

An Overview of Recent Marine Mammal Research in Australia

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Abstract In the 16 years since John Ling published an overview of cetacean research in Australia, there has been considerable information emerge on the biology of marine mammals. Several books have been published, and workshops held, reviewing aspects of marine mammal biology in Australia. For cetaceans, there have been numerous studies on live animals, human impacts and ecology. Some museum collections have expanded considerably yet there are many difficulties in funding museum work. For pinnipeds, there is a good knowledge of distribution and abundance. There have been recent attempts by the Australian government to co-ordinate data and specimen collecting from stranded marine mammals. Research into animal husbandry and medicine of marine mammals is restricted to the few oceanaria that still keep cetaceans and pinnipeds. Two dugongs are captive, with some information available on husbandry, growth and development. Collecting data on the pathology and toxicology of wild marine mammals has been carried out by some researchers but correlating the two is difficult because of specimen decomposition in most cases. Some new information on the anatomy and physiology of Australian marine mammals has been made available in recent years. One of the areas of increasing research effort is that of natural history and ecology. Diet has been researched in traditional and new ways, with a view to understanding the trophic position that pinnipeds hold in the ecosystem and the possibility of competition with commercial fisheries. Considerable emphasis has been placed in recent years on research that will benefit species management, in particular the direct and indirect effects of human activities. Workshops are held to refine ways of disentangling large whales but little effort is made to research ways of avoiding small cetacean entanglements. Studies have been made of dolphin/finfish farm entanglements and some recommendations adopted on how to reduce mortalities. A growing field of pinniped research involves determining the future impact of the increasing population of the New Zealand Fur Seal on commercial fisheries and finfish aquaculture. Taxonomic research includes morphologic and genetic studies of Australian marine mammals. Recent examples include: *Orcaella*, *Tursiops*, *Delphinus* and *Balaenoptera acutorostrata* (dwarf form) with studies in progress on *Sousa*. Members of the family Otariidae have been revised in a world-wide context.

Key words: marine mammal, cetacea, sirenia, pinipedia, research overview.

Introduction

There has been much activity in the field of marine mammal research in Australia since the late 1980s when John Ling (1988) published his overview of cetacean research. Several field and regional guides, specifically on marine mammals or Australian mammals in general, have appeared (Judd *et al.*, 1992; Bannister, 1995; Bryden, Marsh and Shaughnessy, 1998; Gill and Burke, 1999; Menkhorst and Knight, 2004) and two ‘action plans’ have been commissioned by the Australian Government (Bannister *et al.*, 1996; Shaughnessy, 1999). Two symposia on South-

ern Hemisphere marine mammal research have taken place with publications arising out of each (Hindell and Kemper, 1997; Gales *et al.*, 2003). The Queensland Museum hosted symposia on humpback whales and published proceedings of these in 1991 and 2001 (Jell and Paterson, 1991; Jell, 2001).

A number of workshops were convened by the Australian Government, with the assistance of non-government organisations. Some workshops were on specific subjects such as disentanglement, Southern Right Whale photo-identification and data analysis (Adelaide in 2002 and 2004 (Anon, 2004)), and strandings (Jervis Bay in 1996 (Anon, 1996), Sydney in 2004 (Kindleysides *et al.*, 2004)). Others were of a more comprehensive nature such as 'Conserving Whales and Dolphins in Australian Waters: National Research Partnerships Workshop' (Ballina, New South Wales in 2004). The latter were particularly important because they brought together policy makers, operational personnel and researchers to discuss management issues and possible solutions. They also have helped to determine priority areas for future research.

The following overview broadly follows the pattern adopted by Ling (1988) with some additional topics. It includes research on cetaceans, pinnipeds and dugongs, and is not intended to be a comprehensive review of these subjects.

Husbandry, Medicine and Strandings (including Parasitology and Toxicology)

There are few facilities housing live marine mammals in Australia and for this reason, limited research is carried out on captive animal husbandry and medicine. The largest oceanarium is Sea World (south eastern Queensland), an institution that also supports marine mammal research through funding from the Sea World Research and Rescue Foundation. Sea World recently successfully reared two orphaned wild dugongs and in the process much was learned about this species' captive management (Anon, 2000). Some veterinary degrees offer courses in marine mammal pathology and husbandry (e.g. Rogers, 2000) but there is a need for more veterinarians to be trained in this specialised field.

The publication of Geraci and Lounsbury's (1993) guide to sampling marine mammal carcasses has given some impetus to collecting material from wild, dead animals in Australia in recent years. Stranding workshops held at Jervis Bay (Anon, 1996) and Sydney (Kindleysides *et al.*, 2004) emphasised the need to determine the cause of death and pathology of 'stranded' animals but the logistics of training professional staff and obtaining adequate funding are problematical. In addition, the remote nature of much of the large Australian coastline makes it difficult to obtain fresh specimens for study. It is likely to be some time before a co-ordinated national system is in place. At present, several states (South Australia, Tasmania, Queensland) have procedures for studying the pathology of stranded animals. A summary is available for cause of death of South Australian cetaceans (Kemper *et al.*, 2005) and forensic methods have been applied to mortalities involving human activities there (Byard *et al.*, 2001; in press). Evans *et al.* (2002) studied the age structure, reproductive status and behaviour of sperm whales in three mass strandings in Tasmania. An important area of research that has not yet been adequately covered is the study of carcasses obtained from by-catch in the fishing and aquaculture industries. This would provide valuable data on life history and pathology of several species of dolphins and pinnipeds. Some information is available on sex ratio, age composition and diet of Australian Fur Seals taken as by-catch in the blue grenadier fishery off the west coast of Tasmania (Tilzey *et al.*, 2004).

Cetacean stranding statistics have been compiled for Australia as a whole (Nicol, 1990) and

some states (Nicol and Croome, 1988; Kemper and Ling, 1991). Evans *et al.* (2005) concluded that strandings in southeastern Australia were related to cycles of large-scale climatic events. Debate continues about the issue of rescuing stranded cetaceans (Warneke, 2000; Ling, 2003) and most states have management plans for dealing with these events (e.g. Smith, 1987).

The field of toxicology is becoming increasingly important in Australia but there is little co-ordination of collecting and analysing samples from marine mammals. There is a real need for a national facility to study toxic contaminant levels and related pathology. Evans (2003) reviewed heavy metal and organochlorine levels in the southern hemisphere, including Australia, and since then a number of studies have been carried out on South Australian bottlenose dolphins and the Short-beaked Common Dolphin (Butterfield, 2003; 2006; Lavery, 2005).

The national Helminth collection at the South Australian Museum, Adelaide houses many of the available specimens of internal parasites of marine mammals but no published inventory has been made of its collections Arundel (1978) reviewed helminths found in Australian marine mammals. Parasites are routinely collected from pinniped and cetacean carcasses in South Australia. Research on the taxonomy and life cycles of marine parasites is much needed.

Anatomy and Physiology

With the cessation of whaling in Australia, detailed studies of anatomy and physiology of the great whales has been limited to what can be gleaned from stranded animals. Recent research includes studies on skeleton anatomy and variability (e.g. Kitchener *et al.*, 1990; Paterson and Van Dyck, 1996; Paterson *et al.*, 1997) and some organ anatomy (e.g. Quayle, 1991). Material from small cetaceans is being increasingly archived by museums and there is potential for life history research but few studies have been published. Kemper and Gibbs (1997; 2001) used the large collection of South Australian specimens to describe sexual and physical maturity and to create relative age categories for bottlenose and common dolphins. There is also a great deal of material in museums that could be used to accurately assess age for many Australian species but to date, little research has been carried out. A notable exception is the study of age structure and growth of female sperm whales that mass-stranded in Tasmania during the 1990s (Evans and Hindell, 2004a).

Fur seal skull growth and development, including sexual dimorphism and the functional importance of different features, has been studied by Brunner (1998a; b). Recent pinniped research has been concentrating on the physiology of animals in the wild (Slip *et al.*, 1994; Arnould and Hindell, 1999; Field *et al.*, 2005), particularly on Antarctic and Subantarctic species. New techniques are emerging for sampling live marine mammals, including those in the wild, for reproductive parameters using blowhole extracts (Hogg *et al.*, 2005).

There has been no further research on dugong physiology and anatomy of the dugong since the work of Marsh *et al.* (1984).

Natural History and Ecology

This aspect of marine mammal research, which includes diet, distribution, abundance and population structure has expanded more than any other in the last 15 years. In part, this has been as a result of new techniques for field research such as acoustics (McCauley and Cato, 2003) and telemetry but it is also driven by the need for information that will help determine species' conservation status and their interaction with fisheries and offshore mining (McCauley *et al.*, 1998).

For cetaceans, the most-studied have been endangered species (Blue Whale, Humpback Whale, Southern Right Whale) and bottlenose dolphins. Two nearshore aggregations of the Blue Whale (both presumed to be pygmy blues, subspecies *Balaenoptera musculus breviceauda*) have been discovered in Australian waters in the last 10 years and these are yielding important ecological information (Gill, 2002). Long-term monitoring of Humpback Whale abundance on its migration routes along the eastern and western coasts of the continent is showing that populations are increasing (Bannister and Hedley, 2001; Paterson *et al.*, 2004). Studies of Southern Right Whales have concentrated on the western half of southern Australia where there has been an increase in abundance in the last 20 years (Bannister, 2001). There is some evidence that the Australian 'population' may not be closed (Patenaude and Harcourt, 2002; Anon, 2004).

There are now at least eight locations in Australia where the ecology of wild bottlenose dolphins is being studied. The programme at Shark Bay, Western Australia, is the longest running (>20 years) and has produced some important results on behaviour and relationships within groups, for example male alliances (Conner *et al.*, 2000). These may apply to bottlenose dolphins world-wide. A number of studies have looked at the interaction between humans and dolphins, particularly the effects of tourist activities (Scarpaci *et al.*, 2003). Estimates of abundance of bottlenose dolphins have been made in most study areas but there is a need for wider ranging estimates so that the effect of mortality on conservation status is known. There is also a need for more ecological studies on threatened inshore dolphins, especially in northern Australia (Para *et al.*, 2004).

There is limited information on the distribution and abundance of pelagic species of cetaceans in Australian waters, although some sightings surveys have been carried out and published (Thiele *et al.*, 2000). One of the impediments is that such research is expensive and does not always yield many results.

The technique of photographic identification has paved the way for many new research projects on cetaceans. The two workshops convened by the Australian Government (Adelaide in 2002 and 2004) reviewed matching of callosity and other markings, and data-basing, of Southern Right Whales from Australia and New Zealand (Anon, 2004). Movements of individuals have been confirmed within Australia (Bannister, 2001; Burnell, 2001) as well as New Zealand (Anon, 2004) and the Antarctic (Bannister *et al.*, 1999). Several major photo-identification catalogues for Humpback Whales in Australian waters are being developed (Kaufman *et al.*, 1993). Matching unique markings on the dorsal fins of dolphins is the main method used to identify individuals in ecological studies (e.g. Mann *et al.*, 2000).

Research on the diet of marine mammals has been carried out using traditional methods (gastrointestinal tract contents, scat remains) on sperm whales (Evans and Hindell, 2004b), dolphins (Kemper and Gibbs, 2001) and pinnipeds (see review by Goldsworthy *et al.*, 2003). Satellite telemetry is proving a very useful technique for studying foraging of Australian pinnipeds (Harcourt and Davis, 1997; Arnould and Hindell, 2001). New techniques such as fatty acids (Best *et al.*, 2003) and isotope ratios are being investigated, with some promise that they will enhance our understanding of the role of marine mammals in Australian ecosystems, including inter-specific interactions (McKenzie *et al.*, 2005). This is particularly important because of the potential for competition with humans for the same resources and for understanding operational interactions (Shaughnessy *et al.*, 2003).

The study of pinniped ecology, distribution and abundance has been very active in Australia in the last 15 years. The three resident otariid species were heavily exploited during the late 18th and early 19th century (Ling, 1999; 2002) and it appears both the New Zealand and Australian

Fur Seals are now recovering (Gales *et al.*, 1994; Shaughnessy, 1999; Kirkwood *et al.*, 2005). The endemic Australian sea lion does not appear to be increasing in abundance (McKenzie *et al.*, 2005; Shaughnessy *et al.*, in press), although estimates of abundance are increasing slightly as more colonies are discovered and techniques for estimating it improve (Shaughnessy *et al.*, 2005).

There has been considerable research on the abundance of the dugong in Western Australia and Queensland (Marsh *et al.*, 2003; Gales *et al.*, 2004), and as a result, more is known about this species in Australia than anywhere else in its range. Abundance estimates have demonstrated substantial declines in southeast Queensland in recent years (Marsh *et al.*, 2003).

Management

In recent years there has been much emphasis on marine mammal research as it relates to managing wild populations and much of this is reviewed in Gales *et al.* (2003). The Action Plan for Australian Cetaceans (Bannister *et al.*, 1996) and Action Plan for Australian Seals (Shaughnessy, 1999) reviewed the conservation status of all species and recommended research priorities. For cetaceans, some of these recommendations have been adopted or are progressing e.g. disentanglement training, monitoring abundance of Southern Right Whales and Humpback Whales, photo-identification catalogues; while others have not been addressed e.g. uniform legislation relating to such things as co-ordination of archiving stranding data and samples, setting up an advisory body. One of the stumbling blocks in striving for uniformity across Australia and therefore a co-ordinated approach to conservation of marine mammals is the political system where responsibilities are divided between Federal and State bodies.

For pinnipeds, interactions with the fisheries have been identified as the major threatening process (Shaughnessy, 1999; Shaughnessy *et al.*, 2003) and there has been some research to identify and manage the problem (Goldsworthy *et al.*, 2003). However, it may be a difficult task to convince industry that pinnipeds are not competing in a major way for commercial fish at a time when some fur seal species are increasing (Shaughnessy, 1999) and many commercial fish stocks decreasing. In addition to problems with fisheries, fur seals and sea lions interact with finfish aquaculture to the detriment of seals and industry (Kemper *et al.*, 2003). As yet, culling has not been a management option in Australia, although from time to time there are calls for it to be implemented. Any management actions must take into account the often-complicated genetic population structure of some species (e.g. the Australian sea lion, Campbell, 2003).

Australia has a responsibility for conservation of the dugong because elsewhere in its range its status is tenuous (see review by Marsh *et al.*, 2003). Considerable effort has been made to halt the decline of dugongs in southeast Queensland, much of which is believed to be as a result of entanglement in nets and habitat loss (Preen and Marsh, 1995). Studies on the effect of coastal development by humans are needed. There is little monitoring of abundance along the coast of northern Australia where aboriginal hunting is permitted.

Taxonomy and Systematics

Marine mammal taxonomy can be problematical because species occur over large areas and specimens are hard to obtain. The combination of morphological and genetic techniques, and the collection of much new material, has resulted in some solutions to taxonomic problems in Australian cetaceans in recent years. There is now an endemic dolphin (*Orcaella heinshoni*, Beasley

et al., 2005) and taxonomic affinity has been confirmed for some other dolphin species (Bell *et al.*, 2002; Moller and Beheregaray, 2001; Kemper, 2004). In addition, there is now a description of the dwarf minke whale (Arnold *et al.*, 1987), although this has not been formally described. Cladistic analyses have been carried out on some species (Arnold and Heinsohn, 1996). Genetic studies of beaked whales are helping to solve taxonomic problems and species identification of some Australian specimens (Baker *et al.*, 2003; Dalebout *et al.*, 2004).

The same applies to pinnipeds, although the situation there is complicated by the close relationship and hybridisation between *Arctocephalus* species (Brunner, 2004, Wynen *et al.*, 2001).

Palaeontology

This aspect of Australian research was not covered by Ling (1988). Despite large areas of Tertiary marine sediments, cetacean fossils are uncommon in Australia (see review by Fordyce, 1984). A recent significant discovery is that of an early Oligocene whale from South Australia (Pledge, 2005) and a Holocene dugong from Victoria, which indicates that the dugong was much more widespread in Australia (Fitzgerald, 2005).

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Low-Frequency Sound and Marine Mammals: Current Knowledge and Research Needs (NRC, 1994) provided an initial survey of our understanding of the impacts of marine noise on mammals. The second report, Marine Mammals and Low-Frequency Sound: Progress Since 1994 (NRC, 2000), primarily re-viewed the marine mammal research conducted as part of the Acoustic Thermometry of Ocean Climate (ATOC) experiments. In recent years, both the scientific community and the general public have become increasingly aware of and concerned about conserving the earth's marine resources. Ocean noise and marine mammals. Box 1 Overview of the Committee's Research Recommendations. To Evaluate Human and Natural Contributions to Ocean Noise. Australia has a diverse marine mammal fauna, which includes cetaceans, pinnipeds and one sirenian. The papers presented at the 2001 Southern Hemisphere Marine Mammal Conference provide an overview of the scope of marine mammal research in Australian waters. Twenty-eight percent of papers were based on work conducted in tropical waters, 35% in temperate waters, and just over 20% in subantarctic and antarctic waters; the remainder spanned more than one geographic area. The Australian Marine Mammal Centre coordinates Australia's marine mammal research expertise to provide scientific research and advice to underpin Australia's marine mammal conservation and policy initiatives. The Australian Marine Mammal Centre (AMMC) of the Department of the Environment and Energy was established as the first national research centre focused on understanding, protecting and conserving the whales, dolphins, seals and dugongs in our region. The Centre coordinates Australia's marine mammal research expertise to provide scientific research and advice to underpin Australia's marine mammal conservation and policy initiatives.