Cetacean Action Plan: vulnerable

NSW

Threatened Species Conservation Act: vulnerable

Distribution, Habitat and Movements

The Sei Whale is widely distributed in all oceans in both hemispheres, from the equator to near the ice-edge, although chiefly in temperate latitudes (Gambell 1985a, Horwood 1987). In the Northern Hemisphere, it is found in both the North Atlantic and North Pacific Oceans, but the few reports from the northern Indian Ocean are probably just stragglers or misidentifications of Bryde's Whales. In the Southern Hemisphere, the Sei Whale has a circumpolar distribution. It inhabits deep oceanic waters beyond the continental shelf and is seldom seen near land, except around oceanic islands. It has a more varied diet than other rorquals in the Southern Hemisphere, feeding extensively on copepods and amphipods as well as on Antarctic krill (*Euphausia superba*) (Kawamura 1994). It is infrequently recorded in Australia, with records from Western Australia, South Australia, Queensland and waters south of Tasmania (Bannister *et al*. 1996).

In each hemisphere, Sei Whales migrate from their winter breeding grounds in warmer waters at lower latitudes to spend the summer months at higher latitudes, where most feeding takes place (Gambell 1985a, Horwood 1987). These movements, at least in some parts of the range, are more irregular than the movements of Blue and Fin Whales, so that the appearance of large numbers of Sei Whales at a particular whaling ground, such as South Georgia or Iceland, was described as a 'Sei Whale year'. Sei Whales migrate into and out of Antarctic waters rather later than Blue and Fin Whales, and do not penetrate as far south. In summer the Southern Hemisphere population is essentially restricted to latitudes south of about 30^{o}S, but few occur south of 60^{o}S (Horwood 1987, Kasamatsu 1996). In winter the population moves north to temperate and tropical waters, and few are found south of about 40^{o}S.

Subspecies and Stocks

Two subspecies have been described, *schlegelii* in the Southern Hemisphere and *borealis* in the Northern Hemisphere, but although there is some support for this separation, most recent authors do not use the subspecies nomenclature (Horwood 1987). Because the seasons are opposite in the two hemispheres, the two populations do not converge towards the tropics simultaneously, and remain independent except for occasional straying whales. Sei Whales in the Southern Hemisphere have traditionally been divided by the International Whaling Commission into six stocks defined by longitudinal boundaries. Sei Whales off eastern Australia

are part of the Area V stock (130°E to 170°W), while those off Western Australia are part of the Area IV stock (70°E to 130°E). These stock divisions were developed primarily for administrative purposes and had little biological basis. Subsequent studies have provided some evidence of isolation between the stocks, and no reasons to modify the stock boundaries, but much more evidence is needed before Sei Whale stocks can be defined with any biological certainty (Horwood 1987).

Occurrence in NSW

There have been no strandings or other confirmed records of Sei Whales in NSW waters. There was an unconfirmed sighting of a Sei Whale just outside Twofold Bay in November 1991 (Environment Australia marine mammal database), and another unconfirmed record at an unspecified location on the far south coast in September 1997 (Sapphire Coast whale watch reports). Identification of Sei Whales at sea is difficult because of their similarity to other rorquals, especially Bryde's Whales. An animal that stranded at Valla Beach in October 1983 was originally identified as a Sei Whale and reported as such by Australian National Parks and Wildlife Service (1985) and Horwood (1987), but has since been reidentified as a Bryde's Whale.

Population Size

Butterworth *et al.* (1995) have estimated the size of the Sei Whale population in the Southern Hemisphere south of 30°S in summer as 17 000 (c.v. 0.70), based on sightings data from 1965-91 (Butterworth *et al*. 1995).

Population Trends

Sei Whales only became a feasible target for commercial whaling with the introduction of modern whaling methods in the late 1800s (Gambell 1985a, Horwood 1987). In the Southern Hemisphere, they were only taken in large numbers after the stocks of the larger Blue and Fin Whales had been depleted. The main period of exploitation was from 1955 to 1975. Their numbers declined rapidly and in 1977 they were given complete protection in the Southern Hemisphere. The recorded take in the Southern Hemisphere was 168 924, of which 19 690 were taken in Area V and 24 744 in Area IV (Horwood 1987). It now appears that more were taken than the records show: it has recently been revealed that the actual catch by Soviet pelagic whalers between 1946 and 1972 was 52 056, not 33 001 as officially reported (Zemsky *et al*. 1995, 1996, Mikhalev 1997). Horwood (1987) estimated that the Sei Whale population in the Southern Hemisphere declined under whaling from about 100 000 before 1930 to about 24 000 in 1979. Because these assessments were based partly on catch-per-unit-effort data, it is now considered that they understate the decline (Klinowska 1991). It is likely that the population has begun to recover since the cessation of whaling, but supporting data are lacking and the population is still very small compared with its likely pre-whaling size.

2.34 Bryde's Whale *Balaenoptera edeni*

Conservation Status

International

IUCN Red List of Threatened Species: data deficient

Convention on International Trade in Endangered Species: Appendix I
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: not listed
Cetacean Action Plan: no category assigned but possibly secure

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

Bryde's Whale is found in tropical and temperate waters around the world in both hemispheres, its distribution bounded approximately by latitudes 40^{o}N and 40^{o}S (Cummings 1985a, Klinowska 1991). In Australia, Bryde's Whale has been recorded from every state, but not from the Northern Territory (Bannister *et al*. 1996). Some populations of Bryde's Whale appear to undertake limited migratory movements, moving towards the equator in winter and towards more temperate waters in summer, but other populations appear to be more sedentary (Cummings 1985a). The species feeds extensively on pelagic fish, although pelagic crustaceans, especially euphausiids, have been reported as the main prey in some areas (Cummings 1985a, Klinowska 1991). It may be that inshore populations feed largely on shoaling fish, while offshore populations feed largely on euphausiids (Bannister *et al*. 1996).

Subspecies and Stocks

Best (1977) and Omura (1977) have described two forms of Bryde's Whale that are found off both South Africa and Japan: a migratory offshore form and a smaller, more sedentary inshore form. There is also a pygmy form found around the Solomon Islands (International Whaling Commission 1980). Recent genetic studies have shown that this pygmy form is so dissimilar from the standard form of Bryde's Whale that it warrants recognition as a separate species (Wada and Numachi 1991, Dizon *et al*. 1996). In fact, the pygmy form is more distinct from the standard form than is the Sei Whale. The type specimen of *Balaenoptera edeni*, which was collected in Burma, is actually a specimen of the pygmy form. The appropriate name available for the standard form would be *B. brydei* (Dizon *et al*. 1996).

Occurrence in NSW

One animal, subsequently identified from genetic analysis as the pygmy form of Bryde's Whale, entered the Manning River in August 1994 and remained there for 100 days, venturing upstream as far as Taree (Priddel and Wheeler 1997, 1998). It was apparently unable to negotiate its way out again through the shallow waters at the river mouth, and was eventually captured and returned to the sea. There is also a record of a Bryde's Whale that stranded in the Manning River in the 1940s (identified from a photograph; Priddel and Wheeler 1997). Other records of the species in NSW are one that stranded at Valla Beach in October 1983, one found dead at sea off Bermagui in November 1989 (Atlas of NSW Wildlife), and one that stranded alive at Toowoon Bay in September 1999 and was returned to the sea (Appendix 2). There were also unconfirmed sightings of a mother and calf in Twofold Bay in November and December 1999 (Sapphire Coast whale watch reports).

Population Size

Ohsumi (1981) estimated the numbers of Bryde's Whales in the Southern Hemisphere Pacific and Indian Oceans at 77 941 based on sightings data from 1976-80. However, this figure should be treated with caution (Klinowska 1991). A more reliable figure is Wade and Gerrodette's (1993) population estimate of 13 000 (c.v. 0.202) in the eastern tropical Pacific, based on sightings data from 1986-90. No population estimate is available for the pygmy form of Bryde's Whale.

Population Trends

Bryde's Whale has never been a major target for whalers (Gambell 1985a, Klinowska 1991). The exploitation history of Bryde's Whale is unique in that much of its distribution area was closed to pelagic baleen whaling from the 1930s (in order to protect the breeding grounds of other baleen whale species). Furthermore, when interest in exploiting Bryde's Whales increased in the 1970s because of the diminishing stocks of other species, intensive harvesting was delayed by the International Whaling Commission until reliable stock assessments could be made. It has been subject to coastal whaling on a relatively minor scale off Peru, Chile, southern Africa, Japan and other areas, and to pelagic whaling in the North Pacific. A moratorium on pelagic whaling was adopted in 1979, but coastal whaling in the western North Pacific continued until 1987. Even in the western North Pacific, where the species has been most heavily exploited, the decline in the population has not been as great as in some other species: an estimated decline in the exploitable population between 1946 and 1987 from 32 000 to 23 500 based on mark-recapture data, or from 26 000 to 17 000 based on sightings data (Klinowska 1991).

2.35 Blue Whale *Balaenoptera musculus*

Conservation Status

International

IUCN Red List of Threatened Species: endangered
Convention on International Trade in Endangered Species: Appendix I
Convention on Migratory Species: Appendix I

Australia

Environment Protection and Biodiversity Conservation Act: endangered, and also listed as a migratory species
Cetacean Action Plan: subspecies *musculus* endangered; subspecies *brevicauda* no category assigned because of insufficient information

NSW

Threatened Species Conservation Act: subspecies *musculus* endangered; subspecies *brevicauda* not listed

Distribution, Habitat and Movements

The Blue Whale is found throughout the oceans of the world, primarily along the edges of continental shelves and along ice fronts, but also venturing into deep oceanic zones and shallow inshore regions (Leatherwood and Reeves 1983). Blue Whales migrate regularly from winter breeding grounds in tropical and subtropical waters to summer feeding grounds in polar and subpolar waters, although there may

also be resident populations in tropical waters, where they have been recorded throughout the year (Yochem and Leatherwood 1985, Reilly and Thayer 1990). They feed almost exclusively on a few species of euphausiids, with *Euphausia superba* (Antarctic krill) the main food of the 'true' Blue Whale in the Southern Hemisphere, and *E. vallentini* the preferred food of the Pygmy Blue Whale (Yochem and Leatherwood 1985). Blue Whales off western Victoria, thought to be Pygmy Blue Whales, have been reported to feed on the neritic euphausiid *Nyctiphanes australis* (Rafic 1999). Blue Whales have been recorded from every Australian state and the Northern Territory (Bannister *et al*. 1996). Concentrations of Blue Whales have recently been reported off Rottnest Island, Western Australia, and south of Portland, Victoria, where feeding has been recorded along the edge of the continental shelf (Kato *et al*. 1996).

Subspecies and Stocks

Three subspecies of Blue Whale are now generally recognised: *B. m. musculus* in the Northern Hemisphere, and *B. m. intermedia* ('true' Blue Whale) and *B. m. brevicauda* (Pygmy Blue Whale) in the Southern Hemisphere (Yochem and Leatherwood 1985, Kato *et al*. 1995, Clapham *et al.* 1999). The 'true' Blue Whale occurs throughout the Southern Hemisphere, while the Pygmy Blue Whale is known mainly from the southern Indian Ocean, the eastern South Atlantic, and the western South Pacific (Kato *et al*. 1995). In Australia, recent strandings and near coast sightings have been mostly Pygmy Blue Whales, although 'true' Blue Whales have also been recorded (Bannister *et al*. 1996, Kato *et al.* 1996). The main feeding grounds of 'true' Blue Whales are south of 55^{o}S in the circumpolar belt between the Antarctic pack ice and the Antarctic Convergence. Pygmy Blue Whales, by contrast, do not move south of the Antarctic Convergence, their main summer feeding grounds being in latitudes 40^{o}S to 55^{o}S (Kato *et al.* 1995).

Blue Whales in the Southern Hemisphere have traditionally been divided by the International Whaling Commission into six stocks defined by longitudinal boundaries. Blue Whales off eastern Australia are part of the Area V stock (130^{o}E to 170^{o}W), while those off Western Australia are part of the Area IV stock (70^{o}E to 130^{o}E). These stock divisions were developed primarily for administrative purposes and had little biological basis. There is evidence for the existence of relatively discrete feeding stocks in the Southern Ocean (Mackintosh and Wheeler 1929), but the overall population structure in the region is not well understood (Clapham *et al*. 1999).

Occurrence in NSW

The only recorded stranding of Blue Whales in NSW is a 30 m female and 14 m male calf that stranded inside Twofold Bay in 1908 (Mead 1985). Their size indicates that they were 'true' Blue Whales. The jaw of the female is kept at the Eden Killer Whale Museum. Blue Whales have been sighted in or near NSW waters on a number of occasions: six records in the Atlas of NSW Wildlife; four records in the Environment Australia cetacean sightings database; 12 records in the Sapphire Coast whale watch reports; and one record listed by Paterson (1982a). These sightings were all for the area between Green Cape and Bermagui, except for a record near Wollongong in 1981 and one near Coffs Harbour in 1985. Most of the sightings (83%) have been made in October and November, but there have also been sightings in December, February, June and July. The most recent sighting was in November 2000. There have been no confirmed records of Pygmy Blue Whales in NSW, but it is

likely that many, if not all, of the NSW sightings are this subspecies, since it is the more common subspecies in Victorian waters (Warneke 1995c). The waters off the far south coast of NSW, and the adjacent waters off Victoria, are one of only three recognised aggregation areas for Blue Whales in Australia (Environment Australia 2001).

Population Size

Butterworth *et al*. (1995) have estimated the 'true' Blue Whale population in the Southern Hemisphere as only 610 (c.v. 0.63), and the Pygmy Blue Whale population as 4300 (c.v. 0.77), based on summer sightings data from 1965-91. Clapham *et al*. (1999) have noted that a reliable assessment of Southern Hemisphere Blue Whale numbers, both the 'true' and pygmy forms, is not possible from the existing data, although the data indicate that their populations remain small and should be provisionally ranked among the most endangered baleen whale stocks.

Population Trends

Whalers generally did not hunt Blue Whales until technological improvements made it more feasible in the late 1800s. In the Southern Hemisphere, hunting of Blue Whales began from land stations in the early 1900s, and expanded with the introduction of factory ships in the 1920s (Yochem and Leatherwood 1985). Some 360 000 Blue Whales were taken in the Southern Hemisphere during this century (Clapham *et al*. 1999). The species was drastically reduced by whaling and was eventually afforded complete protection by the International Whaling Commission in 1964. The pre-whaling population of Blue Whales in the Southern Hemisphere has been estimated at between 150 000 and 240 000, including about 10 000 Pygmy Blue Whales (Gambell 1976, Butterworth and De Decker 1989), although the Pygmy Blue Whale population may have been rather higher than this, since it is now known that catches were under-reported in the official records. Until recent years, it had been thought that the Pygmy Blue Whale had been less heavily exploited and less depleted than the 'true' Blue Whale. It is now known that the take of Pygmy Blue Whales was much greater than reported. Soviet pelagic whalers took at least 9351 Pygmy Blue Whales between 1946 and 1972, but only reported a catch of 10 (Zemsky *et al*. 1995, 1996, Mikhalev 1997). In view of this, there has been increasing concern over the status of the Pygmy Blue Whale in recent years (Brownell 1995, Clapham *et al*. 1999).

2.36 Fin Whale *Balaenoptera physalus*

Conservation Status

International

IUCN Red List of Threatened Species: endangered
Convention on International Trade in Endangered Species: Appendix I
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: vulnerable
Cetacean Action Plan: vulnerable

NSW

Threatened Species Conservation Act: vulnerable

Distribution, Habitat and Movements

The Fin Whale is widely distributed in all the oceans of the world, although it is less common in tropical waters than in temperate and polar waters (Leatherwood and Reeves 1983, Gambell 1985b). It is usually found in offshore waters, although some Northern Hemisphere populations move into inshore waters in winter. In Australia, there have been confirmed records from every state except NSW and the Northern Territory (Bannister *et al*. 1996). In each hemisphere, Fin Whales make regular seasonal migrations between warmer waters where they mate and calve in the winter months, to high latitude feeding grounds that are occupied in the summer months. In the Southern Hemisphere, Fin Whales are widely distributed south of 50^{o}S in summer, but are less frequent near the ice-edge than Blue and Minke Whales (Kasamatsu *et al*. 1996). Antarctic krill (*Euphausia superba*) is their chief food source in the Southern Hemisphere (Kawamura 1994).

Subspecies and Stocks

Some authors recognise two subspecies: *quoyi* in the Southern Hemisphere and *physalus* in the Northern Hemisphere (Gambell 1985b). Because the seasons are opposite in the two hemispheres, the two populations do not converge towards the tropics simultaneously. It is believed that they remain independent, except for occasional straying whales (Gambell 1985b). In the Southern Hemisphere, the International Whaling Commission has traditionally divided Fin Whales into six stocks defined by longitudinal boundaries. Fin Whales off eastern Australia are part of the Area V stock (130^{o}E to 170^{o}W), while those off Western Australia are part of the Area IV stock (70^{o}E to 130^{o}E). These stock divisions were developed primarily for administrative purposes and had little biological basis. Subsequent studies have indicated that there are, in fact, eight separate breeding stocks: one on each side of Australia, southern Africa and South America, one in the central Pacific, and one in the central Indian Ocean (Gambell 1985b). These stocks overlap and intermingle to a limited extent on the Antarctic feeding grounds.

Occurrence in NSW

There have been no strandings or other confirmed records of Fin Whales in NSW waters. There have been unconfirmed sightings of one near Tathra in November 1981 (Environment Australia cetacean sightings database) and one near Ballina in January 1985 (Atlas of NSW Wildlife).

Population Size

A widely quoted figure for the current Southern Hemisphere population is 103 000 (Allen 1980, Gambell 1985b), but this now appears to be far too large (Klinowska 1991). A better estimate is likely to be that of Butterworth *et al*. (1995), who estimated the size of the population as only 18 000 (c.v. 0.47), based on summer sightings data from 1965-91.

Population Trends

Fin Whales have been a major target of commercial whaling in the Northern Hemisphere since the late 1800s (Gambell 1985b). In the Southern Hemisphere, land-based whaling began in the early 1900s, but the main period of exploitation

followed the introduction of factory ships in the 1920s. The declining stocks were eventually protected from whaling in the Southern Hemisphere in 1975, but commercial whaling continued in the Northern Hemisphere until 1985 (Klinowska 1991). The population of Fin Whales in the Southern Hemisphere at the beginning of this century has been estimated at between 300 000 and 650 000 (Butterworth and DeDecker 1989), compared with their current estimated population of only about 18 000 (Butterworth *et al*. 1995).

2.37 Humpback Whale *Megaptera novaeangliae*

Conservation Status

International

IUCN Red List of Threatened Species: vulnerable
Convention on International Trade in Endangered Species: Appendix I
Convention on Migratory Species: Appendix I

Australia

Environment Protection and Biodiversity Conservation Act: vulnerable, and also listed as a migratory species
Cetacean Action Plan: vulnerable

NSW

Threatened Species Conservation Act: vulnerable

Distribution, Habitat and Movements

Humpback Whales occur widely in tropical, temperate and polar waters in all oceans and both hemispheres (Winn and Reichley 1985, Clapham and Mead 1999). They make regular seasonal migrations between their tropical winter breeding grounds around islands and continental coasts, and their summer feeding grounds in polar waters. The sole known exception to the typical seasonal migratory pattern is a population in the Arabian Sea, which appears to both feed and breed in tropical waters (Clapham and Mead 1999). In the Southern Hemisphere, the summer feeding grounds extend from about 50^{o}S to the edge of the pack ice (Kasamatsu *et al*. 1996). Humpback Whales are winter-spring visitors to Australian waters, and have been recorded from every state, but not the Northern Territory (Bannister *et al*. 1996). Separate populations breed on the north-eastern and north-western sides of the continent. Humpback Whales inhabit inshore waters when present around Australia each winter and spring, but feed in both offshore waters off Antarctica in summer. Euphausiids, especially *Euphausia superba* (Antarctic krill), are the chief food source in the Southern Hemisphere (Kawamura 1994). Elsewhere, the diet includes other euphausiids and schooling fish (Clapham and Mead 1999).

Subspecies and Stocks

The Northern and Southern Hemisphere populations of the Humpback Whale are regarded as distinct, but are not usually accorded separate subspecific status (Klinowska 1991). Because the seasons are opposite in the two hemispheres, the two populations do not converge towards the tropics simultaneously and remain independent except for occasional straying whales. In the Southern Hemisphere, the International Whaling Commission has traditionally divided Humpback Whales into six stocks defined by longitudinal boundaries. These stock divisions were developed

primarily for administrative purposes and had little biological basis. However, it does now appear that they correspond fairly well with the feeding and breeding grounds of six distinct populations of Humpback Whales (International Whaling Commission 1997a). The whales that winter off the east coast of Australia form part (probably the major part) of the Area V (or Group V) stock (130^{o}E to 170^{o}W), which also includes whales that migrate past New Zealand to winter around New Caledonia and Tonga. The whales that winter off the west coast of Australia are the Area IV stock (70^{o}E to 130^{o}E). Studies of marked animals, genetics and songs have confirmed that the whales wintering off the west coast represent a separate population from those wintering off the east coast (although some interchange does occur), with the latter more closely related to the whales that winter off Tonga (Chittleborough 1965, Dawbin 1966, Dawbin and Eyre 1991, Baker *et al*. 1993, 1998).

Occurrence in NSW

Humpback Whales occur in NSW waters as passage migrants, going north in winter and returning south in spring. They pass by close to the coast and are rarely found more than 10 km from shore (Bryden 1985). Many females are accompanied by calves on the southward migration. There is also evidence that some animals calve while in northern NSW waters during the northward migration (Appendix 2). Only negligible amounts of food are taken while in NSW waters (Chittleborough 1965), although there have been repeated observations in recent years of feeding behaviour off Twofold Bay during the southward migration (Warneke 1996, Sapphire Coast whale watch reports). Humpback Whales are regularly recorded each year all along the NSW coast, with 20 strandings and entanglements, and 335 sightings listed in the Atlas of NSW Wildlife, the Environment Australia cetacean sightings database, and Appendix 2. Hundreds of additional sightings are listed in the Sapphire Coast whale watch reports. There have been records in every month except February, but mainly between June and November, peaking in June-July (northward migration) and September-November (southward migration). Humpback Whales have also been recorded at Lord Howe Island, with a stranding there in November 1979 (Atlas of NSW Wildlife). Whales migrating past Lord Howe Island are likely to breed in the New Caledonia-Tonga region, whereas those migrating along the NSW coast breed in Great Barrier Reef waters.

Population Size

Butterworth *et al*. (1995) have estimated the total population of Humpback Whales in the Southern Hemisphere as 15 000 (c.v. 0.30), based on summer sightings data from 1965-91. The size of the population that migrates along the east coast of Australia has been estimated as 1896 $\pm$ 253 (95% confidence interval) in 1992 (Paterson *et al*. 1994), and 3185 (c.v. 0.07) in 1996 (Bryden *et al*. 1997).

Population Trends

All stocks of Humpback Whales in both hemispheres were severely depleted by commercial whaling (Winn and Reichley 1985, Klinowska 1991). In the Southern Hemisphere, the main period of exploitation was from 1910 until 1963, when the species was protected. The Area V stock was only hunted to a limited degree before 1950, including small shore-based whaling operations in NSW at Twofold Bay from 1828 to 1929, and at Jervis Bay in 1912-13 (Dakin 1934, Wellings 1964), but was then heavily exploited by pelagic whaling in Antarctic waters and shore-based

whaling in NSW (Byron Bay), Queensland (Tangalooma), New Zealand, Norfolk Island and Tonga (Paterson and Paterson 1984). The shore stations at Tangalooma and Byron Bay operated from 1952 and 1954, respectively, to 1962. During that period, they processed 7423 whales, or 38% of the 19 687 reported captures for the whole Group V population from 1912 to 1963 (Paterson and Paterson 1984). Chittleborough (1965) estimated that the original size of the Group V population was about 10 000, and that it had been reduced to 500 or less by 1962. The original population may actually have been rather larger than this, as it is now known that the official statistics grossly understate the true extent and duration of pelagic whaling of this species. It has recently been revealed that Soviet pelagic whalers took a total of 48 736 Humpback Whales in the Southern Hemisphere between 1946 and 1972, not 2708 as originally reported (Zemsky *et al*. 1997). Although the species was protected in 1963, Soviet whalers continued to take them until 1972, when international observers were accepted on their vessels. There has been a marked trend of recovery in the Area V stock since the 1970s, although numbers are still well below their original level. Paterson *et al*. (1994) estimated that the number of whales migrating along the east Australian coast had increased at an average annual rate of 11.7% from 1984 to 1992, and that the population in 1992 was about 1900. Bryden *et al*. (1997) have since estimated the average annual rate of increase from 1986 to 1996 as 12.3%, and the 1996 population as about 3200. Similar increases have been recorded in other Southern Hemisphere stocks of Humpback Whales (Best 1993).

2.38 Australian Sea-lion *Neophoca cinerea*

Conservation Status

International

IUCN Red List of Threatened Species: not listed
Convention on International Trade in Endangered Species: not listed
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: marine species
Seal Action Plan: lower risk, near threatened

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Australian Sea-lion is the only species of marine mammal that is endemic to Australia. It breeds on offshore islands and some mainland sites from Houtman Abrolhos, Western Australia, around to The Pages (east of Kangaroo Island), South Australia. A total of 66 breeding colonies are currently known, 28 in Western Australia and 38 in South Australia (Gales *et al*. 1994, Dennis and Shaughnessy 1996, Shaughnessy *et al*. 1997). Many of the breeding colonies are small and isolated, unlike those of the two fur-seals that breed on the south coast of Australia. Colonies are found in various situations, but typically on the sheltered side of islands, avoiding the exposed rocky headlands that are favoured by New Zealand Fur-seals, which have a similar breeding range (Gales *et al*. 1994). At sea, the Australian sea-lion seems to remain mainly within the waters of the continental shelf and its margins. Migration of adult and subadult males has been recorded in Western Australia between breeding colonies in the Jurien Bay area and non-breeding haul-out sites on

islands near Perth (Gales *et al*. 1992a). Some adult females on Kangaroo Island move pups away from the natal area at about 2-3 months of age to continue nursing at other haul-out sites (Higgins and Gass 1993). Stragglers have been recorded at Shark Bay in Western Australia, western Victoria, southern Tasmania and NSW (Shaughnessy 1999). Australian Sea-lions feed on a wide variety of prey, including cephalopods, fish, sharks, rock lobsters and seabirds (Shaughnessy 1999).

Subspecies and Stocks

No subspecies or stocks have been distinguished.

Occurrence in NSW

Occasional stragglers haul out in NSW, with records at Rose Bay in October 1987, Birdie Beach (Budgewoi) in December 1989, Wollongong Harbour in March 1990, and Montagu Island in August 1998 (Fulton 1990, Atlas of NSW Wildlife). No breeding sites are known in NSW, either recent or historical.

Population Size

Shaughnessy (1999) estimated the total population of the Australian Sea-lion as 9 900 to 12 500 animals, with a mean of 11 200. Of these, 2590 were pups. The estimate was based on a survey of most breeding colonies by Gales *et al*. (1994), combined with a survey of additional breeding colonies in the Great Australian Bight by Dennis and Shaughnessy (1996).

Population Trends

The Australian Sea-lion formerly occupied a more extensive range than it now does. There were breeding colonies in Bass Strait, particularly on Clarke Island and adjacent islands in the Furneaux Group, but these were rapidly eliminated early last century by sealers (Warneke 1982). The species also appears to have been more common in the past on islands near Albany and Perth, on the Houtman Abrolhos, and on the north and east coasts of Kangaroo Island (Shaughnessy 1999). Hence, the overall population size is probably lower now than it was historically. Historical records indicate that Australian Sea-lion colonies, together with the more commercially valuable fur-seals, were reduced to very low numbers over much of southern Australia last century by sealers (Warneke 1982, Shaughnessy 1999). It appears that sea-lion numbers have increased substantially since protection, but have not recovered to former levels. King and Marlow (1979) have suggested that the Australian Sea-lion population may now be decreasing. There has been little supporting evidence of this (Shaughnessy 1999), but sea-lion numbers are certainly not increasing like New Zealand Fur-seal numbers in the same regions, and it has been postulated that the increase in the latter species may be having an adverse effect on sea-lion numbers (Gales *et al*. 2000). Determination of present population trends is confounded by variability in pup production in some colonies between seasons.

2.39 New Zealand Fur-seal *Arctocephalus forsteri*

Conservation Status

International

IUCN Red List of Threatened Species: not listed
Convention on International Trade in Endangered Species: Appendix II
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: marine species
Seal Action Plan: lower risk, conservation dependent

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The New Zealand Fur-seal breeds on islands and some mainland sites in New Zealand (South Island and the islands and island groups to the south and in subantarctic waters), southern Australia, and Macquarie Island (Reijnders *et al*. 1993, Shaugnessy 1999). In Australia, breeding colonies are known from Flinders Island near Augusta, Western Australia, east to Kangaroo Island, South Australia, and the Maatsuyker Group, Tasmania. Overall, 32 Australian breeding colonies are known: 17 in Western Australia, 13 in South Australia, one in Tasmania, and one at Macquarie Island (Shaughnessy *et al*. 1994, Shaughnessy 1999, Gales *et al*. 2000). There has also been a recent report of breeding on a couple of islands in north-eastern Bass Strait (Arnould *et al.* 2000). Non-breeding animals have been reported from the west coast of Western Australia, from NSW and Queensland (south of Fraser Island), and from New Caledonia (Shaughnessy 1999). Ashore, New Zealand Fur-seals are most often observed on irregular rocky habitat, such as jumbled boulders (Goldsworthy *et al*. 1997). They usually avoid open rock platforms and sandy or pebbly beaches. At sea, they seem to remain mainly within the waters of the continental shelf and its margins. Around Kangaroo Island, they prey mainly on fish and cephalopods, but also take penguins. Cephalopods are more important in summer, while fish are more important in winter (Goldsworthy and Crawley 1995).

Subspecies and Stocks

No subspecies are recognised, despite the species' fragmented distribution.

Occurrence in NSW

The only known regular haul-out site for the New Zealand Fur-seal in NSW is at Montagu Island, where they were first recorded only in 1993, but may have been missed in earlier years through confusion with Australian Fur-seals. The species was present throughout the year during monthly censuses in 1993-94: only 1-3 were present between December and June, but numbers increased to 13-18 from July to November (Irvine *et al*. 1997). Numbers of up to 30 have since been recorded on the island (A. Irvine, pers. comm.). The animals, or at least some of them, come from breeding colonies on Kangaroo Island, as shown by an observation of a tagged animal. Animals with tags applied at colonies on Kangaroo Island have also been reported from Tathra, Jervis Bay and Sydney (Shaughnessy 1999). However, animals from breeding colonies in New Zealand may also visit NSW, as indicated by

a recent record of a New Zealand animal in Victoria (Warneke 1995a). Apart from Montagu Island, New Zealand Fur-seals have been reported hauling out at scattered sites along the NSW coast north to Yamba, between the months of July and December (Atlas of NSW Wildlife and Appendix 2). Some animals remain only a few hours, others a few days or weeks, and one stayed in Sydney Harbour for three months in 1990. No breeding sites are known in NSW, either recent or historical.

Population Size

The total population of the New Zealand Fur-seal throughout its range has been estimated at about 135 000 (Wickens and York 1997). Shaughnessy *et al*. (1994) estimated the size of the population in Australian waters at about 34 700 in the early 1990s, of which an estimated 20% were pups. Up to 30 have been recorded at Montagu Island (A. Irvine, pers. comm.).

Population Trends

New Zealand Fur-seals in Australian waters suffered a severe decline in numbers due to indiscriminate commercial sealing from 1798 until protection measures were introduced in Western Australia in 1892 and South Australia in 1919 (Warneke 1982). The species formerly bred on islands in Bass Strait, but was rapidly eliminated from there in the early 19th century. There were no further breeding records in Bass Strait until a few pups were seen on a couple of islands in the late 1990s, possibly representing the early stages of recolonisation of the region (Arnould *et al.* 2000). The species has shown a strong trend of increasing numbers at breeding colonies on Kangaroo Island during the 1980s and 1990s at an exponential rate of increase of r = 0.103 (Shaughnessy *et al*. 1995a, Shaughnessy 1997). A strong trend of increasing numbers has also been recorded at the Western Australian colonies during the 1990s (Gales *et al*. 2000). Nevertheless, the total population in Australia is still probably lower than it was before exploitation (Shaughnessy 1999).

2.40 Australian Fur-seal *Arctocephalus pusillus*

Conservation Status

International

IUCN Red List of Threatened Species: not listed
Convention on International Trade in Endangered Species: Appendix II
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: marine species
Seal Action Plan: lower risk, conservation dependent

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The species consists of two widely disjunct subspecies, one in southern Africa and one in Australia. The Australian subspecies breeds only on islands in Bass Strait, where there are ten colonies - four in Victoria and six in Tasmania (Shaughnessy 1999). The largest colonies are at Lady Julia Percy Island and Seal Rocks in Victoria,

and at Judgement Rocks and Reid Rocks in Tasmania. Non-breeding animals have been recorded in South Australia, southern Tasmania and NSW. Australian Fur-seals favour rocky rather than sandy sites for their breeding colonies and other haul-out sites. They occur on bare rock, boulder stacks and pebble-boulder beaches, and may be found in caves (Warneke and Shaughnessy 1985). Compared with the New Zealand Fur-seal, they generally occur on more open, flat or sloping rocks where many animals can lie together (Goldsworthy *et al*. 1997). At sea, they seem to remain mainly within the waters of the continental shelf and its margins. They prey on surface, mid-water and bottom-dwelling fish, cephalopods and some crustaceans (Warneke and Shaughnessy 1985).

Subspecies and Stocks

Subspecies *pusillus* is endemic to southern Africa, while subspecies *doriferus* is endemic to Australia.

Occurrence in NSW

The main site for the Australian Fur-seal in NSW is Montagu Island. The species is present there all year, but its numbers vary widely. Counts reported by Irvine *et al*. (1997) ranged from 9 to 305, being low between December and June, and high between July and November. One pup was born on the island in October 1993, but died the next day, apparently a premature birth (Irvine *et al*. 1997). Cassell (1953) reported that over 500 seals were present on the island in early October 1953, including at least 120 pups. This is a very early date for pups and suggests that they were actually juveniles that had come from the Bass Strait colonies. Warneke (1982, 1996) made an extensive search of historical references, but found no convincing evidence that Montagu Island had ever supported a seal breeding colony. However, it does appear that there was once a breeding colony in NSW at Seal Rocks. Apart from Montagu Island, other sites where Australian Fur-seals haul out regularly in NSW are near Steamers Beach (Atlas of NSW Wildlife) and Green Cape (Warneke 1996). Seals also come ashore irregularly at other sites all along the coast from Nadgee Nature Reserve north to Tweed Heads. Records away from the regular haul-out sites occur throughout the year, but most frequently between July and November (81% of 75 records in the Atlas of NSW Wildlife and Appendix 2).

Population Size

Pemberton and Kirkwood (1994) estimated the size of the Australian population of the Australian Fur-seal in 1992 as between 46 000 and 60 000, including about 13 000 pups. The maximum count on Montagu Island by Irvine *et al*. (1997) was 305.

Population Trends

The Australian Fur-seal population was exploited by sealers from 1798 until 1923, causing an initial collapse of the population by 1810, then preventing recovery until conservation measures were progressively introduced from 1889 onwards (Warneke and Shaughnessy 1985). The species formerly bred more widely, with breeding colonies at Seal Rocks in NSW and sites in southern Tasmania, south to the Maatsuyker Group. The breeding distribution is now restricted to Bass Strait and, even there, many former breeding sites have not been recolonised (Warneke and Shaughnessy 1985, Shaughnessy 1999). Counts at the large colony at Seal Rocks,

Victoria, from 1967 to 1991 showed considerable fluctuations, but indicated a slow increase in the population at an exponential rate of r = 0.02 (Shaughnessy *et al*. 1995b). A greater rate of increase (r = 0.059) has since been recorded at this colony for the period from 1991 to 1998 (Shaughnessy *et al*. 2000). Increasing numbers are also indicated at Tasmanian colonies (Pemberton and Kirkwood 1994). Despite such recent increases, the total population in Australia still appears to be well below its original size. Warneke (1982) estimated that the pre-sealing annual pup production would have been between 20 000 and 50 000. By comparison, total pup production was estimated at about 8000 in 1986 (Warneke 1988) and about 13 000 in 1992 (Pemberton and Kirkwood 1994).

2.41 Subantarctic Fur-seal *Arctocephalus tropicalis*

Conservation Status

International

IUCN Red List of Threatened Species: not listed
Convention on International Trade in Endangered Species: Appendix II
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: marine species
Seal Action Plan: endangered

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Subantarctic Fur-seal breeds on subantarctic islands from Tristan da Cunha and Gough Island in the South Atlantic, east to Macquarie Island, south-east of Tasmania (Reijnders *et al*. 1993). The only breeding colonies in Australian territory are at Macquarie Island (Shaughnessy 1992). The seals haul out at Heard Island and one pup was born there during the 1987-88 summer, but it is not a regular breeding site. Subantarctic Fur-seals are occasional non-breeding visitors to the coastline of southern Australia, with over 50 records from Western Australia, South Australia, Victoria, Tasmania and NSW (Gales *et al*. 1992b, Shaughnessy 1999). Most of the records are of juveniles found between July and October, suggesting that they are the result of a post-weaning dispersal of young (Gales *et al*. 1992). Subantarctic Fur-seals prefer rocky coasts. At Macquarie Island, breeding animals use open cobble-stone beaches, while non-breeding animals also use the tussock slopes above the beaches (Shaughnessy 1999). At Macquarie Island, they feed almost entirely on pelagic myctophid fish, especially *Electrona subaspera* (Green *et al*. 1990, Goldsworthy *et al*. 1997).

Subspecies and Stocks

The species has a disjunct breeding distribution on widely scattered islands, but no subspecies are recognised.

Occurrence in NSW

Records of the Subantarctic Fur-seal in NSW are: one that hauled out at Wamberal

Beach in July 1980; one at Wanda Beach in July 1991; three apparently different animals at Camden Head, Port Macquarie and Queens Head to Crescent Head in July to September 1996; one at Kioloa in winter 1997; and one at North Bondi in May 1998 (Gales *et al*. 1992b, Atlas of NSW Wildlife, ORRCA 1998 Seal Newsletter).

Population Size

The total population of the species has been estimated at over 310 000 animals, with about 200 000 at Gough Island/Tristan da Cunha (mainly on Gough Island), about 70 000 at Prince Edward and Marion Islands, and about 40 000 at Amsterdam, St Paul and the Crozet Islands (Reijnders *et al*. 1993). The population on Macquarie Island in the 1995-96 breeding season was estimated at between 90 and 110, including pups (Shaughnessy 1999).

Population Trends

The various island populations of the Subantarctic Fur-seal were heavily and indiscriminately exploited by sealers during the 19th century, and in many cases virtually eliminated. The current populations have recovered during the present century from tiny remnants. For example, there were only about 300 animals at Gough Island/Tristan da Cunha in 1892 (Bonner 1979). At Macquarie Island, fur-seals were eliminated within about 10 years of their discovery in 1810. It has been estimated that as many as 193 000 were harvested, but the species present on the island at the time is uncertain (Shaughnessy 1999). The Subantarctic Fur-seal was first recorded from Macquarie Island in 1959 (Shaughnessy 1992). Its population is currently increasing on the island, but the exponential rate of increase for the five years to 1996-97, at r = 0.019, is low (Shaughnessy 1999). Until recently, there were no commercial fisheries in the vicinity of Macquarie Island, but expansion of fisheries for Patagonian toothfish and for myctophid fish now pose threats to the Subantarctic Fur-seal population (incidental catches and reduction of food supplies). Myctophid fish are the main food source for Subantarctic Fur-seals at Macquarie Island (Green *et al*. 1990, Goldsworthy *et al*. 1997). A further threat is hybridisation with the New Zealand Fur-seals (*Arctocephalus forsteri*) and Antarctic Fur-seals (*A. gazella*) that also breed on the island. Extensive hybridisation between the species could threaten the integrity of their local populations (Shaughnessy 1999).

2.42 Southern Elephant Seal *Mirounga leonina*

Conservation Status

International

IUCN Red List of Threatened Species: not listed
Convention on International Trade in Endangered Species: Appendix II
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: marine species
Seal Action Plan: vulnerable

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Southern Elephant Seal has a circumpolar distribution in the Southern Hemisphere, mainly in subantarctic waters, but with records from 16^{o}S (Saint Helena) to 78^{o}S (Ling and Bryden 1981, 1992). The largest breeding colonies are on islands in the vicinity of the Antarctic Convergence: South Georgia, Iles Kerguelen, Heard Island and Macquarie Island. The last two sites are Australian territory. The species also occurs as a visitor to the Australian mainland, particularly Tasmania, where occasional births have been recorded (Shaughnessy 1999). Maatsuyker Island off southern Tasmania is a key locality in Australian mainland waters, with several births and many animals recorded. Occasional births have also been recorded in Victoria and Tasmania, and the species has been recorded as a non-breeding visitor to Western Australia and NSW. Large breeding colonies formerly occurred in Bass Strait, but these were eliminated early last century by sealers. In the Australian Antarctic Territory, small numbers of pups have been reported from Browning Peninsula and Peterson Island, near Casey Station, and there is a well frequented haul-out area at Vestfold Hills (Shaughnessy 1999). On subantarctic islands, Southern Elephant Seals favour beaches, tussock grass and mud wallows. They feed mainly on cephalopods and fish (Green and Burton 1993). Their major foraging areas are located close to the Antarctic continent, and in the vicinity of the Antarctic Convergence (Hindell *et al*. 1991, Slip *et al*. 1994b).

Subspecies and Stocks

No subspecies are currently recognised. Traditionally, three distinct populations have been distinguished, corresponding to the major breeding sites: South Georgia, Iles Kerguelen/Heard Island and Macquarie Island. However, distinct populations may also be associated with the breeding sites at Peninsula Valdes/Falkland Islands, Prince Edward Islands/Iles Crozet and Tristan da Cunha/Gough Island (Reijnders et al. 1993). The foraging areas of the different populations may overlap. Genetic differences have been demonstrated between the populations on Macquarie Island and Heard Island, with the Heard Island population being much closer genetically to the South Georgia population than to the Macquarie Island population (Gales *et al*. 1989, Slade 1997).

Occurrence in NSW

There have been only six recorded occurrences of Southern Elephant seals in NSW: one at Emerald Beach near Woolgoolga in September 1972; one at Royal National Park in October 1980; one at Cremorne in July 1993; one at Dee Why in August 1994; one recorded at various sites from Jervis Bay north to Vaucluse in February 1996; and one at Batemans Bay in December 1999 (Atlas of NSW Wildlife and Appendix 2). At least four of the six were young animals (males and females).

Population Size

The world population of the Southern Elephant Seal has been estimated at 700 000 to 800 000 in 1990, including about 189 000 pups (Reijnders *et al*. 1993). About 53% of the population occurs on South Georgia. The size of the population on Macquarie Island has been estimated at about 86 500 in 1985, of which about 24 713 were pups (Hindell and Burton 1987). The estimated size of the population on Heard Island was about 46 000 in 1985, based on a pup count of 13 111 (Burton 1986).

Population Trends

Southern Elephant Seals formerly bred on islands in western Bass Strait, where there were "large rookeries on the Hunter Islands, King Island and the New Year Islands" according to the French naturalist, Francois Peron (Shaughnessy 1999). Indiscriminate sealing rapidly eliminated these colonies between 1798 and 1805 (Warneke 1982), and they have not been re-established. Southern Elephant Seals were also subject to intensive exploitation at their other breeding colonies around the world in the early decades of the last century. Their numbers were soon reduced to uneconomic levels throughout their range. Hunting had ceased in most areas by early this century, and by the 1950s most of the populations (except for South Georgia, which maintained a seal oil industry until 1964) were thought to have regained their original levels (Carrick *et al*. 1962). However, population declines have since been recorded at both Macquarie Island and Heard Island. At Macquarie Island, the estimated population decreased by 44.6% from 156 000 in 1959 to 86 500 in 1985 (Hindell and Burton 1987). At Heard Island, pup production decreased by 60% from 31 827 in 1949 to 13 111 in 1985 (Burton 1986). The population at Macquarie Island appears to have stabilised in recent years (Hindell and Slip 1997). The reasons for the declines are unclear. They are thought to be related to high juvenile mortality, but the factors involved are unknown (Hindell 1991, Hindell *et al*. 1994, Hindell and Slip 1997). Similar declines have occurred at other breeding colonies in the Indian Ocean (Marion Island, Iles Kerguelen and Iles Crozet), but populations in the Atlantic Ocean have been stable (South Georgia) or increasing (Peninsula Valdes) (Reijnders *et al*. 1993, Hindell *et al*. 1994). A fishery for Patagonian toothfish and icefish has developed in recent years in Australian subantarctic waters. Because these fish are considered an important food source for Southern Elephant Seals at Macquarie Island and Heard Island, the fishery could pose a threat to these populations (Shaughnessy 1999).

2.43 Leopard Seal *Hydrurga leptonyx*

Conservation Status

International

IUCN Red List of Threatened Species: not listed
Convention on International Trade in Endangered Species: not listed
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: marine species
Seal Action Plan: lower risk, least concern

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Leopard Seal has a circumpolar distribution at high latitudes in the Southern Hemisphere (Kooyman 1981b, King 1983, Reijnders *et al*. 1993). Its principal habitat is the pack ice zone, where it is most common in areas of brash or cake ice within 100 km of the northern edge of the zone (Gilbert and Erickson 1977). It is present all year on the pack ice and breeds there. There is a seasonal north-south movement of the population in response to the expansion and contraction of the pack ice, and

some animals reach the edge of the Antarctic continent in summer. There is also a regular dispersal, mainly of young animals, northwards away from the pack ice in winter, when they haul out on subantarctic islands. Leopard Seals congregate in large numbers around Heard Island, where they haul out in all months of the year, but are most abundant from July to September (Gwynn 1953, Brown 1957). Pregnant females visit Heard Island, but do not pup there. At Macquarie Island, which is further north, Leopard Seals are usually present only between late June and early December, their numbers fluctuating from year to year, with a peak in abundance every four or five years (Gwynn 1953, Rounsevell and Eberhard 1980). Leopard Seals are also regular winter visitors to mainland Australian waters, where they have been recorded in Western Australia, South Australia, Victoria, Tasmania, NSW and Queensland, north to Heron Island (King 1983, Shaughnessy 1999). There have been records throughout the year, but predominantly from July to November, and chiefly juvenile seals only one or two years old (King 1983, Rounsevell and Pemberton 1994). The diet of the Leopard Seal includes krill, penguins, other seals, fish and cephalopods (Laws 1984).

Subspecies and Stocks

No subspecies are currently recognised. It has been suggested that there may be six discrete breeding populations of Leopard Seals associated with the six areas of residual pack ice that remain around Antarctica each summer (Gilbert and Erickson 1977). Genetic differences between animals from Heard Island and Macquarie Island have been tested, but the results were inconclusive (Slip *et al*. 1994a).

Occurrence in NSW

Leopard Seals frequently haul out along the NSW coast, where they have been recorded from Nadgee Nature Reserve north to Ballina (Atlas of NSW Wildlife and Appendix 2). Most records come from southern NSW, south of the Hunter River (87% of 117 records). The records span the period from June to February, but most records (91%) are between July and October, especially in August and September (66%). Elliott (1982) reported a similar seasonal pattern from Taronga Zoo's records of Leopard Seals in NSW between 1950 and 1981. West (1978) noted that Leopard Seals were rarely seen around Sydney until the 1960s. The species has also been recorded at Lord Howe Island (Shaughnessy 1999).

Population Size

Erickson and Hanson (1990), using survey data from 1968-1983, estimated that the Leopard Seal population on the pack ice of the Southern Ocean is about 300 000, although they considered this an underestimate because it does not include animals that were not on the pack ice surface during the surveys. At Heard Island, counts of up to 1004 Leopard Seals were made in 1952 (Brown 1957). At Macquarie Island, tagging indicated that at least 204 and up to 227 different Leopard Seals visited the island during 1977, but the maximum number known to be present at any one time was 48 (Rounsevell and Eberhard 1980).

Population Trends

Little is known about population trends in the Leopard Seal. The species has been taken by sealers in the past, but has never been subjected to high levels of

exploitation. No major conservation problems are evident at present, although there is some concern about the potential impacts on their food supply of a possible future expansion of the Antarctic krill fishery (Reijnders *et al*. 1993, Shaughnessy 1999).

2.44 Crab-eater Seal *Lobodon carcinophagus*

Conservation Status

International

IUCN Red List of Threatened Species: not listed
Convention on International Trade in Endangered Species: not listed
Convention on Migratory Species: not listed

Australia

Environment Protection and Biodiversity Conservation Act: marine species
Seal Action Plan: lower risk, least concern

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Crab-eater Seal is restricted to the Southern Hemisphere, where it has a circumpolar distribution throughout the Antarctic pack ice (Kooyman 1981a, King 1983, Reijnders *et al*. 1993). It breeds, moults and rests on the pack ice, and there is a seasonal north-south movement of the population in response to the expansion and contraction of the pack ice. Occasional stragglers have been recorded at Heard Island, Macquarie Island, Western Australia, South Australia, Victoria, Tasmania and NSW (Shaughnessy 1999). The species feeds primarily on Antarctic krill (*Euphausia superba*), and small amounts of fish and squid (Oritsland 1977).

Subspecies and Stocks

No subspecies are currently recognised. It has been suggested that there may be six discrete breeding populations of Crab-eater Seals associated with the six areas of residual pack ice that remain around Antarctica each summer (Gilbert and Erickson 1977).

Occurrence in NSW

There have been only two records of Crab-eater Seals in NSW. An adult female hauled out at Port Hacking in July 1982 and was taken to Taronga Zoo, where she died 39 days later (Lonnon 1983, Robinson 1984). King (1983) mentioned a second record of one at Nambucca Heads, but did not provide details.

Population Size

Erickson and Hanson (1990), using survey data from 1968-1983, estimated that the Crab-eater Seal population on the pelagic pack ice of the Southern Ocean is at least seven million. They believed this estimate to be conservative, and that a more realistic estimate of the population would be 11-12 million.

Population Trends

Little is known about population trends in the Crab-eater Seal. The species has been taken by sealers in the past, but has never been subjected to high levels of exploitation. It has been suggested that its population may have increased significantly since the 1950s, together with the populations of certain other krill predators, such as Minke Whales and Antarctic Fur-seals, in response to the increased availability of krill following the decimation of the larger krill-eating whale species by whaling (Laws 1984, Bryden 1993). No major conservation problems are evident for Crab-eater Seals at present, although there is some concern about the potential impacts of a possible future expansion of the Antarctic krill fishery (Reijnders *et al*. 1993, Shaughnessy 1999).

2.45 Dugong *Dugong dugon*

Conservation Status

International

IUCN Red List of Threatened Species: vulnerable

Convention on International Trade in Endangered Species: Appendix I

Convention on Migratory Species: Appendix II

Australia

Environment Protection and Biodiversity Conservation Act: migratory species, also listed as a marine species

Draft Dugong Action Plan (Endangered Species Scientific Subcommittee 1997): assessments made for seven of 13 sections of Australian distribution (insufficient data for other six sections, and no overall assessment made): critically endangered - Great Barrier Reef south of Cooktown; endangered - Hervey Bay; lower risk, near threatened -Torres Strait; lower risk, conservation dependent - Great Barrier Reef north of Cooktown, Moreton Bay; lower risk, least concern - Shark Bay, Exmouth Gulf-Ningaloo

Queensland

Nature Conservation Act: vulnerable

NSW

Threatened Species Conservation Act: not listed

Distribution, Habitat and Movements

The Dugong has a wide but now disjunct distribution in tropical and subtropical shallow coastal waters of the Indian and western Pacific Oceans, between about 27^{o}N and 27^{o}S. It is found from south-eastern Africa and Madagascar north and east to the Ryukyu Islands near Japan, and south through the Philippines, Indonesia, New Guinea, the Solomon Islands, Vanuatu and New Caledonia to northern Australia (Husar 1978, Nishiwaki and Marsh 1985, Marsh and Lefebvre 1994). It is now represented over much of its range by small relict populations separated by large areas where it is extinct or close to extinction. Australia is its stronghold and may support the majority of the current world population. Resident Dugong populations occur around the northern coastline of Australia from Shark Bay, Western Australia, to Moreton Bay in southern Queensland (Marsh and Lefebvre 1994). Dugongs feed primarily on seagrasses and tend to occur in warm, shallow, sheltered inshore and reef areas where there are extensive seagrass beds. They feed on a wide variety of

seagrass species, and also feed on algae, although usually only in very small amounts if seagrasses are abundant (Nishiwaki and Marsh 1985).

Subspecies and Stocks

No subspecies are currently recognised. In view of the species' sedentary, inshore habits, the Australian population may be considered as a separate entity, although some interchange is possible with populations outside Australia. The draft Dugong Action Plan for Australia distinguishes 13 different regions for Dugongs in Australia, but these were selected rather arbitrarily and may not reflect true stock boundaries (Endangered Species Scientific Subcommittee 1997). Stock structure of Dugongs within Australia is currently being investigated (Marsh and Lefebvre 1994).

Occurrence in NSW

Dugongs usually only occur in NSW as occasional stragglers, the nearest resident population being that in Moreton Bay. Until 1992, there had been only 14 records for NSW (Marlow 1962, Atlas of NSW Wildlife, Appendix 2). There was a sudden invasion of Dugongs in that year, resulting in 50 reports between June 1992 and August 1993, many of them animals found dead. Since that time there have been only two records, the last in January 2000. Dugongs have been recorded in NSW all along the coast south to Twofold Bay, but most records (95%) have been north of Jervis Bay. The animals in 1992-93 apparently came from Hervey Bay, where two floods and a cyclone in early 1992, their effects exacerbated by poor catchment management, resulted in the loss of more than 1000 km^2 of seagrasses and a dramatic collapse of the local Dugong population (Preen and Marsh 1995). It has been estimated that full recovery of this population will take more than 25 years.

Population Size

The size of the Australian population of the Dugong has been estimated to be at least 85 000, but is probably rather more than this, since large sections of the coastline have not been surveyed and were not included in the estimate (Marsh and Lefebvre 1994). The most comprehensively surveyed section of the coastline is the east coast of Queensland, from Torres Strait to Moreton Bay, where the current Dugong population is estimated to be about 38 000, of which about 35 000 occur in the northern Great Barrier Reef and Torres Strait regions.

Population Trends

Dugongs have been exterminated or are now extremely rare in many parts of their former world distribution, largely because of over-hunting (Husar 1978, Nishiwaki and Marsh 1985). In Australia, as a result of the loss of seagrass beds in 1992, the Hervey Bay Dugong population collapsed from an estimated 2206 (s.e. 420) in 1988 to only 600 (s.e. 126) at the end of 1993 (Preen and Marsh 1995). There is also grave concern for the future of the population in the southern Great Barrier Reef. Aerial surveys have shown that the population has declined in recent years by approximately 50%, from an estimated 3479 (s.e. 459) in 1986/87 to only 1682 (s.e. 236) in 1994 (Marsh *et al*. 1996). Dugongs in this region are threatened by loss of seagrass beds due to coastal development, by traditional hunting, and by incidental mortality in commercial gillnets and in shark nets set for bather protection. There has been no evidence of decline in Dugong populations in the northern Great Barrier

Reef, Torres Strait and Shark Bay (Marsh and Lefebvre 1994). A recent review of the species' national conservation status concluded that it did not yet warrant listing on the then Commonwealth Endangered Species Protection Act, but its conservation status should be kept under review because of the severe population declines that have occurred in Queensland (Endangered Species Scientific Subcommittee 1997).

3. Threatening Processes

The following account considers potential threatening processes affecting marine mammals in NSW and adjacent Australian waters. Other Australian reviews of threatening processes include those of Bannister *et al*. (1996), Paton (1996), Smith (1997), Queensland Department of Environment (1997), Bryden *et al*. (1998) and Shaughnessy (1999). Worldwide reviews include those of Klinowska (1991), Reijnders *et al*. (1993) and Reeves and Leatherwood (1994).

3.1 Deliberate Killing

Until recently, the major human impact on marine mammals was hunting. Commercial whaling ceased in Australia for Humpback Whales in 1963, but continued on Sperm Whales off Western Australia until 1978. Catches of Southern Right Whales in the Southern Hemisphere have been prohibited since 1935, Blue Whales since 1964, Fin Whales since 1976, and Sei Whales since 1978. However, illegal catching of Southern Right Whales, Humpback Whales and Blue Whales by pelagic whalers continued until the early 1970s (Zemsky *et al*. 1995). Commercial hunting of seals for their pelts was a major industry in Australia last century and seals were harvested indiscriminantly until protection measures were introduced at the end of the century and early this century.

The killing of marine mammals in NSW waters (to 3 nautical miles offshore) and adjacent Australian waters (to 200 nautical miles offshore) is now prohibited by legislation. Nevertheless, sporadic reports are received of seals and dolphins being deliberately killed. They are killed because they are interfering with fishing or to provide bait, or as an act of vandalism. Shooting is the usual method of killing. Warneke (1975) recorded that of 182 tagged juvenile Australian Fur-seals recovered away from their natal colony (Seal Rocks in Victoria), 15 (8%) showed evidence of having been shot. There are no reliable estimates of the extent of the problem in NSW (Smith 1997), but the main casualties are probably fur-seals killed by commercial or amateur fishers, particularly in the vicinity of Montagu Island, which is the main seal haul-out site in the state. Interference with the local fishing industry is a significant problem and pressure is being applied to allow culling of seals that interfere with fishing operations (Woodford 2000).

3.2 Incidental Catches

Incidental catches (bycatch) of marine mammals in nets, traps, longlines and other fishing gear is a worldwide problem. There have been many examples of particular fisheries that have had a severe impact on whale, dolphin and seal populations (Klinowska 1991, International Whaling Commission 1992, Reijnders *et al*. 1993, Reeves and Leatherwood 1994, Perrin *et al*. 1994). The highest levels of bycatch reported in Australian waters were in a gillnet fishery by Taiwanese vessels off northern Australia in the 1970s and 1980s. The total cetacean bycatch in this fishery for the period June 1981 to December 1985 was in the order of 14 000 animals, of which about 60% were Bottlenose Dolphins, 35% Spinner Dolphins and 5% Pantropical Spotted Dolphins, with occasional animals of other species (Harwood

and Hembree 1987). The fishery no longer operates within Australian waters, but just outside, where there are continuing high levels of bycatch (Bannister *et al*. 1996). Another particular concern has been bycatch of Dugongs in commercial gillnet fisheries in the southern Great Barrier Reef region, where the Dugong population declined by about 50% between 1986 and 1994 (Marsh *et al*. 1996).

A nomination to list 'incidental catch of Dugong, turtles, crocodiles and cetaceans due to gillnetting' as a key threatening process under the then Commonwealth Endangered Species Protection Act was reviewed by the Endangered Species Scientific Subcommittee (1998a). The nomination referred only to gillnetting conducted around Australia's tropical and subtropical coasts from Moreton Bay to Shark Bay, and was primarily concerned with threats to Dugong populations, although threats to Indo-Pacific Humpbacked Dolphins, Irrawaddy Dolphins (*Orcaella brevirostris*) and other tropical inshore cetaceans (and to turtle and crocodile species) were also considered. The Subcommittee recommended against listing on the basis that the species of greatest concern, the Dugong, was not listed in the Act, did not meet the criteria for listing as either endangered or vulnerable (Endangered Species Scientific Subcommittee 1997), and that gillnetting was not causing the species to become threatened in Australia as a whole (although it was one factor affecting Dugongs in Queensland). The Subcommittee also concluded that there was insufficient evidence that gillnetting was adversely affecting the other species mentioned in the nomination. They were concerned, however, that there may be deleterious effects from gillnetting on the Indo-Pacific Humpbacked Dolphin and the Irrawaddy Dolphin, and that the lack of evidence may be due to a lack of research into this issue.

A general review of marine mammal bycatch in fisheries operating in Australian waters found that the reported levels of bycatch are generally low (Evans 1998). However, it was stressed that many incidents go unreported, and that the true levels of bycatch in these fisheries, and their impact on marine mammal populations, are unknown. The only reliable method of obtaining data on bycatch is through independent observer schemes. For example, in the New Zealand Hoki fishery, 198 incidental catches of New Zealand Fur-seals were reported from nine vessels with observers, but only six such catches were reported from the 38 vessels without observers.

No major bycatches of marine mammals have been reported in fisheries operating in NSW waters and adjacent Australian waters. However, this may well be due to lack of reporting, not lack of catches. One potential problem could be mortality of fur-seals in kingfish traps set around Montagu Island, and on longlines and droplines set in nearby Australian waters (Smith 1997).

Incidental catches of marine mammals also occur in the shark-meshing program in NSW. Since 1937, nets have been regularly set off popular beaches in an effort to reduce local populations of potentially dangerous sharks as a protective measure for swimmers and surfers. Shark-meshing is currently undertaken at a total of 49 beaches between Newcastle and Wollongong. The bycatch of dolphins (probably mainly Bottlenose Dolphins and Common Dolphins) has averaged about one or two per year in recent years (D. Reid, NSW Fisheries, pers. comm.). Other marine mammals caught at times in the shark nets have been Dugongs and Killer Whales.

The bycatch in NSW is low compared with the numbers caught in the Queensland

shark-meshing program, where reported bycatch between 1962 and 1995 averaged 20 Dugongs, 19 dolphins, 2 small whales and 0.1 Humpback Whales per year (Paterson 1990, Gribble *et al*. 1998). Measures taken to reduce bycatch resulted in a reduction between 1992 and 1995 to an annual bycatch of 4 Dugongs and 10 dolphins (Gribble *et al*. 1998).

A nomination to list 'beach meshing to reduce the threat of humans from shark attack' as a key threatening process under the then Commonwealth Endangered Species Protection Act was reviewed by the Endangered Species Scientific Subcommittee (1998b). They concluded that beach meshing is not adversely affecting two or more listed threatened species, and is not causing other species to become endangered. They recommended against the listing of beach meshing.

3.3 Reduction of Prey Populations by Fisheries

Commercial and recreational fisheries can potentially have a serious impact on marine mammal populations by reducing the stocks of their prey species, or the stocks of species that sustain the prey species. These species may be the target of the fishing operations or they may be an unwanted bycatch. The extent of this problem for marine mammals in NSW and adjacent waters is unknown.

Corkeron (1997) compared the feeding ecology of Bottlenose Dolphins in Moreton Bay and the inshore oceanic waters off nearby Point Lookout. He concluded that there were indications that the food supply for Bottlenose Dolphins in Moreton Bay had been depleted or altered to the point where the dolphins may now rely on the discarded bycatch of prawn trawlers as a major food source. Obtaining food from this source may have led to increased mortality of dolphins by increasing the likelihood of them coming into contact with predatory sharks, although the available data were insufficient to be definitive about this. Indo-Pacific Humpbacked Dolphins also follow prawn trawlers in Moreton Bay and may face similar problems (Corkeron *et al*. 1990). In the waters off Point Lookout, fish stocks are such that Bottlenose Dolphins range over a much smaller area to find sufficient food, do not need 'handouts', and may be less prone to shark attack (Corkeron 1997).

3.4 Entanglement and Ingestion of Marine Debris

Increasing quantities of marine debris, especially plastic debris, are entering the marine environment each year, either cast overboard from vessels or washed out to sea from land (Laist 1987, 1997, Jones 1994). Marine mammals are at risk of entanglement in debris, which may lead to death from asphyxiation, abrasion, infection, or reduced ability to catch food or to avoid predators. They are also at risk from ingestion of debris, either accidentally or in mistake for prey. The ingested debris may then cause fatal blockages in the animal's digestive system.

Examples from NSW include observations of entangled Humpback Whales, Bottlenose Dolphins and Australian Fur-seals, and a Killer Whale found dead after ingestion of plastic bags (Atlas of NSW Wildlife). In 1995 alone, three Humpback Whales and another unidentified whale were observed off the north coast of NSW entangled in fishing gear (Paton 1996).

The incidence of entanglement in Australian Fur-seals has been measured in a Tasmanian study as 1.9%, referring to the proportion of animals with neck collars of man-made debris (Pemberton *et al*. 1992). The neck collars were causing obvious physical injury to 73% of the animals bearing them. In the two worst cases, the collars had cut through the oesophagus. The effects at the population level are unknown, but it is a disturbingly high rate of entanglement. By comparison, an entanglement rate of 0.4% observed in Northern Fur-seals (*Callorhinus ursinus*) in the Pribilof Islands, Alaska, has been implicated as a major factor in the decline of this population (Fowler 1987).

The entanglement material in the Tasmanian study consisted predominantly of trawl-nets, packaging bands, monofilament nets and nylon ropes. The chief source of this material was commercial fisheries. Collars of trawl-net were seen as the greatest problem, being large, buoyant and originating from a fishery that is increasing in size and produces a lot of debris. Another major cause of entanglement was the packaging bands from bait boxes, a problem that could be avoided by use of boxes without bands.

3.5 Harassment from Whale, Dolphin and Seal Watching

Whale, dolphin and seal watching activities have expanded rapidly in Australia since the mid 1980s as a tourism industry and as a private pastime. If done responsibly, these are rewarding and educational experiences and are of great benefit in increasing public awareness and concern for marine mammals. However, marine mammal populations may suffer considerable disturbance from the combined impact of the increasing numbers of commercial operators, private boat owners, film crews, researchers and others taking an interest in them. The tolerance levels of the animals and the ultimate effects of excessive disturbance are largely unknown, but it is clear that the problem requires careful monitoring and management.

A commercial whale watching industry, focusing on Humpback Whales, was established at Hervey Bay, Queensland, in 1987. Vessel-based whale watching has since expanded greatly in Queensland and NSW. There are now over 49 commercial operators working from NSW ports all along the coast south to Eden (Paton 1996). It is a matter of some concern that unregulated expansion of whale watching will result in the Humpback Whale population being subject to continual high levels of disturbance throughout its migration route along the east coast of Australia, and on its breeding grounds off northern Queensland. The Southern Right Whale also is becoming subject to increasing levels of disturbance at its inshore breeding grounds along the NSW coast.

Corkeron (1995) studied the effects of whale watching on the behaviour of Humpback Whales in Hervey Bay, and found that the behaviour of the whales changed in the presence of vessels. Whether the short-term behavioural changes he observed are accompanied by longer-term avoidance of Hervey Bay by Humpback Whales is unclear.

Whales that are subject to continual disturbance may partially or totally abandon their preferred habitats for less favourable but quieter areas. Depending on the species and the location, this may apply to migration, resting, courtship, calving, nursing or feeding habitats. The end result is likely to be decreased survivorship in the

population. Females calving or nursing young are likely to be particularly affected by disturbance, resulting in increased mortality of calves. In addition, there is always the risk of accidental collisions between vessels and whales. Collisions between whales and large whale watching vessels travelling at speed are known to have occurred in Hervey Bay, and collisions with whale watching vessels have also been reported at Coffs Harbour (Paton 1996).

In parallel with the expansion of the commercial whale watching industry, there has also been a proliferation of commercial dolphin watching enterprises in NSW in recent years at sites with resident populations of Bottlenose Dolphins, such as Port Stephens, Jervis Bay and Wallis Lake. The increasing number of operators involved (there are seven different operators involved at Port Stephens and likely to be more in future; Smith 1997) means that local dolphin populations may be subject to almost continuous disturbance throughout the day. Furthermore, the main dolphin watching season is summer, which coincides with the time of birth and mating among the dolphins. Overseas studies have reported that the behaviour of Bottlenose Dolphins is more affected by boats that follow them than it is by normal boat traffic (Acevedo 1991, Janik and Thompson 1996).

Environment Australia (2000) have identified four areas in NSW of special interest for cetacean observation in order to ensure that development of cetacean-based tourism activities in these areas is appropriate:

- Area 1 - Cape Byron-Tweed Heads: observation of migrating Humpback Whales.

- Area 2 - coastal waters in the vicinity of Coffs Harbour: observation of migrating Humpback Whales (occasional calving events have also been reported).

- Area 3 - waters within and adjacent to Port Stephens: Bottlenose Dolphins here are subject to the most intensive commercial tourism operations along the NSW coast, and observation of migrating Humpback Whales is also involved.

- Area 4 - waters within and adjacent to Twofold Bay: chiefly observation of migrating Humpback Whales, also Bottlenose Dolphins, and occasionally other species such as Southern Right Whales, Blue Whales and Killer Whales.

The chief site for commercial seal-watching activities in NSW is Montagu Island, which is a nature reserve controlled by the NSW National Parks and Wildlife Service. Some commercial seal-watching also occurs at the haul-out site near Steamers Beach (south of Jervis Bay).

3.6 Collisions with Vessels

Marine mammals may be killed accidentally in collisions with vessels of all sizes, including 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, while dolphins and seals are vulnerable to collisions with smaller, faster vessels, including jet skis. The animal may be killed outright in the collision or it may suffer debilitating injuries that lead to its death. The incidence of collisions with marine mammals in Australian waters is largely unknown, but it is potentially a significant cause of mortality. As an example, a study of mortality in Northern Right

Whales (*Eubalaena glacialis*) in the North Atlantic concluded that approximately one third of all deaths were caused by human activities, with ship collisions responsible for 20% of all deaths, while entanglements accounted for another 12% (Kraus 1990).

Laist *et al*. (2001) have recently reviewed historical and recent records for evidence of ship strikes involving large whales (baleen whales and the Sperm Whale). The historical records suggest that ship strikes fatal to whales first occurred in the late 1800s as ships began to reach speeds of 13-15 knots, remained infrequent until about 1950, and then increased during the 1950s to 1970s as the number and speed of ships increased. Fin Whales were found to be the species struck most frequently, while other species hit commonly include Northern and Southern Right Whales, Humpback Whales and Sperm Whales.

3.7 Oil Spills

Oil spills in the marine environment have the potential to cause significant mortality among marine mammals and other wildlife. The degree of threat depends on many factors, such as the amount and type of oil, weather conditions, currents, the success of containment and clean-up operations, the habitats affected, and the sensitivity of the particular species to oil.

Information on the sensitivity of marine mammals to oil spills is limited, but does suggest that cetaceans are relatively resilient, at least to the direct lethal effects of oil spills; seals are more sensitive, particularly otariid seals (fur-seals and sea-lions); while virtually nothing is known of the effects on Dugongs (Geraci and St Aubin 1990, Volkman *et al*. 1994). Concern for otariid seals relates chiefly to fouling of their thick coats, which have an important insulating role. Young, inexperienced seals are generally more prone to fouling than adult seals.

Australia has had few major marine oil spills and only one is known to have had a significant effect on marine mammals. In February 1991, the bulk carrier Sanko Harvest was wrecked in the Recherche Archipelago, Western Australia, and spilled 570 tonnes of heavy fuel oil into the sea. Two-month-old New Zealand Fur-seal pups were contaminated with oil at two breeding colonies, but prompt action resulted in about 80% of the oiled pups being captured, cleaned and saved (Baker 1991).

In NSW the site of greatest concern in relation to the impact of oil spills on marine mammals is the fur-seal haul-out site on Montagu Island.

3.8 Toxic Pollutants

Modern technology and the associated development of chemical industries have resulted in the production and release into the environment of large quantities of a wide variety of man-made chemicals. Various toxic chemicals, especially organochlorine compounds and heavy metals, have polluted the marine environment. The main sources of contamination are industrial and residential wastes, and agricultural biocides and fertilisers. The contaminants may be deliberately released into rivers and seas, or may enter via drainage and seepage from contaminated land. They may also enter the sea via atmospheric pollution.

High levels of toxic pollutants have been recorded in marine mammals around the world and they are regarded as one of the animal groups most at risk from the long-term build-up of toxic chemicals in the environment (e.g. Tanabe *et al.* 1994). Seals and toothed whales are specially vulnerable since they feed at high trophic levels in the food web and hence are subject to the effects of bioaccumulation of pollutants. Baleen whales, which feed at lower trophic levels, generally have lower levels of contaminants in their tissues (O'Shea and Brownell 1994).

Direct mortality of marine mammals from chemical pollutants is rarely reported and would normally be expected only with specific incidents involving unusually high levels of pollution. More general threats are immune suppression, impaired reproduction and other sub-lethal effects of chemical pollution. For example, concerns have been raised over a number of mass mortalities among seals and dolphins in the Northern Hemisphere during the last decade. The mortalities were caused by morbillivirus infections, but high levels of organochlorines are suspected of contributing substantially to the severity of the epidemics through impairment of immune function in the affected populations (Simmonds *et al*. 1993, Aguilar and Borrell 1994).

Kemper *et al*. (1994), reviewing the available information on heavy metal and organochlorine levels in marine mammals in Australia, concluded that the levels are generally low when compared with many other parts of the world. This is in keeping with a general pattern of lower contaminant levels found in Southern Hemisphere vertebrates. However, there were some exceptions. For example, mercury levels were found to be very high in False Killer Whales from two mass strandings in NSW. Organochlorine levels were moderately high in some Bottlenose Dolphins from Victoria, and there was circumstantial evidence that these animals were immunologically compromised and had died of disease. Preen *et al*. (1992) have reported that Bottlenose Dolphins and Indo-Pacific Humpbacked Dolphins in Moreton Bay, Queensland, regularly feed around sewage outlets and port facilities, where they are at risk from high local levels of chemical pollution.

3.9 Acoustic Disturbance

Marine mammals employ an acute acoustic sense to monitor their environment, and are correspondingly sensitive to underwater sounds. Human activities which produce loud sounds underwater are likely to interfere with the acoustic perception and communication of marine mammals, causing stress, interfering with behavioural patterns, and possibly causing physical damage at close quarters. Sound energy at high frequencies is absorbed by seawater, but low frequency sounds can travel and be detected hundreds of kilometres away. The levels of man-made ocean noise are increasing around the world, and the impact on marine mammals is a matter of concern, especially the impact of loud low frequency sounds on baleen whales, which are highly sensitive to such sounds (Green *et al*. 1994, Richardson *et al*. 1996).

One area of concern is the impact of marine seismic surveys, which are a major component of offshore oil and gas exploration. The surveys use high energy, low frequency sound sources towed behind a ship travelling at 4-6 knots. The sound sources, which are usually arrays of air-guns, are triggered every 6-20 seconds. Seismic survey activity has increased steadily in Australia over the last few years,

particularly off the north and north-west coasts.

McCauley (1994) has reviewed the available information on the likely effects of seismic surveys on marine mammals. The sound intensities required to produce pathological effects are poorly known, but are probably only experienced at ranges of less than 100 m from an air-gun array. Marine mammals are likely to stay well away from continuously operating air-gun arrays, but may be harmed if an array is suddenly triggered close beside them. Behavioural effects are evident at much greater distances. Baleen whales are the most sensitive group and show a gradation of behavioural responses to operating seismic vessels. Subtle responses have been observed at distances out to 54-73 km from the seismic vessel. The responses become more pronounced as the distance from the vessel decreases and the sound intensity increases, but in most instances normal activities such as feeding and socialising continue until the vessel approaches within a few kilometres, when the whales begin to move away from it.

McCauley *et al*. (2000) have carried out an experimental program to assess the environmental implications of marine seismic surveys in Australian waters. The generalised response of migrating Humpback Whales to a seismic survey vessel was to take some avoidance manoeuvre at distances of over 4 km, then to allow the vessel to pass no closer than 3 km. Humpback pods containing cows which were involved in resting behaviour in key habitat types, as opposed to migrating animals, were more sensitive and showed an avoidance response estimated at 7-12 km from a large seismic source. However, male Humpbacks were attracted to a single operating air-gun, probably because of the similarity between the air-gun signal and the sound of a whale breaching.

Other examples of activities which produce considerable underwater sound and may have an impact on marine mammals include dredging and harbour construction; underwater explosions in military testing or removal of shipping hazards; concentration of shipping in commercial sea lanes, 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 (Bannister *et al*. 1996). A particular concern elsewhere in the world in recent years has been several mass strandings of beaked whales that have occurred during or following naval manoeuvres. It has been postulated that the strandings were caused by the ships' sonar, although a definite link between the two, and the exact cause of the strandings, have not yet been established (Balcomb and Claridge 2000).

3.10 Habitat Degradation

Marine mammal habitats can be rendered uninhabitable or substantially modified by human activities, especially in coastal waters. The species most likely to be affected in NSW is the Bottlenose Dolphin, which occurs in localised populations in coastal waters, including bays, estuaries and coastal lakes. Other marine mammal species using NSW waters may also be affected.

Habitat modification may take various forms. Some forms, such as chemical pollution and reduction of food resources by fisheries, have been considered separately above. Another example is the loss or deterioration of estuarine seagrass and mangrove communities. These are critical spawning, nursery and shelter habitats for

fish and other marine animals, and their loss could have a significant effect on marine mammal food resources.

The expansion of marine aquaculture in NSW could also pose threats to marine mammal habitats. Marine aquaculture is the farming of fish, oysters, mussels and other species in protected coastal waters. The NSW aquaculture industry historically has been based on the Sydney Rock Oyster, but is now undergoing a period of expansion and diversification. An example is a recent proposal to farm mussels on a large scale in Twofold Bay, which poses some concerns in relation to local marine mammal populations (Warneke 1996).

Modification of marine mammal habitats may also occur through the introduction of exotic organisms , which may interact directly with marine mammals or may have an effect on their food resources. A problem that is receiving increasing attention is the introduction of exotic organisms in the ballast water of ships. A variety of organisms are known or suspected to have been introduced to Australia in this way, including several species of toxic dinoflagellate algae (Jones 1991). Dinoflagellate toxins are a known cause of death in Humpback Whales (Geraci *et al*. 1989).

4. Conservation Priority Scores

Conservation priority scores for each species were calculated using the scoring system devised by Millsap *et al*. (1990) and detailed in Appendix 1. Because NSW waters only extend a distance of 3 nautical miles (5 km) from the coast, and the marine mammals that occur there generally range over a much wider area and form part of a larger population, it was unrealistic to make the assessments only in terms of that part of the population that occurs in NSW waters. Instead, the assessments were based on either the population associated with Australian waters (up to 200 nautical miles from the coast, including Macquarie Island) or the Area V population (south of the equator between 130^{o}E and 170^{o}W), whichever was more appropriate for the particular species.

The scoring system was originally devised not for marine fauna, but for the terrestrial and freshwater vertebrate fauna of Florida. Its application to marine mammals is questionable. Furthermore, lack of knowledge of population size, stock structure, distribution, ecology and history of many of the species makes it difficult to score them reliably. The scores should therefore be treated with some caution.

The resulting scores are shown in Table 3 and compared with various international, national and state conservation status assessments. The derivation of the scores is shown in Table 4. In general, the scores correspond well to the conservation status assessments. Exceptions are the Australian Fur-seal, Australian Sea-lion and New Zealand Fur-seal, which have high conservation priority scores, but are not considered threatened in any of the assessments. Their high scores are due to their reduced population sizes (as a result of overexploitation in the past by sealers), their relatively restricted distributions (for marine mammals), and the concentration of their populations at specific breeding sites. All three species have recovered well from past exploitation, but have not yet reached their former levels of abundance.

Table 3. Comparison of conservation priority scores with conservation status assessments

E = endangered, V = vulnerable, K = insufficiently known

Species	Conservation priority score	IUCN Red List E or V	CITES Appendix I	CMS Appendix I	EPBC Act E or V	Action Plan E, V or K	TSC Act E or V
Subantarctic Fur-seal	**55.6**					E	
Blue Whale - ssp. *musculus*	**39.3**	E	I	I	E	E	E
Southern Right Whale	**39.3**		I	I	E	V	V
Southern Elephant Seal	**34.3**					V	
Fin Whale	**33.3**	E	I		V	V	V
Humpback Whale	**32.6**	V	I	I	V	V	V
Blue Whale - ssp. *brevicauda*	**32.3**	E	I	I	E		
Australian Fur-seal - ssp. *doriferus*	**32.3**						
Indo-Pacific Humpbacked Dolphin	**31.3**		I			K	V
Australian Sea-lion	**29.3**						
Sei Whale	**28**	E	I		V	V	V
Sperm Whale	**26.3**	V	I			K	V
Dugong	**26.3**	V	I			*	
New Zealand Fur-seal	**25.3**						
Spinner Dolphin	**22**					K	V
Strap-toothed Beaked Whale	**20.3**						
Gray's Beaked Whale	**20.3**						
Andrew's Beaked Whale	**20.3**						
Ginkgo-toothed Beaked Whale	**20.3**						
Bryde's Whale - pygmy form	**19**		I				
Southern Bottlenose Whale	**17.3**		I				
Risso's Dolphin	**17.3**						
Long-finned Pilot Whale	**17.3**						
Short-finned Pilot Whale	**17.3**						
Arnoux's Beaked Whale	**17**		I				
Pygmy Right Whale	**16.3**		I				
Pygmy Sperm Whale	**16.3**						
Dwarf Sperm Whale	**16.3**						
Minke Whale - diminutive form	**16**		I				
Killer Whale	**16**						
Blainville's Beaked Whale	**15**						
Bottlenose Dolphin - *truncatus* form	**14**						
Bottlenose Dolphin - *aduncus* form	**14**						
Pantropical Spotted Dolphin	**14**						
Striped Dolphin	**14**						
Southern Right Whale Dolphin	**14**						
Melon-headed Whale	**14**						
Pygmy Killer Whale	**14**						
Cuvier's Beaked Whale	**14**						
Dusky Dolphin	**13**						
Minke Whale - dark-shoulder form	**11.3**		I				
Rough-toothed Dolphin	**12**						
Fraser's Dolphin	**12**						
Common Dolphin	**10**						
Crab-eater Seal	**9.3**						
Leopard Seal	**8**						

* Southern Great Barrier Reef and Hervey Bay populations endangered

Table 4. Derivation of the conservation priority scores (Appendix 1)

Species and area	Population size	Population trend	Range size	Distribution trend	Population concentration	No. of young per female per year	Age when females first reproduce	Dietary specialisation	Reproductive specialisation	Other specialisations	Total score
Subantarctic Fur-seal - Australia	10	6	7	10	10	3	3	3.3	3.3	0	**55.6**
Blue Whale - ssp. *musculus*, Area V	10	6	0	10	0	5	5	3.3	0	0	**39.3**
Southern Right Whale - Australia	8	6	0	10	2	5	5	0	3.3	0	**39.3**
Southern Elephant Seal - Australia	0	10	4	5	6	3	3	0	3.3	0	**34.3**
Fin Whale - Area V	5	6	0	10	0	5	4	3.3	0	0	**33.3**
Humpback Whale - Area V	4	6	1	5	2	5	3	3.3	3.3	0	**32.6**
Blue Whale - ssp. *brevicauda*, Area V	8	6	0	5	0	5	5	3.3	0	0	**32.3**
Australian Fur-seal - Australia	2	6	4	5	6	3	3	0	3.3	0	**32.3**
Indo-Pacific Humpbacked Dolphin - Australia	4	8	1	5	0	5	5	0	0	3.3	**31.3**
Australian Sea-lion - Australia	4	6	1	5	2	5	3	0	3.3	0	**29.3**
Sei Whale - Area V	6	6	0	8	0	5	3	0	0	0	**28**
Sperm Whale - Area V	2	6	0	5	0	5	5	3.3	0	0	**26.3**
Dugong - Australia	0	10	1	2	0	5	5	3.3	0	0	**26.3**
New Zealand Fur-seal - Australia	2	6	1	5	2	3	3	0	3.3	0	**25.3**
Spinner Dolphin - Area V	2	8	0	2	0	5	5	0	0	0	**22**
Strap-toothed Beaked Whale - Area V	5	2	0	0	0	5	5	3.3	0	0	**20.3**
Gray's Beaked Whale - Area V	5	2	0	0	0	5	5	3.3	0	0	**20.3**
Andrew's Beaked Whale - Area V	5	2	0	0	0	5	5	3.3	0	0	**20.3**
Ginkgo-toothed Beaked Whale - Area V	5	2	0	0	0	5	5	3.3	0	0	**20.3**
Bryde's Whale - pygmy form, Area V	5	2	0	2	0	5	5	0	0	0	**19**
Risso's Dolphin - Area V	2	2	0	0	0	5	5	3.3	0	0	**17.3**
Long-finned Pilot Whale - Area V	2	2	0	0	0	5	5	3.3	0	0	**17.3**
Short-finned Pilot Whale - Area V	2	2	0	0	0	5	5	3.3	0	0	**17.3**
Southern Bottlenose Whale - Area V	2	2	0	0	0	5	5	3.3	0	0	**17.3**
Arnoux's Beaked Whale - Area V	5	2	0	0	0	5	5	0	0	0	**17**
Pygmy Sperm Whale - Area V	3	2	0	0	0	5	3	3.3	0	0	**16.3**
Dwarf Sperm Whale - Area V	3	2	0	0	0	5	3	3.3	0	0	**16.3**
Pygmy Right Whale - Area V	3	2	0	0	0	5	3	3.3	0	0	**16.3**
Killer Whale - Area V	2	2	0	2	0	5	5	0	0	0	**16**
Minke Whale - diminutive form, Area V	4	2	0	0	0	3	3	0	0	0	**16**
Blainville's Beaked Whale - Area V	3	2	0	0	0	5	5	0	0	0	**15**
Bottlenose Dolphin - *truncatus* form, Australia	0	2	0	2	0	5	5	0	0	0	**14**
Bottlenose Dolphin - *aduncus* form, Australia	0	2	0	2	0	5	5	0	0	0	**14**
Pantropical Spotted Dolphin - Area V	2	2	0	0	0	5	5	0	0	0	**14**
Striped Dolphin - Area V	2	2	0	0	0	5	5	0	0	0	**14**
Southern Right Whale Dolphin - Area V	2	2	0	0	0	5	5	0	0	0	**14**
Melon-headed Whale - Area V	2	2	0	0	0	5	5	0	0	0	**14**
Pygmy Killer Whale - Area V	2	2	0	0	0	5	5	0	0	0	**14**
False Killer Whale - Area V	2	2	0	0	0	5	5	0	0	0	**14**
Cuvier's Beaked Whale - Area V	2	2	0	0	0	5	5	0	0	0	**14**
Dusky Dolphin - Area V	2	2	1	0	0	5	3	0	0	0	**13**
Rough-toothed Dolphin - Area V	2	2	0	0	0	5	3	0	0	0	**12**
Fraser's Dolphin - Area V	2	2	0	0	0	5	3	0	0	0	**12**
Minke Whale - dark-shoulder form, Area V	0	2	0	0	0	3	3	3.3	0	0	**11.3**
Common Dolphin - Area V	0	2	0	0	0	5	3	0	0	0	**10**
Crab-eater Seal - Area V	0	2	0	0	0	3	1	3.3	0	0	**9.3**
Leopard Seal - Area V	0	2	0	0	0	3	3	0	0	0	**8**

5. Conclusions

A large variety of marine mammal species have been recorded in NSW, including a mixture of cold-water and warm-water species. However, most of the species are only occasional visitors or stragglers to the narrow strip of coastal waters that lies within NSW jurisdiction. Many species are only known in NSW from strandings. None of the species is restricted to NSW. Most have very wide distributions. The 44 species of marine mammals considered in this review include only one endemic Australian species, the Australian Sea-lion, and one endemic subspecies, the Australia Fur-seal.

The review has indicated a number of changes to the current listings of marine mammal species in the Threatened Species Conservation Act that warrant consideration by the NSW Scientific Committee:

- ***Blue Whale.*** Only subspecies *musculus* is currently listed in the Act. There have been no confirmed records of subspecies *brevicauda* in NSW, but it is likely to occur and recent Blue Whale sightings in NSW waters may be entirely or mostly this subspecies. The conservation status of subspecies *brevicauda* has been a matter of increasing concern in recent years following revelations of much higher levels of exploitation by whalers than previously thought. Listing of the Blue Whale as an endangered species is warranted, not just subspecies *musculus*.

- ***Fin Whale and Sei Whale.*** Both are currently listed as vulnerable species, but there have been no confirmed records of either in NSW. If they do occur it would only be as occasional vagrants. In light of the NSW Scientific Committee's view that neither unconfirmed species nor vagrant species are eligible for listing, both species should be delisted. They would still be protected in NSW waters as vulnerable species under the Commonwealth Environment Protection and Biodiversity Conservation Act.

- ***Indo-Pacific Humpbacked Dolphin and Spinner Dolphin.*** Both are currently listed as vulnerable species. However, they are only rare vagrants to NSW (three records for the Indo-Pacific Humpbacked Dolphin and six records for the Spinner Dolphin). Neither species occurs with sufficient consistency to warrant listing in the Act.

- ***Australian Fur-seal and New Zealand Fur-seal.*** Not considered threatened at national level, but the small NSW populations of both species warrant listing as vulnerable in NSW. Both are regular visitors to NSW and concentrated at Montagu Island, the main haul-out site. The numbers at Montagu Island are small (maximum reported counts for the two species of 305 and 30, respectively) and there are several factors that could potentially threaten the long-term viability of the site.

- ***Dugong.*** Warrants listing as a vulnerable species. Although Dugongs are usually only rare vagrants to NSW, the large temporary influx of animals in 1992-93 following catastrophic losses of seagrass beds at Hervey Bay shows that NSW waters can play an occasional role as a temporary refuge area for Queensland animals. There have been major population declines in Queensland in both the Hervey Bay and southern Great Barrier Reef regions in recent years, and the

species is classified as vulnerable in the Queensland Nature Conservation Act.

A variety of potential threatening processes have been identified for marine mammals in NSW and adjacent Australian waters, but not enough information is available to make a proper assessment of the impact of these threats. None is sufficiently well documented to warrant a nomination for listing as a key threatening process in the Threatened Species Conservation Act at this stage. However, they are matters of concern and require further investigation. A particular concern is the unknown level of marine mammal bycatch in fisheries operating in NSW and adjacent Australian waters.

Acknowledgements

Dr Mike Fleming was the project manager for this consultancy and I am grateful for his assistance. I also gratefully acknowledge the information and assistance provided by Dr Graham Ross, Milena Rafic, Geoff Larmour and Susie Edwards of Environment Australia, David Paton, Dr Fiona Mandelc, Kelly Waples, Murray Ellis and David Coote of NSW National Parks and Wildlife Service, Dr Peter Corkeron of James Cook University, Dr Sandy Ingleby of the Australian Museum, Samantha Fulton of ORRCA, and Jenny Drenkhahn of the Eden Killer Whale Museum.

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Appendix 1. Conservation priority scoring process of Millsap et al. (1990)

Biological variables and categories within variables	Assigned points
1. Population size - the estimated number of adults throughout the range of the taxon.	
(a) 0-500 individuals	10
(b) 501-1000 individuals, or population size is unknown but suspected to be small	8
(c) 1001-3000 individuals	6
(d) 3001-10 000 individuals	4
(e) 10 001-50 000 individuals, or size is unknown but suspected to be large	2
(f) >50 000 individuals	0
2. Population trend - overall trend in number of individuals throughout taxon's range over last two decades (or other appropriate time interval considering taxon's generation time)	
(a) Population size known to be decreasing	10
(b) Trend unknown but population size suspected to be decreasing	8
(c) Population formerly experienced serious declines but is presently stable or increasing	6
(d) Population size stable or suspected to be stable or increasing	2
(e) Population size known to be increasing	0
3. Range size - the size of area over which the taxon is distributed during the season when distribution is most restricted	
(a) <100 km^2	10
(b) 101-1000 km^2	9
(c) 1001-40 000 km^2	7
(d) 40 001-100 000 km^2	4
(e) 100 001-2 000 000 km^2	1
(f) >2 000 000 km^2	0
4. Distribution trend - % change (since European settlement) in area occupied by the taxon (this is an estimate of change in the portion of the total range that is occupied or utilised; it may not equal the change in total range - for marine mammals it was often assessed from the % change in population size)	
(a) Area occupied has declined by 90-100%	10
(b) Area occupied has declined by 75-89%	8
(c) Area occupied has declined by 25-74%	5
(d) Area occupied has declined by 1-24%	2
(e) Area occupied is stable or has increased	0
5. Population concentration - degree to which individuals within populations congregate or aggregate seasonally or daily at specific locations (implies a regular temporal compression of the distribution independent of factors considered in variables 3 and 4 above)	
(a) Majority concentrates at single location	10
(b) Concentrates at 1-25 locations	6

Biological variables and categories within variables	Assigned points
(c) Concentrates at >25 locations	2
(d) Does not concentrate	0
6. Reproductive potential for recovery - ability of the taxon to recover from serious declines in population size	
(A) Average number of eggs or live young produced per adult female per year	
(a) <1 offspring per female per year	5
(b) 1-9 offspring per female per year	3
(c) 10-100 offspring per female per year	1
(d) >100 offspring per female per year	0
(B) Minimum age at which females typically first reproduce	
(a) >8 years	5
(b) 4-8 years	3
(c) 2-3 years	1
(d) <2 years	0
7. Ecological specialisation - degree to which the taxon is dependent upon certain environmental factors	
(A) Dietary specialisation - choices below relate to the primary way in which local populations respond to decreases in availability of preferred food type	
(a) Number of individuals declines; no substantial shift in diet	3.3
(b) Substantial shift in diet with little change in number of individuals	0
(B) Reproductive specialisation - choices below relate to the primary way in which local populations respond to decreases in availability of preferred breeding sites	
(a) Number of individuals or number of breeding attempts declines but no substantial shift to other breeding sites	3.3
(b) Substantial shift to alternate breeding sites with little change in number of individuals	0
(C) Other specialisations - ecological or behavioural specialisations not covered in variables 7A or 7B	
(a) Highly specialised	3.3
(b) Moderately specialised	1.7
(c) Not specialised	0

Appendix 2. Additional marine mammal records for NSW not listed in Atlas of NSW Wildlife

Scientific name	Common name	Date	Location	No.	Notes	Source
Arctocephalus forsteri	New Zealand Fur-seal	10/07/1990	Sawtell	1	Hauled out injured, taken to Pet Porpoise Pool for rehabilitation, released to sea on 23/01/91, 1m male pup	Pet Porpoise Pool report to Environment Australia
Arctocephalus forsteri	New Zealand Fur-seal	25/07/1990	Scotts Head	1	Hauled out injured, taken to Pet Porpoise Pool for rehabilitation, released to sea on 23/01/91, 1m male pup	Pet Porpoise Pool report to Environment Australia
Arctocephalus forsteri	New Zealand Fur-seal	04/08/1990	Yamba	1	Hauled out injured, taken to Pet Porpoise Pool for rehabilitation but died, 1m male pup	Pet Porpoise Pool report to Environment Australia
Arctocephalus forsteri	New Zealand Fur-seal	Winter 1993	Sydney Harbour, ranging between Shark Island and Watsons Bay	1	First seen 23/07/1993, stayed for a couple of weeks, 3m male	ORRCA Newsletter Winter 1993
Arctocephalus forsteri	New Zealand Fur-seal	Winter 1997	Sydney Harbour	1	Stayed for several weeks	ORRCA 1998 Seal Newsletter
Arctocephalus pusillus	Australian Fur-seal	04/09/1990	Port Macquarie	1	Hauled out injured, taken to Pet Porpoise Pool for rehabilitation but died, 1m male pup	Pet Porpoise Pool report to Environment Australia
Arctocephalus tropicalis	Subantarctic Fur-seal	Winter 1997	Kioloa	1	Stayed for some time	ORRCA 1998 Seal Newsletter
Arctocephalus tropicalis	Subantarctic Fur-seal	Winter 1996	Between Queens Head and Crescent Head	1	Seen 6-7 times; different animal to the ones that hauled out at Port Macquarie and Camden Head during the same season	ORRCA 1998 Seal Newsletter
Balaenoptera edeni	Bryde's Whale	06/09/1999	Toowoon Bay	1	Live stranding, 4.1m calf, returned to sea	ORRCA Newsletter Winter 1999
Berardius arnuxii	Arnoux's Beaked Whale	28/05/1997	35°32'S, 150°44'E, c.13km east of Brush Island	1	Skull and rib dragged up in trawl net	Specimen at Australian Museum
Caperea marginata	Pygmy Right Whale	Unknown	Twofold Bay	1	Undated specimen held at Australian Museum	Pavey (1992)
Delphinus delphis	Common Dolphin	1962-64	Seal Rocks	15	Mass stranding of 15 animals, 6 of which got themselves back to sea unaided	Dawbin (1964)
Delphinus delphis	Common Dolphin	January 1971	Twofold Bay	c.40	Mass stranding of about 40 animals, of which 4-6 died before the rest were eventually returned to the sea	Warneke (1996)
Delphinus delphis	Common Dolphin	21/04/1995	Shark net off Sydney	1	Dead after being caught in net 2-3 days earlier, 2.09m female	ORRCA Newsletter Spring 1995
Delphinus delphis	Common Dolphin	21/09/1995	Sydney Harbour	1	Dead stranding, 1.41m female	ORRCA report to Environment Australia
Delphinus delphis	Common Dolphin	22/09/1996	Honeymoon Bay	1	Live stranding, died same day, 1.14m male calf	ORRCA Newsletter Summer 1997
Delphinus delphis	Common Dolphin	27/11/1996	Currarong Beach	1	Live stranding, euthanased on 29/11/96, 1.79m female	ORRCA Newsletter Summer 1997
Delphinus delphis	Common Dolphin	15/12/1996	Dee Why Beach	1	Dead stranding, extensively damaged	ORRCA Newsletter Summer 1997

Scientific name	Common name	Date	Location	No.	Notes	Source
Delphinus delphis	Common Dolphin	21/12/1996	Foreshore Road, Botany Bay	1	Live stranding, died same day, calf just over 1m long	ORRCA Newsletter Summer 1997
Delphinus delphis	Common Dolphin	Feb-Mar 1998	Central Coast, offshore in net	1	Dead in net, had been dead for several days, even weeks	ORRCA Newsletter Autumn 1998
Delphinus delphis	Common Dolphin	17/12/1998	The Entrance Beach	1	Dead stranding, extremely bloated, 2.38m male	ORRCA Newsletter Summer 1999
Delphinus delphis	Common Dolphin	22/08/2000	Flint and Steel Beach	1	Dead stranding, 2.0m female	ORRCA Newsletter Summer 2000/01
Delphinus delphis	Common Dolphin	07/11/2000	Newport Beach	1	Dead stranding, 1.0m male calf, very young	ORRCA Newsletter Summer 2000/01
Dugong dugon	Dugong	23/03/1980	Manly Cove	1	Dead stranding, sub-adult male	Taronga Zoo report to Environment Australia
Dugong dugon	Dugong	Jan 2000	Hastings River near Port Macquarie	1	Seen on several occasions over a couple of days	ORRCA Newsletter Summer 2000
Eubalaena australis	Southern Right Whale	11/10/1978	Wollongong	2	Sighting of mother and calf	Robinson (1984)
Eubalaena australis	Southern Right Whale	5/08/79 to 4/09/79	Thirroul to Kiama	2	Sightings of mother and calf	Robinson (1984)
Eubalaena australis	Southern Right Whale	17/09/1979	South Beach, Wollongong	1	Sighting of lone animal, believed to be different to the above mother and calf	Robinson (1984)
Eubalaena australis	Southern Right Whale	29-30/08/80	Wollongong to Gerroa	2	Sightings of mother and calf	Robinson (1984)
Eubalaena australis	Southern Right Whale	11-17/08/81	Kiama to Austinmer	1	Sightings of single animals	Robinson (1984)
Eubalaena australis	Southern Right Whale	19/09/1983	Coledale Beach	2	Sighting of mother and calf	Robinson (1984)
Eubalaena australis	Southern Right Whale	June 1991	Off Cape Byron	1	Sighting of single animal	Australian Whale Conservation Society report to Environment Australia
Eubalaena australis	Southern Right Whale	17/07/1993	Norah Head	1	Dead stranding, 5.0m male	ORRCA Newsletter Winter 1993
Eubalaena australis	Southern Right Whale	24/07/1997	Off Woolgoolga	3	Sighting of 2 adults and a calf	*Coffs Harbour Advocate* 29/07/97
Feresa attenuata	Pygmy Killer Whale	04/11/1999	Dee Why Beach	1	Dead stranding, 2.6m male	ORRCA Newsletter Spring 1999
Globicephala macrorhynchus	Short-finned Pilot Whale	29/04/1997	Stockton Beach	1	Live stranding, died during night, 3.8m female	ORRCA Newsletter Summer 1998
Globicephala macrorhynchus	Short-finned Pilot Whale	16/01/1998	Lighthouse Beach	3	Live stranding, euthanased that evening, 3.58m female, 3.07m female, 2.17m male	ORRCA Newsletter Autumn 1998
Globicephala macrorhynchus	Short-finned Pilot Whale	12/04/2000	Bundjalung National Park	1	Live stranding	NPWS Coordinator Wildlife Management
Grampus griseus	Risso's Dolphin	26/12/1999	Bombo Beach, Kiama	1	Dead stranding, 2.9m male	ORRCA Newsletter Summer 2000
Grampus griseus	Risso's Dolphin	11/03/2000	Terrigal Beach	1	Live stranding, returned to sea	ORRCA Newsletter Autumn 2000
Hydrurga leptonyx	Leopard Seal	04/09/1990	Port Macquarie	1	Hauled out injured, captured on 6/09/90 but died during transport to Pet Porpoise Pool	Pet Porpoise Pool report to Environment Australia
Hydrurga leptonyx	Leopard Seal	09/09/1990	Ballina	1	Hauled out injured, captured for treatment but died on beach	Pet Porpoise Pool report to Environment Australia

Scientific name	Common name	Date	Location	No.	Notes	Source
Kogia breviceps	Pygmy Sperm Whale	07/11/1988	5.8km north of Hawks Nest	1	Dead stranding, very decomposed, female	Australian Museum report to Environment Australia
Kogia breviceps	Pygmy Sperm Whale	20/08/1997	Newport	1	Dead stranding, 3.17m female	ORRCA Newsletter Summer 1998
Kogia breviceps	Pygmy Sperm Whale	18/02/1998	Iluka	1	Live stranding, euthanased	NPWS report to Environment Australia
Kogia breviceps	Pygmy Sperm Whale	01/03/1998	Port Macquarie	1	Dead stranding	NPWS report to Environment Australia
Kogia breviceps	Pygmy Sperm Whale	23/09/1998	Yuraygir National Park	1	Live stranding, euthanased	NPWS report to Environment Australia
Kogia breviceps	Pygmy Sperm Whale	19/11/1998	One Mile Beach, Forster	1	Dead stranding, 2.86m female	ORRCA Newsletter Summer 1999
Kogia breviceps	Pygmy Sperm Whale	26/02/1999	Empire Vale Beach	1	Live stranding, euthanased	NPWS report to Environment Australia
Kogia breviceps	Pygmy Sperm Whale	31/07/1999	Lighthouse Beach	1	Stranding	NPWS report to Environment Australia
Kogia simus	Dwarf Sperm Whale	20/08/1991	Sandy Beach, c.20km north of Coffs Harbour	1	Live stranding, taken to Pet Porpoise Pool for rehabilitation, eventually died on 25/08/91, 1.2m juvenile female	Pet Porpoise Pool report to Environment Australia
Kogia simus	Dwarf Sperm Whale	07/05/1996	Hawks Nest Beach	2	Stranding, 1.6m female alive, euthanased, 2.3m female dead	ORRCA Newsletter Winter 1996
Lagenodelphis hosei	Fraser's Dolphin	23/06/1999	Tallow Creek	1	Dead stranding, 2.3m female	Specimen at Australian Museum
Megaptera novaeangliae	Humpback Whale	24/11/1994	Tyagarah just north of Cape Byron	1	Dead stranding, calf	NPWS report to Environment Australia
Megaptera novaeangliae	Humpback Whale	27/07/1997	Off Bonville Beach	2	Female gave birth and was seen with calf for two days	Pet Porpoise Pool report to Environment Australia
Megaptera novaeangliae	Humpback Whale	21/08/1997	Shores Bay, Richmond River, Ballina	1	Live stranding, died same day, 4m male calf	Pet Porpoise Pool report to Environment Australia
Megaptera novaeangliae	Humpback Whale	31/08/1998	Eden	1	Dead stranding	NPWS report to Environment Australia
Megaptera novaeangliae	Humpback Whale	15/07/1999	Stockton Beach	1	Dead stranding	NPWS report to Environment Australia
Megaptera novaeangliae	Humpback Whale	23/11/1999	Port Macquarie	1	Dead stranding	NPWS report to Environment Australia
Megaptera novaeangliae	Humpback Whale	09/06/2000	Port Macquarie	1	Entangled in net, released	NPWS Coordinator Wildlife Management
Megaptera novaeangliae	Humpback Whale	09/07/2000	Warringah	1	Entangled in net, released	NPWS Coordinator Wildlife Management
Megaptera novaeangliae	Humpback Whale	31/07/2000	Shelley Headland, Yuraygir National Park	1	Dead stranding	NPWS Coordinator Wildlife Management
Megaptera novaeangliae	Humpback Whale	19/09/2000	Great Lakes	1	Entangled, released	NPWS Coordinator Wildlife Management

Scientific name	Common name	Date	Location	No.	Notes	Source
Mesoplodon grayi	Gray's Beaked Whale	14/01/1999	Budgewoi	1	Live stranding, died same day, 4m male	ORRCA Newsletter Summer 1999
Mesoplodon grayi	Gray's Beaked Whale	15/01/1999	Redhead Beach	1	Dead stranding, 3.9m male	ORRCA Newsletter Summer 1999
Mesoplodon grayi	Gray's Beaked Whale	05/04/1999	Tura Beach	1	Dead stranding	NPWS report to Environment Australia
Mesoplodon layardii	Strap-toothed Beaked Whale	July 1923	About 7 km north of Broken Bay	1	Skull at Australian Museum	Dixon (1980)
Mirounga leonina	Southern Elephant Seal	04/02/1996	Jervis Bay	1	Sighting	ORRCA Newsletter Autumn 1996
Mirounga leonina	Southern Elephant Seal	06/02/1996	Windang Island	1	Sighting	ORRCA Newsletter Autumn 1996
Mirounga leonina	Southern Elephant Seal	07/02/1996	Coalcliff and Stanwell Park	1	Sightings	ORRCA Newsletter Autumn 1996
Mirounga leonina	Southern Elephant Seal	08/02/1996	North Bondi and Vaucluse	1	Captured at Vaucluse on 9/02/96 for rehabilitation at Taronga Zoo, where it was eventually euthanased, young female	ORRCA Newsletter Autumn 1996
Orcinus orca	Killer Whale	05/07/1995	Off Cape Byron	4	Pod sighted travelling north, one adult male and 3 females or subadult males	NPWS report to Environment Australia
Orcinus orca	Killer Whale	10/10/1995	Off Cape Byron	12	Pod sighted travelling south	NPWS report to Environment Australia
Orcinus orca	Killer Whale	15-16/08/98	Off Eden	7	Pod sighted on two consecutive days	Pacific Whale Foundation report to Environment Australia
Peponocephala electra	Melon-headed Whale	10/02/1994	Sandon River	1	Live stranding, taken to Pet Porpoise Pool for rehabilitation, released to sea on 13/02/94	Garbett (1996)
Peponocephala electra	Melon-headed Whale	05/02/1995	South West Rocks	1	Live stranding, taken to Pet Porpoise Pool for rehabilitation, euthanased 6/02/95, juvenile male	Pet Porpoise Pool report to Environment Australia
Peponocephala electra	Melon-headed Whale	06/02/1995	Collaroy Beach	1	Live stranding, towed out to sea but restranded at Budgewoi and euthanased, 2.3m male	Pet Porpoise Pool report to Environment Australia
Peponocephala electra	Melon-headed Whale	22/02/1997	Seven Mile Beach, Booti Booti	1	Live stranding, euthanased on 23/02/97, 2.6m female	Pet Porpoise Pool report to Environment Australia
Physeter macrocephalus	Sperm Whale	14/01/1994	Stockton Beach	1	Dead stranding, very young calf, seen and identified by Stephen Barry, but washed back to sea before it could be retrieved	ORRCA Newsletter Summer 1994
Physeter macrocephalus	Sperm Whale	23/10/1996	8km south Birubi Beach	1	Dead stranding, advanced decomposition, 11.2m long	ORRCA Newsletter Summer 1997
Physeter macrocephalus	Sperm Whale	Apr-Jul 1997	Wreck Bay	1	Dead stranding	ORRCA Newsletter Summer 1998

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Physeter macrocephalus	Sperm Whale	June 1997	Mara Creek, Angourie Point	1	Dead stranding, skull	Pet Porpoise Pool report to Environment Australia
Physeter macrocephalus	Sperm Whale	18/02/1998	Yuraygir National Park	1	Live stranding, euthanased, calf	NPWS report to Environment Australia
Physeter macrocephalus	Sperm Whale	23/02/1998	Iluka	1	Live stranding, euthanased, newborn calf	NPWS report to Environment Australia
Physeter macrocephalus	Sperm Whale	21/03/1998	Buckleys Beach	1	Dead stranding, 3.47m female newborn calf	ORRCA Newsletter Autumn 1998
Physeter macrocephalus	Sperm Whale	05/04/1998	Terrigal	1	Live stranding, died 6/04/98, 3.058m male calf	ORRCA Newsletter Autumn 1998
Physeter macrocephalus	Sperm Whale	27/03/2000	Currarong Beach	1	Dead stranding	NPWS Coordinator Wildlife Management
Pseudorca crassidens	False Killer Whale	16/10/1995	Sharpes Beach near Lennox Head	1	Live stranding, taken to Sea World for rehabilitation, eventually released off Southport, 5.25m male	Pet Porpoise Pool and Sea World reports to Environment Australia
Pseudorca crassidens	False Killer Whale	10/01/1997	South Birubi Beach	1	Live stranding, died same day, 1.65m newborn female calf	ORRCA Newsletter Summer 1997
Pseudorca crassidens	False Killer Whale	16/05/1997	North Minnie Water Beach	1	Dead stranding, 4.2m female	Pet Porpoise Pool report to Environment Australia
Pseudorca crassidens	False Killer Whale	24/05/1997	Yadda Beach near Jervis Bay	1	Live stranding, successfully returned to sea, calf	ORRCA Newsletter Winter 1997
Sousa chinensis	Indo-Pacific Humpbacked Dolphin	19th century	Wollongong	1	Skull at Cambridge Museum, UK	Baker (1990)
Stenella attenuata	Pantropical Spotted Dolphin	11/02/1998	Stockton Beach	1	Dead stranding, 2.006m male	ORRCA Newsletter Autumn 1998
Stenella coeruleoalba	Striped Dolphin	03/05/2000	Junction of Sussex Inlet and St Georges Basin	1	Seen in difficulties, rehabilitation attempted but animal died, c.1.5m	ORRCA Newsletter Autumn 2000
Tursiops truncatus	Bottlenose Dolphin	04/12/1990	Ocean View Beach, Mullaway	1	Dead stranding, 1.2m long	Pet Porpoise Pool report to Environment Australia
Tursiops truncatus	Bottlenose Dolphin	22/03/1992	Tuncurry	1	Died when caught in shark net at rock pool, 1.75m female	*Great Lakes Advocate* 25/03/1992
Tursiops truncatus	Bottlenose Dolphin	15/09/1992	Merimbula	1	Live stranding, pushed back to sea by people unknown	ORRCA Newsletter Autumn 1993
Tursiops truncatus	Bottlenose Dolphin	07/08/1993	Harrington Beach	1	Live stranding, calf, returned to sea by volunteers	Environment Australia strandings summary for 1993
Tursiops truncatus	Bottlenose Dolphin	06/11/1993	Coffs Harbour	1	Dead stranding, female	Environment Australia strandings summary for 1993
Tursiops truncatus	Bottlenose Dolphin	23/01/1994	Minnie Water	1	Live stranding, taken to Pet Porpoise Pool for rehabilitation but died, newborn female calf	Garbett (1996)
Tursiops truncatus	Bottlenose Dolphin	Sept 1994	Halfway between Byron Bay and Brunswick Heads	1	Dead stranding	Garbett (1996)
Tursiops truncatus	Bottlenose Dolphin	05/11/1994	Corindi	1	Dead stranding	Garbett (1996)

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Tursiops truncatus	Bottlenose Dolphin	12/08/1995	Towra Point	1	Dead stranding, 2.46m male	ORRCA Newsletter Spring 1995
Tursiops truncatus	Bottlenose Dolphin	20/09/1995	Grassy Head	1	Dead stranding, 1.56m female	ORRCA report to Environment Australia
Tursiops truncatus	Bottlenose Dolphin	c.28/12/95	Ballina	1	Dead stranding, male calf	NPWS report to Environment Australia
Tursiops truncatus	Bottlenose Dolphin	29/09/1996	McMasters Beach	1	Dead stranding, 1.01m female calf	ORRCA Newsletter Summer 1997
Tursiops truncatus	Bottlenose Dolphin	28/11/1996	NW corner of Wallis island	1	Dead stranding, 2.4m female	ORRCA Newsletter Summer 1997
Tursiops truncatus	Bottlenose Dolphin	30/11/1996	Budgewoi Beach	1	Dead stranding, advanced decomposition, 2.9m male	ORRCA Newsletter Summer 1997
Tursiops truncatus	Bottlenose Dolphin	22/07/1997	Port Stephens	1	Dead stranding, 2.4m male	ORRCA Newsletter Summer 1998
Tursiops truncatus	Bottlenose Dolphin	08/08/1997	Port Stephens	1	Dead stranding, 2.2m female	ORRCA Newsletter Summer 1998
Tursiops truncatus	Bottlenose Dolphin	09/10/1997	Woolgoolga	1	Live stranding, died on beach, male	Pet Porpoise Pool report to Environment Australia
Tursiops truncatus	Bottlenose Dolphin	09/11/1997	Woolgoolga	1	Dead stranding, had been seen earlier swimming offshore, male calf	Pet Porpoise Pool report to Environment Australia
Tursiops truncatus	Bottlenose Dolphin	21/01/1998	Angourie	1	Dead stranding	NPWS report to Environment Australia
Tursiops truncatus	Bottlenose Dolphin	19/05/1998	South Ballina	1	Dead stranding	NPWS report to Environment Australia
Tursiops truncatus	Bottlenose Dolphin	08/06/1998	Port Stephens	1	Dead stranding	NPWS report to Environment Australia
Tursiops truncatus	Bottlenose Dolphin	22/01/2000	Raymond Terrace	1	Dead stranding	NPWS Coordinator Wildlife Management
Tursiops truncatus	Bottlenose Dolphin	02/03/2000	Nambucca Heads	1	Live stranding, euthanased	NPWS Coordinator Wildlife Management
Tursiops truncatus	Bottlenose Dolphin	07/08/2000	Brunswick River	1	Live stranding, returned to sea	NPWS Coordinator Wildlife Management
Tursiops truncatus	Bottlenose Dolphin	24/10/2000	Wollongong	1	Dead in shark net	NPWS Coordinator Wildlife Management
Tursiops truncatus	Bottlenose Dolphin	09/11/2000	Gosford	1	Live stranding, died	NPWS Coordinator Wildlife Management
Ziphius cavirostris	Cuvier's Beaked Whale	before 1885	Sydney	1	Specimen	Beneden (1885)