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Distribution of Sea Snakes in the Indian Coastal Waters

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Abstract

Forty one sightings of sea snakes representing eight species were recorded during on board observations of the cruises of Fishing and Oceanographic Research Vessel (FORV) "*Sagar Sampada*" in the Bay of Bengal, Andaman and Nicobar Islands, and in the Arabian Sea. Most sightings (70%) were in the Arabian Sea followed by the Bay of Bengal (20%) and (10%) were in the Bay Islands. The Hook-nosed Sea Snake *Enhydrina schistosa* was the most abundant sea snake as it was sighted most frequently (29%) and was followed by Annulated Sea Snake *Hydrophis cyanocinctus* (19.5%), Yellow Sea Snake *Hydrophis spiralis* (17%) and Malacca Sea Snake *Hydrophis caerulescens* (2.5%), The Black and Yellow Sea Snake *Pelamis platurus*, (8%), Jerdon's Sea Snake *Kerilia jerdonii* (2.5%) and Cochin Banded Sea Snake *Hydrophis ornatus,* (5%) in the order of abundance. The Short Sea Snake *Lapemis curtus* was observed rarely (2.5%). Unidentified sea snakes accounted for 14% of the sightings.

Keywords : sea snakes, Arabian sea, Bay of Bengal, trawl net, conservation

INTRODUCTION

Sea snakes are among the most uniquely adapted serpents, spending most of their active lives at sea. Four families of sea snakes with 60 representative species inhabit the world's oceans and estuaries. They are commonly found in tropical and sub-tropical coastal waters of the Indian and Pacific Oceans (Heatwole, 1999). Sea snakes are adapted to live in sea by having flattened body and oar shaped tail. However, they occupy a variety of habitats like mud flats, mangrove swamps, coral reefs and estuaries even though some species have narrow ecological requirements and occupy a particular habitat. They grow medium to large size. Their highly toxic venom is an adaptation to catch prey instantly in the marine environment. Most species of sea snakes give birth to young ones. They have often been seen in the surface in calm weather with some species aggregating in vast numbers during their breeding seasons (Moore, 1980). The genus *Hydrophis* is the most widely distributed group of sea snakes with 52 species. A number of species of *Hydrophis* are found only in deep waters while some others prefer to live in shallow waters. Members of the genus *Laticauda* (sea kraits), bask, rest and lay eggs on small islands (Das, 2003). Some sea snakes are common while some others are extremely rare.

The seas around India are reported to harbor a rich sea snake fauna with strong endemic components and greater species diversity (Smith, 1943; Murthy, 1977). Ahmed (1975) described 29 species from the Indian Ocean, of which 19 species could be found in the collection of Zoological Survey of India. Voris (1972), Murthy (1992) and Whitaker and Captain (2004) listed 20 species of sea snakes from the Indian Coastal waters. In India, the sea snakes are not commercially exploited, but indiscriminately killed during fishing operations (Srinivasan, 2000; Venkatraman *et al*., 2007). The decline of sea snake population of India is attributed to increase in the fishery related mortalities mainly through trawl and gill nets. Trawl nets are designed to catch economically valuable target species such as shrimps and are operated from mechanized boats called trawlers. As a mobile non-selective fishing gear, the trawl net collects every organism in its path and sea snakes are one among the marine animals that caught incidentally during trawling operations. Apart from trawl, the gill net is also a source of increasing concern due to the incidental catch of sea snakes. It is an age-old fishing practice that has shown a spectacular increase in operation in recent years along the Indian coastal waters and acts as a curtain of death on a large number of non-targeted species like sea snakes.

Sea snakes of India are poorly accounted owing to the logistical difficulties inherent in sampling them. Earlier studieas on sea snakes of India mostly relied on the washed ashore or incidentally caught specimens during fishing operations and pertain to their systematics (Murthy, 1977) systematics and ecology (Ahmed, 1975), trophic structure (Voris, 1972), weight-length relationships (Lobo *et al*, 2004), trophic ecology (Lobo *et al*, 2005) and information on incidental catch (Srinivasan, 2000; Venkatraman *et al*., 2007). The present study describes at-sea observations on the geographical distribution of sea snakes in the Indian coastal waters during cruises of the Fishing and Oceanographic Research Vessel, "Sagar Sampada" during 2003-2005.

METHODS

We have conducted at-sea observations on sea snakes during the research cruises conducted during 30.10.2003

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to 8.11.2003, 21.7.2004 to 30.7.2004 in Arabian Sea and 26.1.2005 to 15.2.2005 in the Bay of Bengal and Andaman and Nicobar Islands. Using binoculars (Vanguard Br.7500, 7x50 mm field: 7.1), we searched the ocean surface for signs of sea snakes during day light hours (06:00-17:30). Each sighting was given a unique number and the following information were recorded: date and time of sightings, general locality (nearest land mark), latitude and longitude (by using cruise's GPS), sea state (calm, rough, slightly sea swell, moderate sea swell and high sea swell), number of animals, distance from the vessel, depth of the area (m) (by using automatic recorders in the cruises) and the presence of any other animals. The behaviors of the snakes such as twisting and coiling, floating horizontally and surface basking were noted. Morphometric measurements such as snout-vent length, tail length, head length and head width were also collected from the incidentally caught sea snakes during trawling operations. The measurements were taken using the flexible tape measures to the nearest 0.5 cm accuracy. After taking measurements the snakes were released back in to the sea.

RESULTS

A total of 41 sightings representing eight species of sea snakes were recorded during this study (Table 1). Most sightings were in the Arabian Sea (70%) followed by the Bay of Bengal (20%) and a total of 10% were in the Bay Islands. The Hook-nosed Sea Snake *Enhydrina schistosa* was recorded most frequently (29%) followed by Annulated Sea Snake *Hydrophis cyanocinctus* (19.5%), Yellow Sea Snake *Hydrophis spiralis* (17%) and Malacca Sea Snake *Hydrophis caerulescens* (2.5%). Other species recorded included black and Yellow Sea Snake *Pelamis platurus* (8%), Jerdon's Sea Snake *Kerilia jerdonii* (2.5%) Cochin Banded Sea Snake *Hydrophis ornatus* (5%) and Short Sea Snake *Lapemis curtus* (2.5%) (Table 2). Unidentified species of sea snakes accounted for 14% of the sightings (Table 2). No sightings of sea snakes were observed in and around Lakshadweep and Nicobar group of Islands.

The sea snakes observed were mostly active during morning and evening hours. They were sighted throughout the cruise programme mostly in the near shore waters between 15-50 m depth along Cannanore, Calicut and Mangalore in the west coast of India at the latitude 11^0 44. 40′ N and longitude 75^0 08.59′ E. In the Bay of Bengal, most sightings were observed in Chennai coast and Andaman waters. Activities such as twisting and coiling, swimming actively and some times against the surface currents, basking on the sea surface, and floating with their whole body horizontally were noticed. The association of yellow sea snake with sticks and wood were noticed in Andaman Island.

During the study period, a total of 35 stranded sea snakes belonging to three genera comprising 5 species *viz*., *Hydrophis spiralis, H.cyanocinctus, H.gracilis, Enhydrina schistosa* and *Lapemis curtus* were recorded along the Rameswaram and Chennai coast. All those stranded snakes were found dead on the beaches.

DISCUSSION

Shuntov (1966) reported that the salinity gradients may influence the distribution of certain sea snakes and they prefer to capture prey on or near the bottom in relatively shallow water (50 m or less), hence deep ocean areas limit the distribution of sea snakes except the Yellow Sea Snake. The present study also revealed the same that sea snakes mostly distributed in shallow waters in near shore areas. The wide range of distribution of *Enhydrina schistosa* could be due to its strong swimming efficiency and adaptation to prey on a variety of food.

By-catch is the term used to describe the accidental harming of marine life other than non-target species like sea snakes (Alverson *et al*., 1994). In the present study fishing and harvesting operations were found to be are responsible for the deaths of sea snakes, many of which are accidental. In India, expansion of the fisheries began with the introduction of mechanized fishing vessels for bottom trawling and with synthetic gear materials. This technological advancement and capabilities resulted in the extension of fishing operations from the near shore waters to about 40-50 m depth zone with increasing fishing effort. Consequently, the contribution from the mechanized sector enhanced considerably over that of the indigenous sector in the total marine fish landings of the country. Both targeted and untargeted species were landed by these mechanized gears, which caused great damages to populations of sea snakes. Wasenberg *et al*. (2004) mentioned that the survival rate of sea snakes from commercial trawl fishery was about 60% only. Thus commercial fishery has both direct and indirect impacts not only on the marine ecosystem but also on the diversity of sea snakes.

Several life history characteristics make it difficult for the heavily exploited sea snake populations to rebound, and thereby cause uncertainties in their management. Entanglement of sub adults and adults in gill nets in near-shore coastal waters was more when the mesh size was small. Such incidental catches of sea snakes can be avoided by educating the fishermen. Furthermore, awareness programmes on the importance of sea snakes should be launched for fishermen and public so as to provide information on the proper release of incidentally caught snakes back in to the sea.

Table 1. Details of the geographical distribution of sea snakes in the Indian coastal waters

S.No	Date	Time (hrs)	Latitude & Longitude	Place of Sighting	Depth (m)	Species and their activities
1	30.10.03	15.30	11^0 42.87′ N 73^0 38.17′ E	Off Calicut, Kerala, Arabian Sea	90	Hook-nosed Sea Snake *Enhydrina schistosa,* sighted on the surface of the water. Swimming. Medium sized. Fish shoals were observed in the same locality.
2	2.11.03	7.25	12^0 49.26′ N 74^0 27.20′ E	Mangalore coast, Arabian Sea	40	Annulated Sea Snake *Hydrophis cyanocinctus*. Sighted in shallow waters. Medium sized. Swimming in *zig-zag* manner on the surface. 35 nautical miles away from the shore. Calm sea with clear weather.
3	2.11.03	7.40	12^0 49.26′ N 74^0 27.20′ E	Mangalore coast, Arabian Sea	40	Annulated Sea Snake *Hydrophis cyanocinctus*. Larger sized. Sighted on the surface of the water.
4	2.11.03	7.28	12^0 49.26′ N 74^0 27.20′ E	Mangalore coast, Arabian Sea	45	Jerdon's Sea Snake *Kerilia jerdonii*. Smaller sized. Short head, sighted on the surface of the water and moving towards mid sea.
5	2.11.03	8.05	12^0 49.26′ N 74^0 32.20′ E	Mangalore coast, Arabian Sea	43	Hook-nosed Sea Snake *Enhydrina schistosa*. Medium sized. Sighted on the surface of the water. Fishing operations noticed nearby.
6	2.11.03	8.18	12^0 49.57′ N 74^0 32.20′ E	Mangalore coast, Arabian Sea	43	Hook-nosed Sea Snake *Enhydrina schistosa*. Larger in size. Dirty white in colour.
7	2.11.03	8.20	12^0 49.57′ N 74^0 32.11′ E	Mangalore coast, Arabian Sea	43	Hook-nosed Sea Snake *Enhydrina schistosa*. Jet black with cross bands.
8	5.11.03	15.40	13^0 00.30′ N 74^0 37.81′ E	Mangalore coast, Arabian Sea	15	Hook-nosed Sea Snake *Enhydrina schistosa*. Medium sized.
9	5.11.03	16.25	13^0 00.30′ N 74^0 37.81′ E	Mangalore coast, Arabian Sea	15	Yellow Sea Snake *Hydrophis spiralis*. Seen on the surface of the water.
10	5.11.03	17.00	13^0 00.30′ N 74^0 37.81′ E	Mangalore coast, Arabian Sea	18	Yellow Sea Snake *Hydrophis spiralis*. Medium sized. Taking dive in to deep water.
11	7.11.03	16.00	12^0 23.16′ N 74^0 20.33′ E	Off Kazargode coast, Kerala, Arabian Sea	141.2	Yellow Sea Snake *Hydrophis spiralis*. Larger in size. Seen on the surface of the water.
12	8.11.03	9.00	11^0 44.40′ N 75^0 08.59′ E	Off Cannanore coast, Kerala, Arabian Sea	48.5	Hook-nosed Sea Snake *Enhydrina schistosa*. Caught in trawl net while fishing.
13	8.11.03	9.00	11^0 44.40′ N 75^0 08.59′ E	Off Cannanore coast, Kerala, Arabian Sea	48.5	Hook-nosed Sea Snake *Enhydrina schistosa*. Caught in trawl net while fishing in the sea.
14	21.7.04	12.05	12^0 00.133′ N 74^0 56.90′ E	Kottekunnu coast, Kerala, Arabian Sea	46.5	Hook-nosed Sea Snake *Enhydrina schistose*. Medium in size.
15	21.7.04	17.00	12^0 24.53′ N 74^0 40.18′ E	Off Kottekunnu coast, Kerala, Arabian Sea	50	Hook-nosed Sea Snake *Enhydrina schistosa*. Medium sized snake. Moving along with water current.

Table 1 Contd.,

S.No	Date	Time (hrs)	Latitude & Longitude	Place of Sighting	Depth (m)	Species and their activities
16	22.7.04	10.30	11^0 29.208′ N 74^0 54.67′ E	Off Beypore coast, Kerala, Arabian Sea	69	Yellow Sea Snake *Hydrophis spiralis*. Medium sized snake moving along with water current.
17	23.7.04	17.00	10^0 59.73′ N 75^0 27.04′ E	Off Beypore coast, Kerala, Arabian Sea	69	Annulated Sea Snake *Hydrophis cyanocinctus*. Medium sized snake.
18	23.7.04	17.05	10^0 59.73′ N 75^0 27.04′ E	Off Beypore coast, Kerala, Arabian Sea	69	Cochin Banded Sea Snake *Hydrophis ornatus*. Medium in size. Moving towards mid sea.
19	23.7.04	17.05	10^0 59.73′ N 75^0 27.04′ E	Off Beypore coast, Kerala, Arabian Sea.	69	Species not identified due to rough sea.
20	23.7.04	17.05	10^0 59.73′ N 75^0 27.04′ E	Off Beypore coast, Kerala, Arabian Sea	69	Cochin Banded Sea Snake *Hydrophis ornatus*. Medium sized snake. Moving along the water current.
21	26.7.04	9.30	09^0 24.37′N 076^0 12.72′E	Alleppy coast, Kerala, Arabian Sea	20	Two Hook-nosed Sea Snake *Enhydrina schistosa*. By catch during trawling operations. 117 cm Snout vent length, 9 and 2.5 cm tail length and width each head length and width were 3.3 and 2 cm. Weight 308 g. White colored exo-parasites noticed along the dorso lateral side of the snake. After taking measurements released back in to the sea.
22	26.7.04	9.30	09^0 24.37′N 076^0 12.72′E	Alleppy coast, Kerala, Arabian Sea	25	Unable to identify the species due to rough weather. Sighted 120 nautical miles away from the shore.
23	26.7.04	9.30	09^0 24.37′N 076^0 12.72′E	Alleppy coast, Kerala, Arabian Sea	28	Unable to identify the species due to rough sea and poor visibility.
24	26.7.04	9.30	09^0 24.37′N 076^0 12.72′E	Alleppy coast, Kerala, Arabian Sea	40	*Hydrophis cyanocinctus.* Sighted in shallow water near the shore.
25	29.7.04	17.20	09^0 24.37′N 076^0 12.72′E	Quilon coast, Kerala, Arabian Sea	50	Unable to identify the species due to rough weather.
26	29.7.04	17.20	09^0 06.09′N 76^0 22.85′E	Quilon coast, Kerala, Arabian Sea	57	*Hydrophis cyanocinctus.* Floating on the surface.
27	29.7.04	17.35	09^0 06.09′N 76^0 22.85′E	Quilon coast, Kerala, Arabian Sea	19.2	*Hydrophis cyanocinctus*. Sighted in shallow water in near the shore.
28	30.7.04	10.35	09^0 06.09′N 76^0 22.85′E	Quilon coast, Kerala, Arabian Sea	19.2	*Hydrophis cyanocinctus*. Sighted in shallow water in near shore area.
29	30.7.04	10.00	09^0 06.09′N 76^{0}27.04′E	Off Beypore coast, Kerala Arabian Sea	46.9	Unable to identify the species. Sighted far away from the ship. Swimming on the surface.
30	28.1.05	10.00	13^0 42.19′N 93^0 00.41′E	Off North, Andaman Island	8125	Short Sea Snake *Lapemis curtus.* Body short, compressed laterally, and sighted on the surface of the water. 83 nautical miles away from the shore.

Table 1 Contd.,

S.No	Date	Time (hrs)	Latitude & Longitude	Place of Sighting	Depth (m)	Species and their activities
31	30.1.05	16.15	12^0 28.45′N 93^0 02.42′E	Off Rangat, Andaman Island	44.8	Black and Yellow Sea Snake *Pelamis platurus*. Elongated head. Belly yellow in colour, sighted 80 nautical miles away from the shore.
32	31.1.05	12.30	11^0 59.68′N 94^0 07.57′E	South east Barren Island, South Andaman	783	Black and Yellow Sea Snake *Pelamis platurus*. 35 nautical miles away from the shore.
33	02.2.05	10.55	11^0 40.40′N 92^0 46.50′E	Ross Island, South Andaman	68	Black and Yellow Sea Snake *Pelamis platurus*. Floating on the surface.
34	14.2.05	12.45	13^0 02.69′N 87^0 18.23′E	Off Chennai, Bay of Bengal	2100	*Hydrophis spiralis*. Larger in size. Sighted on the surface of water.
35	14.2.05	16.30	10^0 02.91′N 86^0 39.66′E	Off Chennai, Bay of Bengal	2200	*Hydrophis spiralis*. Moving in *zig- zag* manner.
36	14.2.05	13.40	13^0 02.69′N 87^0 18.23′E	Off Chennai, Bay of Bengal	3107	*Hydrophis spiralis*. Often coiling around the body.
37	14.2.05	13.45	13^0 02.37′N 87^0 10.17′E	Off Chennai, Bay of Bengal	3100	Hook-nosed Sea Snake *Enhydrina schistosa*. Calm sea, clear weather. 300 nautical miles away from the shore.
38	14.2.05	16.25	13^0 02.60′N 86^0 44.68′E	Off Chennai, Bay of Bengal	3072	Malacca Sea Snake *Hydrophis caerulescens*. Calm sea, good weather.
39	14.2.05	16.45	13^0 02.91′N 86^0 39.56′E	Off Chennai, Bay of Bengal	3071	Annulated Sea Snake *Hydrophis cyanocinctus*.
40	14.2.050	17.15	13^0 03.19′N 86^0 35.24′E	Off Chennai, Bay of Bengal	3000	Species not identified due to poor visibility and rough sea.
41	15.2.05	07.30	13^0 03.35′N 84^0 07.85′E	Off Chennai, Bay of Bengal	3261	Hook-nosed Sea Snake *Enhydrina schistosa*. Calm sea, good visibility. Sighted 219 nautical miles away from the shore.

Table 2. List of sea snakes and their relative (%) sightings in the Indian coastal waters

Species	Arabian Sea	Bay of Bengal	Andaman Island	Nicobar Island	No	Relative sightings (%)
Enhydrina schistosa	10	2	-	-	12	**29.0**
Hydrophis cyanocinctus	7	1	-	-	8	**19.5**
Hydrophis spiralis	4	3	-	-	7	**17.0**
Hydrophis caerulescens	-	1	-	-	1	**2.5**
Pelamis platurus	-	-	3	-	3	**8.0**
Kerilia jerdonii	1	-	-	-	1	**2.5**
Hydrophis ornatus	2	-	-	-	2	**5.0**
Lapemis curtus	-	-	1	-	1	**2.5**
Unidentified sea snakes	5	1	-	-	6	**14.0**
Total	**29**	**8**	**4**	**-**	**41**	**100.0**

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