

Marine Mammal Sightings in Southern Ocean

Introduction

The Southern Ocean (SO) comprises more than 10% of the world's oceans and plays a substantial role in the Earth System. In total, it covers an area of 34.8 million km². The shelves around Antarctica are on average 450 – 500 m deep, but exceed 1000 m in places. Of the total SO area, the continental shelf (<1000 m in depth) covers 4.59 million km², the continental slope (1000 – 3000 m in depth) covers 2.35 million km² and the deep sea (>3000 m in depth) covers approximately 27.9 million km² (Clarke and Johnston, 2003). Sea ice covers roughly half of the Southern Ocean during winter and approximately 10% during the summer. The Southern Ocean represents a complex suite of habitats for its unique biota, defined by light, temperature, water chemistry, depth, and geomorphology, as well as winds, currents, and sea ice. The diversity of Antarctic continental shelves exceeds that of Arctic, and is comparable with temperate and even non reef tropical shelves (Clarke, 2008). The SCAR-MarBIN (Register of Antarctic Marine Species) reported the presence of 6651 species of marine animals in the Southern Ocean. More than 26 major taxonomic groups are recognized among the megafauna of the Southern Ocean deep sea. The Southern Ocean's ability to store carbon dioxide (more than 40% of the total human-generated carbon dioxide stored by the world's oceans) has reduced the rate of global warming. The Southern Ocean is in many respects an ideal region to study marine animal populations in the context of global climate change. If the Antarctic ice were to melt, scientists predict global sea level would rise by an average of 200 ft. There are two main reasons why the Southern Ocean is so full of life. The first is the existence of a large amount of nutrients in the water, which act as a fertilizer, allowing for vigorous growth of tiny photosynthetic or algae, which form the basis of the food chain. These nutrients are brought to the Southern Ocean by the southerly flow of deep, nutrient-rich water known as 'Circumpolar Deep Water' which rises to the surface (upwells) near the continent of Antarctica and makes nutrients available to photosynthetic organisms in the sunlit waters near the surface, which then grow into large 'phytoplankton blooms'. The second reason the Southern Ocean is so productive is that over the six summer months the sun never sets, meaning that photosynthesis, and growth of the phytoplankton blooms, can occur 24 hours a day. Taking advantage of this abundant production are the Southern Ocean's most plentiful residents - the small shrimp-like Antarctic krill, *Euphausia superba*, which feed on the tiny photosynthetic diatoms which make up the phytoplankton blooms (WWF, 2010).

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Baleen whales eat 30-50 million tonnes of krill in the Antarctic each year. The Southern Ocean is the feeding and breeding grounds for the marine mammals. The marine mammals are the top predators in the Southern Ocean ecosystem. Marine mammals typically mature late, live longer than 15 years and have only one or two offspring each year after maturation. Some species do not reproduce every year and individuals will not reproduce if their body condition is poor. Furthermore marine mammals are of significant conservation concern, with 23% of species currently threatened by extinction (Schipper et al., 2008). Marine mammals also influence the availability of micronutrients such as iron (Nicol et al., 2010). Baleen whales are important contributor to the Southern Ocean iron cycle, they need to be able to convert large quantities of iron from a particulate form (in krill) into a diffuse form (faeces) containing a soluble fraction, which may then be available again for phytoplankton growth. Baleen whale faecal iron content (145.9 ± 133.7 mg kg) is approximately ten million times that of Antarctic seawater, suggesting that it could act as a fertilizer (Nicol et al., 2010).

Whaling in Southern Ocean

The first of the Southern Ocean's resources to be exploited by humans were the Pinnipeds. Upon returning to England in 1775, Captain Cook told of the Island of South Georgia with its beaches teeming with Antarctic fur seals (*Arctocephalus gazella*). Sealing voyages thus ensued, and in 1822, James Weddell, a Scottish sealer, estimated that over 1.2 million skins had been taken from the area and that the species was nearly extirpated (Knox, 1994). Sealing in the late 1700s and early 1800s, along with whaling in the first half of the 1900s and fishing in the mid-1900s drastically reduced the abundance of many groups of organisms. The first to be removed as the seas and continent were being explored were the Antarctic fur seals (*Arctocephalus gazella*), which were taken for their valuable skins. This was followed by the export of meat and blubber from large whales in the early 1900s (Best, 1993). While the fur seals were being harvested for their pelts, southern elephant seals (*Mirounga leonina*) were being taken for their oil, although not in such large numbers (Berkman, 2002).

By 1960's when Blue Whale hunting was banned by the IWC it is estimated that over 330,000 Blue Whales had been killed. Pre-whaling population estimates were over 350,000 blue whales, but up to 99% of blue whales were killed during whaling efforts (Sears, 2002). Presently, there are estimated 5-10,000 blue whales in the Southern Hemisphere, and only around 3-4,000 in the Northern Hemisphere (Branch et al., 2007).

Similar to the Blue whales fate, Fin whales were heavily hunted beginning in the mid-1900's. It is estimated that 7,25,000 were killed until the IWC granted them protection in 1966, with full protection awarded in 1976. Since that time their numbers have begun to recover. There were about 2,00,000 Humpback whales heavily exploited by commercial whaling primarily from the 1920s-1950s in both their Southern Ocean feeding grounds and in their tropical breeding grounds. IWC banned hunting of Southern Ocean in 1963. Southern Right whales are slow swimmers, moving at 3-4 miles per hour. Because of their slow speed and high oil content blubber these whales were obvious targets for early whalers. It is estimated that in the 18th century 12,000 whales were killed in a 30 year period. This slaughter continued in the 19th century with estimations of up to 100,000 right whales killed. Sei whale populations in the SO were heavily exploited by industrial whaling after the decline in numbers of blue and fin whales, primarily from the mid-1960s to early 1970s. There were about 2,00,000 Sei Whale killed during the 20th Century (IUCN, 2011). Antarctic Minke whales were not then regularly hunted by the large-scale whaling operations in the Southern Ocean because of their relatively small size. However, by the early 1970s, following the overhunting of larger whales such as the Sei, Fin, and Blue whales, Minkes attracted their attention. By 1979, about 3,29,212 Minke whales caught by Southern Ocean fleets. Hunting continued apace until the general moratorium on whaling began in 1986 (IUCN, 2011). After rampant commercial whaling in the twentieth century brought most great whale species in the Southern Ocean close to extinction, the International Whaling Commission (IWC) established the Southern Ocean Whale Sanctuary in 1994, recognising the critical importance of protecting whales in this special place. In 1979, The International Whaling Commission (IWC) declared the Indian Ocean (north of 55°S) a Whale Sanctuary.

Marine Mammal Sightings in Southern Ocean

The studies on marine mammals of Southern Ocean were initiated after the establishment of International Whaling Commission in Washington, USA in 1946. Its aim was to achieve the maximum sustainable utilisation of whale stocks, and protect the future of stocks as a resource. Whales and seals are the two groups of marine mammals found in the Southern Ocean where they are an important part of the marine ecosystem. Whales and seals of the Southern Ocean have been severely exploited by man in the past, but are now mostly protected. Some seals and whales have had dramatic population increases in recent decades, though others remain greatly reduced compared to pre-hunting levels. There are about 30 marine mammals reported so far in the Southern Ocean. The present status of the marine mammals of Southern Ocean is shown in Table 1.

Marine Mammal Sightings by India

Information on marine mammal population of Indian sector of Southern Ocean is

unknown except few surveys undertaken by the Indian Scientists. The distribution of marine mammals and migration along the different oceanic realm in the Southern Ocean is unknown. The first comprehensive marine mammal survey was initiated during the First Indian Antarctic Expedition conducted by the Department of Ocean Development, Government of India in the year 1981. So far five opportunistic surveys on marine mammals were conducted. The details of the surveys are given in Table 2. The Central Marine Fisheries Research Institute (CMFRI) initiated the study of marine mammals in India in the 1950s. CMFRI had also participated in the Pilot Expedition (PESO) organized by the NCAOR on January – March, 2004 and investigated the distribution and abundance of cetaceans in the Southern Ocean. About 22 individuals of marine mammals were observed in the 13 sighting records. Recently, the first author participated in the 5th Indian Southern Ocean Expedition for marine mammal studies. A pod of Minke whales (Fig. 1) and pod of Killer whales (Fig. 2) were sighted during the expedition. The Killer whales were in different form and identified as type 'D' described by Jefferson et al., (2008). It has been reported for the first time from Indian sector of Southern Ocean. Killer whales attacks have been observed on 20 species of cetaceans, 14 species of pinnipeds, the Sea Otter, and the Dugong (Jefferson et al., 2008). Southern Hemisphere Killer Whales prefer to feed on tongue and lips of Baleen Whales (Wellings, 1944). Three readily field-identifiable killer whale ecotypes have been described from Antarctic waters (types A, B, and C; Pitman and Ensor, 2003). A fourth and markedly different looking killer whale from the southern hemisphere was described by Jefferson et al., (2008); it was referred to as 'type D' and was easily recognizable by its extremely small white post-ocular eye patch. Pitman et al., (2011) suggest that type D likely represents yet another ecotype or possibly even species of killer whale in the Southern Ocean.

Conclusion

Marine mammal richness was predicted to be highest in temperate waters of both hemispheres with distinct hotspots around New Zealand, Japan, Baja California, the Galapagos Islands, the Southeast Pacific, and the Southern Ocean (Kaschner et al., 2011). In the Southern Ocean, seabirds and marine mammals are threatened by incidental mortality from interactions with fishing gear such as long lines and trawls. Marine mammals of Southern Ocean play a important role in reduction of global carbon level. Recent studies showed that populations of large baleen whales now store 9.1×10^6 tons less carbon than before whaling. Pershing et al (2010) estimated that rebuilding whale populations would remove 1.6×10^5 tons of carbon each year through sinking whale carcasses. For example, rebuilding the southern hemisphere blue whale population would sequester 3.6×10^6 tons C in living biomass. Assuming 82 tons C ha⁻¹ of forest (FAO, 2006), the new blue whales would be equivalent to preserving 43,000 hectares of temperate forest, an area comparable in size to the City

of Los Angeles. Rebuilding all of the whale populations would store 8.7 x 106 tons C, equivalent to 110,000 hectares of forest or an area the size of the Rocky Mountain National Park. Therefore, dedicated continuous monitoring and management of marine mammals are required in Southern Ocean.

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Table 1. Status of Marine Mammals of Southern Ocean

No	Common Name	Scientific Name	Recent Population	IUCN Status
1.	Blue Whale	<i>Balaenoptera musculus</i> (Linnaeus, 1758)	2,300	Critical Endangered
2.	Fin Whale	<i>Balaenoptera physalus</i> (Linnaeus, 1758)	38,185	Endangered
3.	Sei Whale	<i>Balaenoptera borealis</i> (Lesson, 1828)	11,000	Endangered
4.	Antarctic Minke Whale	<i>Balaenoptera bonaerensis</i> (Burmeister, 1867)	3,39,000	Data Deficient
5.	Humpback Whale	<i>Megaptera novaeangliae</i> (Borowski, 1781)	42,000	Least Concern
6.	Southern Right Whale	<i>Eubalaena australis</i> (Desmoulines, 1822)	7,500	Least Concern
7.	Pygmy Right Whale	<i>Caperea marginata</i> (Gray, 1846)	Few sightings	Data Deficient
8.	Sperm Whale	<i>Physeter macrocephalus</i> (Linnaeus, 1758)	9,500	Vulnerable
9.	Arnoux's Beaked Whale	<i>Berardius amuxii</i> (Duvemoy, 1851)	30,000	Data Deficient
10.	Cuvier's Beaked Whale	<i>Ziphius cavirostris</i> (G. Cuvier, 1823)	80,000	Least Concern
11.	Southern Bottlenose Whale	<i>Hyperoodon planifrons</i> (Flower, 1882)	5,99,300	Least Concern
12.	Shepherd's Beaked Whale	<i>Tasmacetus shepherdi</i> (Oliver, 1937)	Few Sightings	Data Deficient
13.	Gray's Beaked Whale	<i>Mesoplodon grayi</i> (von Hasst, 1876)		Data Deficient
14.	Hector's Beaked Whale	<i>Mesoplodon hectori</i> (Gray, 1871)	No Estimates	Data Deficient
15.	True's Beaked Whale	<i>Mesoplodon mirus</i> (True, 1913)	No Estimates	Data Deficient
16.	Strap toothed Beaked Whale	<i>Mesoplodon layardii</i> (Gray, 1865)	153	Data Deficient
17.	Spade toothed Beaked Whale	<i>Mesoplodon traversii</i> (Gray, 1874)	No Estimates	Data Deficient
18.	Killer Whale	<i>Orcinus orca</i> (Linnaeus, 1758)	25,000	Data Deficient
19.	Long finned Pilot Whale	<i>Globicephala melas</i> (Traill, 1809)	2,00,000	Data Deficient
20.	Dusky Dolphin	<i>Lagenorhynchus obscurus</i> (Gray, 1828)	7,252	Data Deficient
21.	Hourglass Dolphin	<i>Lagenorhynchus cruciger</i> (Quoy and Gaimard, 1824)	1,44,300	Least Concern
22.	Southern Right Whale Dolphin	<i>Lissodelphis peronii</i> (Lacepede, 1804)	No Estimates	Data Deficient
23.	Spectacled Porpoise	<i>Phocoena dioptrica</i> (Lahille, 1912)	No Estimates	Data Deficient
24.	Sub Antarctic Fur Seal	<i>Arctocephalus tropicalis</i> (Gray, 1872)	3,10,000	Least Concern
25.	Antarctic Fur Seal	<i>Arctocephalus gazella</i> (Peters, 1875)	60,20,000	Least Concern
26.	Southern Elephant Seal	<i>Mirounga leonina</i> (Linnaeus, 1758)	6,50,000	Least Concern
27.	Crabeater Seal	<i>Lobodon carcinophaga</i> (Hombron and Jacquinot, 1842)	1,20,00,000	Least Concern
28.	Ross Seal	<i>Ommatophoca rossii</i> (Gray, 1844)	1,30,000	Least Concern
29.	Leopard Seal	<i>Hydrurga leptonyx</i> (Blainville, 1820)	3,00,000	Least Concern
30.	Weddell Seal	<i>Leptonychotes weddellii</i> (Lesson, 1826)	5,00,000	Least Concern

Table 2. Indian's Marine Mammals Sightings

Species	Parulekar 1983	Sathya kumar, 1998	Bhatnagar & Sathyakumar, 1999	Jayasankar, 2004	Jeyabaskaran, 2011
Blue Whale, <i>Balaenoptera musculus</i> (Linnaeus, 1758)	2	-	3	3	-
Fin Whale, <i>Balaenoptera physalus</i> (Linnaeus, 1758)	-	-		4	-
Sel Whale, <i>Balaenoptera borealis</i> (Lesson, 1828)	-	-	-	5	6
Antarctic Minke Whale, <i>Balaenoptera bonaerensis</i> (Burmeister, 1867)	-	-	5	3	-
Humpback Whale, <i>Megaptera novaeangliae</i> (Borowski, 1781)	5	9	-	-	-
Southern Bottlenose Whale, <i>Hyperoodon planifrons</i> (Flower, 1882)	2	-	32	-	-
Killer Whale, <i>Orcinus orca</i> (Linnaeus, 1758)	-	4	3	-	7
Crabeater Seal, <i>Lobodon carolinophaga</i> (Hombron and Jacquinot, 1842)	8	363	30	-	-
Leopard Seal, <i>Hydrurga leptonyx</i> (Blainville, 1820)	4	2	-	-	-
Unidentified Baleen Whale	-	-	-	4	3

Fig. 1. Photo taken onboard ORV Sagar Nidhi on 16.02.2011 by R. Jeyabaskaran at 60°00'S & 52°18'E



Fig. 2. Killer Whale *Orcinus orca* sighted at Southern Ocean

