Marine Mammal Research and Conservation in India

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Front cover photo : Stenella longirostris (off Kanyakumari)

Back cover photo : Balaenoptera musculus (Indian Ocean)

Director's Foreword

Marine mammals in the Indian EEZ are one of the least studied animals. In recent years, with increasing fishing activity and extension of fishing to oceanic waters, the encounters between fishing gear and marine mammals are on the rise. This is causing concern in the effort to conserve these mega fauna, which are protected under Wildlife (Protection) Act, 1972. Central Marine Fisheries Research Institute has collected data on the stranding of marine mammals for the last 60 years. Research on distribution, abundance, species identity, molecular sequencing and fisheries interaction was strengthened after initiating a project on marine mammals funded by Centre for Marine Living Resources and Ecology, Ministry of Earth Sciences in the year 2003. Since then the knowledge base on these charismatic animals in the Indian EEZ has substantially increased. This booklet outlines the results of this project in brief besides listing the threats faced by the marine mammals and emphasizes the need for developing a National Plan of Action for Marine Mammal Conservation.

I compliment the scientists of CMFRI who are associated with the project, and have authored this booklet. I consider that this publication is an important step towards strengthening conservation efforts on marine mammals.

Kochi

11.1.2010

G. Syda Rao
Director

Introduction

Marine mammals are major consumers of production at most trophic levels from primary production (i.e. sirenians) to predatory fish and even to other marine mammals, as in the case of killer whales. Because of their large body size and abundance, they have a major influence on the structure and function of marine communities. They play an important role in shaping the behaviour and life history traits of prey species and predators, in nutrient storage and recycling, and in modifying benthic habitats (Katona and Whitehead, 1988). The ecological importance of marine mammals is poorly understood, but they are conspicuous as the charismatic megafauna of marine ecosystems that elicit strong human emotions (Bowen, 1997). Marine mammals are probably one of the best sentinel organisms in aquatic and coastal environments because many species have long life spans and have extensive fat stores that can serve as depots for anthropogenic toxins.

There are currently 125 recognized species of marine mammals in the world (whales, dolphins, porpoises, dugong, seals, sea lions,

Stenella longirostris (off Kanyakumari)

walruses, manatees and sea otter). IUCN has listed 25% of these species as threatened (IUCN, 2009). Several species are in danger of extinction (Prideaux, 2003).

Grampus griseus (off Kannur)

Global threats to marine mammals

Marine mammals face a wide range of threats. The greatest threat to coastal populations of dolphins is due to intense fishing activities and the incidental killing as a result of entanglement in fishing gear. With continued proliferation of synthetic gillnets throughout the world, bycatch has emerged as an extremely serious threat to marine mammals, as well as to sea birds, turtles, fishes and other non-target organisms (Northridge, 1991). In addition, reduction of prey due to overfishing affects the abundance of dolphins.

The other known or suspected threats include continued deliberate killing of some species for food and predator control; collisions with powered vessels, and entrapment in water regulation devices; removal of live animals from small coastal populations to supply oceanaria and research/rescue/captive breeding facilities; and the disruption of food webs and depletion of prey resources as a result of industrial or intensive artisanal fishing (Reeves *et al.*, 2003). Apart from this, marine mammals are threatened by pollution and other problems.

Marine mammals worldwide suffer from infectious diseases and harmful algal blooms. Inshore populations of dolphins are possibly at risk of acquiring human infections where untreated human wastes enter coastal environments.

Marine mammal populations are disturbed by seismic testing/drilling on the sea-bed in connection with oil and gas exploration or other off-shore developments; boat traffic and any human activities

which produce loud and persistent sounds under water changes the behaviour and/or physiology of marine mammals. These sounds are likely to interfere seriously with the acoustic perception and communication of marine mammals in the vicinity, and have the potential to induce significant levels of stress.

The effects of ocean warming on marine mammals are more widespread. Ocean warming may lead to a successive reorganization of biodiversity with predicted losses at the equator and gains at high latitudes (Whitehead *et al.*, 2008). Ocean acidification has the potential to affect signaling and sound transmission of marine mammals.

Status of marine mammal research and conservation in India

In India, 26 species of cetaceans and one species of sirenian have been recorded. All the species are placed under Wildlife (Protection) Act, 1972. Under the Act, three species, namely Gangetic dolphin, Irrawaddy dolphin and dugong are under Schedule I and others are under Schedule II. Capture, use and trade of marine mammals are punishable under the Act. However, marine mammal – fisheries interaction is a major cause for concern.

The Central Marine Fisheries Research Institute (CMFRI) initiated the study of marine mammals in India in the 1950s (Jones, 1959). Five

Stenella longirostris (off Dwarka)

dugong were reared in captivity during different time periods in the 1950s at Mandapam. From a vast network of trained field staff located at its research and field centres along the Indian coast, the CMFRI has collected and published

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information on occasional stranding, sighting and accidental gear entanglement for more than 50 years. A research project on Conservation of Marine Mammals and Turtles was executed by the Institute during 1981-1985. The main objective of the project was to develop a Cetacean Data Centre at CMFRI. Silas *et al.* (1984) reported that 1% of the total landings by fishing gear at Cochin were dolphins. Kumaran (2002) reported that 1452 strandings have been recorded along the Indian coasts in 200 years. The CMFRI conducted a seminar on endangered marine animals in 1985 (Silas, 1985). Thus, marine mammal research has been undertaken almost exclusively by fishery biologists of CMFRI.

For an understanding on the cetacean species diversity, distribution and abundance, the CMFRI initiated a research project

Tursiops aduncus (off Kasaragod)

"Studies on Marine Mammals of the Indian EEZ and the Contiguous Seas" with funding support from Centre for Marine Living Resources and Ecology, Ministry of Earth Sciences in the year 2003. The project is continuing into the second phase from the year 2007. At present, this is perhaps the only project dedicated to marine mammal research in the country. The important findings of the project are given below:

Distribution

For collecting data on species distribution, 46 opportunistic surveys were conducted on board FORV *Sagar Sampada* between October 2003 and September 2009 in the Indian EEZ and the contiguous seas. In 6554 hours of sighting effort, a total of 579 cetacean records were made with 8838 individuals. Cetaceans were

Neophocaena phocaenoides at Mangalore (Karnataka)

found to have a wide geographical distribution in the Indian EEZ and contiguous seas. High abundance and species richness were recorded in the southeastern Arabian Sea and southern Sri Lankan waters. The Indo-Pacific bottlenose dolphin was the most frequently sighted species, whereas the spinner dolphin was dominant in terms of abundance. Long-beaked common dolphin, Indo-Pacific humpbacked dolphin and sperm whale were also recorded at frequent intervals.

Incidental catch of marine mammals in fishing gears

Mechanized fishing was introduced on a commercial scale in India in the mid 1960s. Since then, the fisheries sector has grown rapidly. Marine fisheries census carried out by CMFRI in 2005 shows that

there are 58,911 mechanized fishing craft along the Indian coast operating trawlnet, gillnet, lines, dolnet and purseseines. The efficiency of fishing vessels has increased, resulting in longer sea endurance, extension of fishing to oceanic waters and introduction of larger and efficient gear. The growing number and efficiency of mechanized boats have increased the chances of fishing gear – marine mammal encounters. Unfortunately the incidental kills of marine mammals have not been regularly monitored in India. However, it is natural to expect that the incidental kills of marine mammals, especially those of small cetaceans, would have increased with the proliferation of mechanized fishing fleet.

About 9000 to 10,000 dolphins are estimated to be caught by gillnet annually along the Indian coast (Yousuf *et al.,* 2008). Gillnet contributed 68.9% to the incidental catch. Two species commonly involved in the gillnet fishery are the spinner dolphin *Stenella longirostris* and the bottlenose dolphin *Tursiops aduncus*. In addition, other species such as Risso's dolphin *Grampus griseus*, long-beaked common dolphin *Delphinus capensis* and Indo-Pacific humpbacked dolphin *Sousa chinensis* are also reported. Maximum number of dolphin entanglements in gillnet was encountered in the fishery for large pelagics such as tuna and seerfish. The length of gillnet operated along the Indian coast ranged from 0.5 to 2 km with varying mesh size. In the surveyed areas, the length of mechanized boats that incidentally caught dolphins

Stenella attenuata (off Vishakapatnam)

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and porpoise ranged from 9 to 15m with 20 to 108 hp engine. The fishing operations were carried out 4 to 70 km from the shore. Off Mangalore, a large number of finless porpoise *Neophocaena phocaenoides* are incidentally caught in purseseines.

Molecular taxonomy of marine mammals

From the samples collected from the carcass of incidentally caught specimens, 65 sequences of cytochrome b gene and control region of mtDNA from 40 individuals of 12 species were deposited in the GenBank (www.ncbi.nl.nih.gov/). A PCR-based sex determination technique has been developed based on the amplification of genomic DNA extracted from skin samples.

Bioaccumulation of trace metals

Marine mammals, as top predators, accumulate trace elements in their tissues from the environment, chiefly via food. Trace metal accumulation depends mainly on the feeding habits, size, length and

Stenella longirostris at Bunder (Karnataka)

habitat. Muscle, liver and kidney samples from 33 incidentally caught and stranded marine mammals at six sampling locations showed that the concentrations in the samples were low compared to those from other parts of world.

Stenella longirostris at Bunder (Karnataka)

Bioaccumulation of pesticides

The cetaceans are unique in terms of the great organochlorine 'storage capacity' of their blubber, which acts as a reserve for ingested lipophilic (fat-loving) chemical contaminants (such as DDT and PCBs, Dioxin). Blubber samples from 37 individuals belonging to eight species were analysed for organochlorine pesticides. The concentrations of ΣHCHs (BHCs), ΣDDTs and Σ chlordanes were generally lower than the values reported from other parts of the world.

Conservation status

From the research findings of CMFRI on distribution and abundance of marine mammals and the earlier published records, it is possible to provisionally revise the status of different species of marine mammals

Tursiops aduncus (off Kakinada)

in the Indian seas. Table 1 provides an indicative conservation status based on the available information, which is subject to changes when more data become available. Table 1 also provides IUCN status report for species occurring in the Indian seas.

Table 1. Conservation status of marine mammals in India

No	Common name	Species name	IUCN Status	India Status*
1.	Blue whale	*Balaenoptera musculus* (Linnaeus, 1758)	Endangered	Endangered
2.	Fin whale	*Balaenoptera physalus* (Linnaeus, 1758)	Endangered	Endangered
3.	Bryde's whale	*Balaenoptera edeni* Anderson, 1878	Data Deficient	Data Deficient
4.	Common Minke whale	*Balaenoptera acutorostrata* Lacépède, 1804	Least Concern	Data Deficient
5.	Humpback whale	*Megaptera novaeangliae* (Borowski, 1781)	Least Concern	Data Deficient
6.	Sperm whale	*Physeter macrocephalus* Linnaeus, 1758	Vulnerable	Vulnerable
7.	Pygmy sperm whale	*Kogia breviceps* (Blainville, 1838)	Data Deficient	Data Deficient
8.	Dwarf sperm whale	*Kogia sima* (Owen, 1866)	Data Deficient	Data Deficient
9.	Cuvier's beaked whale	*Ziphius cavirostris* G. Cuvier, 1823	Least Concern	Data Deficient
10.	Indo-Pacific beaked whale	*Indopacetus pacificus* (Longman, 1926)	Data Deficient	Data Deficient
11.	Short-finned pilot whale	*Globicephala macrorhynchus* Gray, 1846	Data Deficient	Data Deficient
12.	Killer whale	*Orcinus orca* (Linnaeus, 1758)	Data Deficient	Data Deficient
13.	False killer whale	*Pseudorca crassidens* (Owen, 1846)	Data Deficient	Data Deficient

14.	Pygmy killer whale	*Feresa attenuata* Gray, 1875	Data Deficient	Data Deficient
15.	Melon-headed whale	*Peponocephala electra* (Gray, 1846)	Least Concern	Data Deficient
16.	Irrawady dolphin	*Orcaella brevirostris* (Owen in Gray, 1866)	Vulnerable	Vulnerable
17.	Indo-Pacific humpbacked dolphin	*Sousa chinensis* (Osbeck, 1765)	Near Threatened	Least Concern
18.	Rough-toothed dolphin	*Steno bredanensis* (G. Cuvier in Lesson, 1828)	Least Concern	Data Deficient
19.	Risso's dolphin	*Grampus griseus* (G. Cuvier, 1812)	Least Concern	Least Concern
20.	Bottlenose dolphin	*Tursiops aduncus* (Ehrenberg, 1833)	Data Deficient	Least Concern
21.	Pan tropical spotted dolphin	*Stenella attenuata* (Gray, 1846)	Least Concern	Data Deficient
22.	Spinner dolphin	*Stenella longirostris* (Gray, 1828)	Data Deficient	Least Concern
23.	Striped dolphin	*Stenella coeruleoalba* (Meyen, 1833)	Least Concern	Data Deficient
24.	Long beaked common dolphin	*Delphinus capensis* Gray, 1828	Data Deficient	Least Concern
25.	Finless porpoise	*Neophocaena phocaenoides* (G. Cuvier, 1829)	Vulnerable	Near Threatened
26.	South Asian River dolphin	*Platanista gangetica* (Roxburgh, 1801)	Endangered	Endangered
27.	Sea cow	*Dugong dugon* (Müller, 1776)	Vulnerable	Endangered

* Status assigned based on sighting surveys and incidental catch records of CMFRI during the years 2003-2009 under the project "Studies on marine mammals of Indian EEZ and the contiguous seas" funded by CMLRE, Ministry of Earth Sciences, Government of India

Legislation

Wildlife Protection Acts of India

Besides Wildlife (Protection) Act 1972, the following Indian acts and global conventions are intended to directly or indirectly protect the marine mammals:

- The Indian Fisheries Act, 1857
- The Indian Forest Act, 1927
- The Wildlife (Protection) Act, 1972
- The Wildlife (Transactions and Taxidermy) Rules, 1973
- The Wildlife (Stock Declaration) Central Rules, 1973
- Terrestrial water, continental shelf, Exclusive Economic Zone and other marine zones Act, 1976
- Water (Prevention and control of pollution) Act, 1977
- Maritime Zones of India (Regulation and fishing by foreign vessels) Act, 1980
- The Wildlife (Protection) Licensing (Additional matters for consideration) Rules, 1983
- Environmental (Protection) Act, 1986
- Coastal Zone Regulation Notification, 1991
- Wildlife (Protection) Amendment Act, 1991
- The Wildlife (Protection) Rules, 1995
- National Biodiversity Act, 2002

Global Conventions and Agreements

- International Convention for the Regulation of Whaling, 1946: implemented in 1948 with a protocol of amendment to the Convention; adopted in 1956; the International Whaling Commission (IWC) was established.

- Convention on International Trade in Endangered Species of Wild Fauna and Flora – CITES, 1973: implemented in 1975, prohibits international trade in species listed in Appendix 1, which includes sperm whale, northern right whale, and members of the family *Balaenopteridae* with the exception of West Greenland populations of humpback and minke whales.

- MARPOL Agreement, 1973/1978: the 1973 International Convention on the Prevention of Pollution from Ships and 1978 Protocol relating thereto covers all technical aspects of pollution from ships of all types: accidental and operational oil pollution, pollution by chemicals, goods in packaged form, sewage and garbage; implemented in 1983.

- UN Convention on the Law of the Sea (UNCLOS), 1982; implemented in 1995 and established for the preservation and protection of the marine environment and conservation of marine living resources both within and beyond national jurisdiction.

- Convention on the Conservation of Migratory Species (CMS- Bonn Convention), 1979: implemented in 1983, provides strict protection for 28 endangered migratory species listed in Appendix I.

- Convention on Biological Diversity (CBD- Earth Summit), 1992: implemented in 1994, requires each signatory to identify

Delphinus capensis at Kakinada (Andhra Pradesh)

processes and categories of activities that are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity, and to monitor their effects through sampling and other techniques.

Need for developing National Action Plan on Marine Mammals

Conservation management action plans are important for maintaining and restoring the distribution, abundance and diversity of marine mammals in the Indian EEZ. There is need for developing a National Plan of Action (NPOA) on Marine Mammals by constituting a Task Force. The NPOA-Marine Mammals may address the following:

Balaenoptera musculus at Mandapam (Tamil Nadu)

Reducing incidental kills by fishing gear

For advocating measures to reduce incidental kills of marine mammals by fishing gear, the marine fisheries setting in India needs to be recognized. Marine fisheries have very important roles for food supply and security, income generation and employment. About one million people work directly in this sector, producing 3 million tonnes of fish annually. The value of fish catch at production level is about 14,000 crores (US $ 2.8 billion) and India earns Rs 8,500 crores (US $ 1.8 billion) by exporting fish and fishery products. The fisheries remains open access to a large extent. As it is not mandatory for the fishermen to declare details of their fishing operations and catches,

Sousa chinensis at Gangoli (Karnataka)

monitoring marine mammal bycatch is not easy. In the absence of information on fishing grounds, bycatch and discard of marine mammals, it is difficult to quantify the number and identify the species of marine mammals caught by fishing gear. To develop time series database on incidental capture, stranding and beach-cast marine mammals, the potential role of fisheries organizations such as Central Marine Fisheries Research Institute and fisheries departments of state governments, which regularly record fish landings along the Indian coast, should be recognised. With support from Ministry of Environment and Forests (Government of India) and wildlife conservation authorities, a mechanism needs to be developed for collection of data on incidental capture, stranding and beach-cast marine mammals.

It is important to recognize that marine

Stenella longirostris (off Dwarka)

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mammal conservation can take place only with the support and participation of fishermen. Conservation of marine mammals could be achieved by

Balaenoptera musculus (Indian Ocean)

integrating the agenda into fisheries regulatory mechanisms. The fisheries regulatory instruments such as Code of Conduct for Responsible Fisheries and Ecosystem-based Fisheries Management, which have conservation of endangered animals enshrined in the articles, need to be put in place. Establishment of Marine Mammal Sanctuaries may be initiated where populations of dolphins and

Tursiops aduncus (off Kasaragod)

dugong are abundant. Articles on conservation of endangered animals need to be suitably amended into the Marine Fisheries Regulation Act of state governments.

Bycatch reduction

Restrictions on gillnet length will reduce the dolphin bycatch. Modification of fishing gear practices, for example, by forcing changes in fishing areas, reducing the total fishing effort, imposing spatial and/ or temporal fishing closures, or introducing alternate fishing methods and use of acoustic deterrents (pingers) may be useful to reduce incidental kills. Such modifications may be pursued not only to reduce marine mammal's mortality, but also to conserve economically valuable fish stocks that are depleted or rapidly declining.

Physeter macrocephalus (off Badakara)

Other possible modifications of fishing gear and strategies in gillnet fisheries include lowering the net height, changing the mesh size, changing the hanging ratio of the net and increasing the gap between the bridle. In midwater driftnets, researchers have tried to reduce cetacean bycatch by impregnating the nylon of gillnets with a dense material, such as barium sulphate and iron oxide. It increases the acoustic reflectivity of the net and allows cetaceans to detect gillnet and avoid becoming entangled. Another technique trialed is placing objects in gillnet to reflect the sonar, thus ensuring that the cetaceans have an easier time detecting and avoiding the nets.

Feresa attenuata at Munambam (Kerala)

Reducing cetacean bycatch is not simply a matter of designing effective bycatch reduction devices and enforcing their use in fisheries. If fishermen want, they can avoid bycatch of marine mammals. A skilled fisherman knows the area of marine mammal's occurrence and can avoid those areas from fishing.

Research needs

Several research groups are needed to address the following concerns on marine mammals in the Indian Ocean: population abundance and biological characteristics including age, fecundity, reproduction rate and genetic studies at species level; migratory pattern, feeding and breeding sites by using telemetry; prey depletion due to overfishing; GIS mapping of marine mammal occurrence, oceanography, bathymetry and biological features to identify critical habitat components; and impact of climate change.

Ecotourism

There is enormous scope to promote benign ecotourism of marine mammals. By identifying the areas and seasons of abundance of dolphins, Dolphin Watch Atlas may be prepared. Ecotourism for dolphins may also be used for diverting fishing activities of fishermen. These projects should incorporate behavioural impacts and biologically significant effects of tourism on marine mammal populations. New research shows that marine mammals suffer high levels of stress when being watched by tourists. It is therefore important that whale and dolphin watching is carefully managed and codes of conduct developed.

Awareness building

There is a need to create awareness among fishermen and public on the importance of mammals in the marine ecosystems, their status and threats, and the need for conservation. Training to fishermen, wildlife managers and non-governmental organizations may be organized on handling the live strandings and dead carcasses of marine mammals. Fishermen should be encouraged to report live or dead marine mammals caught in fishing gear.

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