

DUGONG IN THE GULF OF KACHCHH, GUJARAT, INDIA-DISTRIBUTION AND THREATS

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ABSTRACT

Gulf of Kachchh (GoK) is the only area on the west coast of India where Dugong is known to occur, but information pertaining to the Sirenian in GoK is limited. Therefore, a study was conducted from 2007 to 2009 mainly through fishermen interview survey to get information pertaining to distribution of Dugong in GoK. The study has indicated that Dugong in the GoK is mainly distributed between Okha and Pirotan Island. The study has also derived information on threats to Dugong in the GoK by understanding fishermen's perception in this regard. According to fishermen's perception, industrial pollution, trawling and boat traffic have been the main threats to Dugong in the GoK.

Key words: Distribution, Dugong, Stranding records, Gulf of Kachchh (GoK), Threats.

Introduction

Dugongs (*Dugong dugon*) have a wide range of distribution in the Indo-Pacific Ocean (Marsh *et al.*, 2002). However, in India, its occurrence is restricted only to Andaman and Nicobar Islands, Palk Bay and Gulf of Mannar in Tamil Nadu on the south-east coast (Annandale, 1905; Prater, 1928; Jones, 1959; Das and Dey, 1999; Pandey *et al.*, 2012; Anand *et al.*, 2015) and in the Gulf of Kachchh (GoK) on the west coast of India (Lal, 1963; Frazier and Mundkur, 1990; Marsh *et al.*, 2002). The only known Dugong population on the west coast of India is found in the Gulf of Kachchh (Lal, 1963; Frazier and Mundkur, 1990). As the majority studies are based on stranding records or dead Dugong and therefore the population status and other information of Dugong in the Gulf of Kachchh are unknown. The population is very isolated and other nearest known population is approximately 1,700 km far in south in Gulf of Mannar, India and approximately 1,500 km far in west in the Arabian Gulf (Marsh *et al.*, 2002). Considerable scientific information is available for this Sirenian in Tamil Nadu and Andaman and Nicobar Islands (Lal, 1976; Jones, 1981; Marsh *et al.*, 2002; Illangakoon *et al.*, 2004; Badrudeen *et al.*, 2004; D'souza and Patankar, 2009) but its status in the GoK is unknown (Marsh *et al.*, 2002). The gap of such information about Dugong in GoK is undesirable considering that the State Forest Department would need latest information about its status including distribution, threats and chalking out recommendations for conservation measures of the

species. Dugong is listed in Appendix I of the CITES and classified as globally Vulnerable (VU) by IUCN. Dugong is also listed as Schedule-I species under Wildlife (Protection) Act, 1972 in India. Any information about Dugong that has been collected in a relatively recent time-frame using an internationally accepted approach would have high importance for conservation of Dugong in GoK. Fishermen interview survey is one such approach (Marsh and Lefebvre, 1994). The present study provides information on distribution of Dugong and threats to it in the GoK mainly through the fishermen interview surveys.

Material and Methods

Gujarat has a long coast-line of about 1600 km (SAC, 2010). However, for interview surveys of fishermen as also for limited boat surveys, the research team of GEER Foundation focused on the southern GoK because old records occurrence of live/dead Dugong in Gujarat are restricted to this area.

The GoK, having an area of 7,300km², is located between 22°22'N and 22°43'N latitudes and 68°58'E and 70°21'E longitudes. It has wedge shaped configuration with 170km length and 75km width at the mouth (Singh, 2003). The average depth of the Gulf is 30m, but it varies from 20m at the head to 60m in outer region (Lal, 1963). Average annual rainfall of 40cm is received from the south-west monsoon and average maximum and minimum temperatures are 15°C and 35°C respectively (ICMAM, 2002; Singh *et al.*, 2004). The Marine Protected Area (PA)

The study revealed that the main threats to Dugong in the Gulf of Kachchh are industrial pollution, trawling and boat traffic, according to fishermen's perception.

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comprising of Marine National Park (162.89 km²) and Sanctuary (295 km²) in the GoK is the first of its kind along the Indian coast. Major part (*i.e.*, 309 km²) of this PA consists of intertidal zone and 42 islands with coral reefs and mangroves (Singh *et al.*, 2004).

Seagrasses that constitute the food resource for Dugong are present in GoK. Jagtap *et al.* (2003) had recorded four seagrass species, viz., *Halodule uninervis*, *Halophila beccarii*, *H. ovalis* and *H. ovata*. In addition to that, Singh *et al.* (2004) has reported *Cymodocea serrulata* and *Thalassia* sp. Nair (2002) reported three species viz., *Halodule uninervis*, *Halophila ovata* and *H. Beccari* on sandy regions of Narara reef and Kalubhar reef. Singh *et al.* (2004) shows the locality-wise status of seagrass. Maximum abundance of seagrass was observed at Paga reef, Chandri reef, Noru reef, Bhural chank reef, Kalubhar reef, Narara reef, Boria, Mangunda, Goose and Pirotan (Singh *et al.*, 2004). On the other hand, minimum abundance of seagrasses was recorded at Meetha Chusna, Bhaidar, Chank, Ajad, Jindra, Chhad and Poshitra (Singh *et al.*, 2004).

Fishermen Interview surveys have been recommended as appropriate starting point to assess Dugong status in developing countries (Marsh and Lefebvre, 1994). Therefore, considering that no systematic Dugong studies have been conducted in the GoK till date, fishermen interview surveys constituted the main strategy of the study with the aim of collecting information on sightings, distribution, and threats. It was also aimed to collect information on some other aspects *i.e.*, biology, food, associated fauna threat to Dugong due to use of Dugong meat or body parts for food and any myths pertaining to Dugong. A questionnaire was developed to collect information on Dugong through fishermen's interview surveys. Few important questions such as "when was last Dugong sighted"; "how Dugong is identified"; "how often Dugongs were sighted in the till the recent past" and "how often Dugong are sighted now" were asked to fishermen during interview survey. Besides fishermen interview surveys, literature survey was also carried out to collect basic secondary information on Dugong's distribution, seagrass (the only food for Dugong) and its distribution as also stranding/accidental records and threats to the Dugong. For reviewing the literature, the survey team used various national and international journals (either on-line or in print) pertaining to marine biology. Moreover, the survey team browsed through

relevant books and web-sites. To collect secondary information on Dugong, relevant Indian organizations, Institutes and other authorities were also contacted to obtain information on past or current Dugong sightings records (live and dead) and threats to Dugong population. Based on Information available from literature survey and organizations/ authorities, priority areas for surveys were identified. The present study was mainly designed considering fishermen's interview surveys. Therefore, the scope for boat surveys was limited. Some likely important islands (viz. Pirotan, Kalubhar and Ajad) and coastal areas (viz. Poshitra and Narara) determined through secondary information were covered during boat surveys. Boat surveys were conducted to have opportunistic sighting of Dugongs, record indirect evidences like feeding trails and to have a qualitative (presence/absence and number of species) assessment of GoK areas as potential Dugong habitats (seagrass beds).

On the basis of literature survey, coastal area of the southern coast (*i.e.*, Jodiya-Okha) was considered important as compared to the northern coast for fishermen interview survey.

In the GoK, the survey team interviewed 355 fishermen in 18 villages (*i.e.*, 16 coastal villages and 2 islands with human settlements) located between Okha (22°26'21.5"N, 69°01'09.8"E) near the mouth of the Gulf and Jodiya (22°40'07"N, 70°16'04.4"E) near the tip of Gulf during October 2008. Various age-groups of fishermen were considered for interviewing them regarding Dugong sighting. The summary of number (proportion) of fishermen belonging to different age-groups is given below:

It may be noted that 297 (out of total 355) fishermen who were interviewed belonged to the age-group of 20-50 years. This is because this was found to be the most active fishermen group from the view-point of livelihood earning. However, we also interviewed about 26 old fishermen (who had ceased fishing activity due to old age) as we wanted to get some information on Dugong's status in the past too. Women were excluded from the interview surveys as women did not indulge in fishing. The Important Dugong Areas were identified based on a) feedbacks of fishermen regarding their sightings of Dugongs (five years with respect to the time-frame of the interview, *i.e.* May 2008); b) stranding observations made during the surveys and stranding/ accidental catch records available from literature; and c)

Number and proportion (%) of fishermen interviewed as per different age-groups

Below 20 years	21-30 years	31-40 years	40-50 years	above 50 years	Total
32(9.01%)	125(35.21%)	101 (28.45%)	71 (20.00%)	26 (7.32%)	355

locations of seagrass beds and Dugong feeding trails therein encountered during the boat surveys. The feedbacks of fishermen and observations/records of stranded Dugongs helped in determining frequency of occurrence of Dugong at certain locations, which in turn, helped in determining important Dugong areas. The survey team also carried out boat surveys to record sightings of live Dugongs opportunistically with an aim to substantiate the important Dugong area. The survey team also carried out foot transects during low tide in potential coastal and island areas for detecting the presence of any likely Dugong feeding trails.

Results and Discussion

The fishermen survey reflected that only small proportion of fishermen community of GoK had come across Dugong. Out of 355 fishermen interviewed during the present study, only 27 (i.e., 7.60%) fishermen claimed to have one or more Dugong sightings in the GoK. In other words, considering minimum one Dugong sighting by each of the 27 fishermen, there might have been at least 27 sightings of Dugong in the GoK, Gujarat till 2008. The fishermen's sighting of the remotest past was in 1980s, whereas the latest one was in January 2008. Such a wide temporal range of sightings was considered in this study as its main aim was to decide the likely distribution of Dugong in the GoK. It was possible to get fishermen's reports about Dugong sighting even for relatively old time-frame of 1980s because while interviewing the fishermen, we had not excluded relatively aged fishermen. Dugong survey through fishermen interviews was also carried out in Gulf of Mannar and Palk Bay in Tamil Nadu state from 2007 to 2009. It was found that compared to the fishermen in Gulf of Mannar and Palk Bay (Tamil Nadu), fishermen of GoK(Gujarat) had poor knowledge about Dugong.

Fishermen surveys in the GoK revealed that individuals of Dugong were encountered by fishermen between Okha and Pirotan island. In this tract, two sightings were reported each from Chank Island and Pirotan island; three sightings were reported each from Okha, Poshitra, Ajad island and Salaya; and 11 Dugong sightings were reported by fishermen at Bet Dwarka Island. Thus, based on above-mentioned localities of Dugong sightings, it is inferred that Dugongs might have distributed between Okha and Pirotan Island in the GoK (Fig. 1). The cluster of islands/reef near Okha (i.e., Chank, Bhaidar, Noru, Ajad, Bet Dwarka, Paga, Boria), area near Salaya and Pirotan island constitute the Important Dugong Area (Fig.1).

Seagrass is the main food of Dugong (Spain and Heinsohn, 1973; Lipkin, 1975) and therefore qualitative seagrass surveys were carried out. Three species of

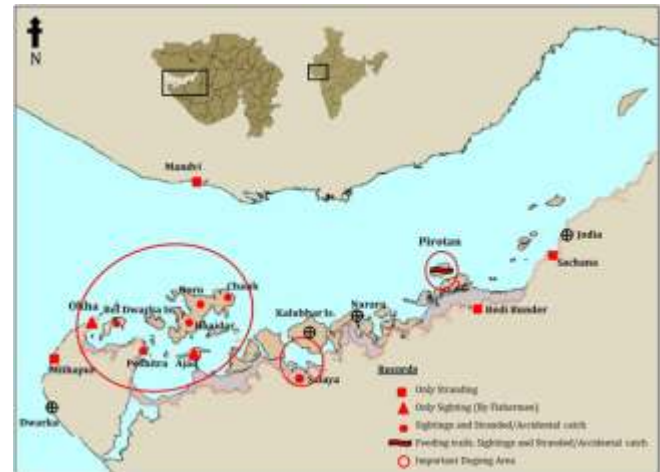


Fig. 1: Likely Distribution of Dugong in GoK, Gujarat.

Note: The sighting and feeding trail records and stranding reports pertain to the sea waters around the encircled places that included islands (e.g., Pirotan) and coastal villages/towns (e.g., Salaya). Important Dugong Areas represented by red circles are indicative only.

seagrass, i.e., *Halodule uninervis*, *Halophila ovalis* and *H. ovata* could be detected near Kalubhar and Pirotan islands and in the coastal area of Narara. Though Dugong could not be detected, feeding trails of Dugong were recorded in the seagrass bed (of *Halodule uninervis*, *Halophila ovalis* and *H. ovata*) adjacent to Pirotan Island (Anand et al., 2012). This was the first report of the feeding trail of Dugong from GoK (Anand et al., 2012). Thus, Pirotan island certainly falls in foraging area of Dugong in GoK. However, Nair (2002); Singh et al. (2004) and SAC (2010) have recorded seagrass beds at/near Chank, Noru, Bhaidar, Kharachusna and Meetha Chusna, Poshitra, Ajad, Paga reef, Boria, Mangunda, Chandri reef, Kalubhar reef, Narara, Goose and Pirotan, Jindra and Chhad. Thus, it is likely that Dugong occurs in those areas too.

In India, stranding records for Dugong have been highest from GoK, Gujarat (Sivakumar and Nair, 2013). Stranding and accidental catch records are summarized in table 1.

Table 1 shows that out of total 21 records of stranding and accidental catches, three were of accidental catch and remaining 18 were of stranding. Out of 18 stranding records, only bones were reported in four records and in each of 14 records an intact dead body of Dugong was found.

The records have revealed that stranded or accidentally caught Dugongs have occurred during all the three seasons. Of these, eight records were in winter (November to February), three in summer (March to June) and three in Monsoon (July to October) though they were not recorded in the months of April, May, August, October and November. Records indicate that maximum records of

Table 1: Stranding and accidental catch records of Dugong in GoK.

S. No.	Date	Place	Stranded/Accidental catch	No. of dugong	Sex*	Source
1	1877	Sachana, Jamnagar	Accidental catch	1	?	Moses, 1942
2	April 1893	Mandvi, Kachchh	Stranded (Skull)	1	?	Phipson (1895)
3	17 July 1959	Bedi Bunder	Stranded	1	M	Mani, 1960
4	30 July 1959	Bedi Bunder	Stranded	1	F	Mani, 1960
5	Oct 1961	Pirotan Island	Stranded (Bones)	2	?	Lal, 1963
6	6 March 1962	Entangled in gillnet brought to Salaya	Accidental catch	1	F	Lal, 1963
7	15 June 1978	Bhaidar Island	Stranded	1	M	Bhaskar 1978
8	3 Sep 1983	Bet Dwarka island	Stranded	2	M&F	Ved, 1983
9	5-6 Jan 1987	Bet Dwarka island	Stranded (Bones)	3	?	Frazier and Mundkur, 1990
10	7 Jan 1987	Poshitra	Stranded	1	M	Frazier and Mundkur, 1990
11	Jan 1994	Poshitra	Stranded	1	?	Singh, 1994
12	March 2000	Noru-Bhaidar Island	Accidental catch	2	M	Singh <i>et al.</i> , 2004
13	7 Dec 2000	Bhaidar Island	Stranded (Skull)	1	?	Singh <i>et al.</i> , 2004
14	13 Feb 2002	Bet Dwarka Island (with photographs)	Stranded	1	?	Mr. Bhavesh Trivedi Pers. Commu.
15	20 Feb 2002	Poshitra (Shaan point)	Stranded	1	?	Singh <i>et al.</i> , 2004
16	2003	Poshitra	Stranded	1	?	Singh <i>et al.</i> , 2004
17	14 Jan 2004	Poshitra	Stranded	1	?	Mr. R.J. Asari
18	2005	Bet Dwarka Island	Stranded	1	?	Mr. Rajendrasinh Jadeja, Pers. comm.
19	Dec 2007	Bet Dwarka Island	Stranded	1	?	Present Study
20	15 Jan 2010	Bet Dwarka Island	Stranded	1	F	MNP&S
21	3 Jan 2013	Mithapur, Okha	Stranded	1	F	Yogesh Kumar <i>et al.</i> , 2013

Note: M-Male, F-Female, ?-Unknown

Indirect evidence of Dugong's past occurrence based on bones availability has not been considered for analysis because such evidence cannot indicate month/season of Dugong mortality. There were total four such records in addition, three more records at sr. no. 1, 16 and 18 in Table 1, for which dates/month of evidence were not available, are also not considered for analysis. Thus, 7 records out of total 21 records in Table 1 are not considered for analysis.

Dugong stranding/accidental catch were reported in winter season during 1877 and 2013 in GoK. The reason of more stranding records in winter is the subject of research.

As shown in table 1, stranded intact carcasses, bones and accidental catch records were highest at Bet Dwarka (n=6) and Poshitra (n=5) and one or two at remaining locations. It is interesting to know that these two sites are camping site for collage or school students. It is the likely reason to have Dugong's report from these two sites. All stranded or accidental caught records were reported only from southern portion of the GoK. Only one record of skull from Mandvi, Kachchh was available. Dugong was accidentally caught at three sites, namely Sachana, Salaya and at a site located between Noru and Bhaidar islands.

Threats

The magnitude and type of threats to Dugong in GoK might be insignificant as compared to those in other Dugong areas of the country. This is not only because Dugong is uncommon in GoK in relatively recent time-frame (Pandey *et al.*, 2010), but also because it has always occurred in very stray numbers since distant past (Jones, 1959). Despite Dugong's low population in GoK, researchers of the present study have attempted to

understand threats to Dugong in GoK. In India, hunting, bottom trawling, accidental catch, heavy boat traffic, dynamite fishing, agricultural pollution, oil spills, dredging, habitat loss and tsunami/cyclone are known to be the threats to Dugong (Marsh *et al.*, 2002; Illangakoon *et al.*, 2004; Pandey *et al.*, 2010; Sivakumar and Nair, 2013).

During the present study in GoK, fishermen perceived trawling and industrial pollution as possible threats to the Dugong population in GoK. Kamboj (2014) has also mentioned that pollution due to various industries and sedimentation affecting the water quality is a major threat to the seagrass meadows in Marine National Park and Sanctuary in GoK. Fishing boat traffic is high in GoK (Sivakumar and Nair, 2013) and it is also one of the threats to the Dugong population in the GoK.

Oil extracted from Dugong is reported to be valuable preservative and conditioner for wooden boats in Gok (Frazier and Mundkur, 1990). Some fishermen reported during the present study that in the past, they had used the fat derived from the body of Dugong for oil extraction. However, through conversations with fishermen, the survey team has inferred that hunting/poaching by fishermen has never been a major threat to the Dugong population in the GoK.

Conclusions

The present study has given indication of likely Dugong distribution in GoK. Dugong appears to be distributed between Okha and Pirotan Island in GoK and the cluster of islands/reefs near Okha, area near Salaya and Pirotan island can be considered as Important Dugong Area. From the view point of threat to Dugong, winter season appears to be critical one as maximum stranding/accidental catches in the GoK were reported during winter season. Bet Dwarka and Poshitra were found to be the main sites for the stranding. As per the fishermen's perception, trawling, fishing boat traffic and industrial pollution are the possible threats to the Dugong in GoK.

Recommendations

The present study has helped in filling up the information gap regarding Dugong's distribution in the GoK. However, besides distribution, population is another important aspect in studying any threatened species. But, there is no reliable population estimates of Dugong in GoK based on systemic study. Therefore, there is an urgent need to carry out periodic scientific population

estimations for Dugong in the GoK. Seagrass is the preferred food of Dugong and therefore it is the strongest factor that decides distribution of Dugong in the GoK. Therefore, along with collecting information on Dugong's distribution, the information on distribution of the seagrass is also very important. Therefore, we recommend carrying out seasonal and multi-year mapping of the distribution of seagrass meadows and their extent in different areas of the GoK. Dugong stranding records in GoK are reported more in winter, but there is an information gap to be filled up about its likely reasons. Apart from collecting comprehensive scientific information on a threatened species, involvement of local communities is also necessary for conservation of a threatened species. Therefore, fishermen who actively support Dugong conservation can be given incentives. Especially, fishermen who take care to release Dugong captured in their nets, should be suitably rewarded. Education and awareness creation, especially for fishermen communities, should be considered as the major activities for the conservation of Dugong.

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कच्छ की खाड़ी, गुजरात, भारत में डूगोंग-विस्तरण एवं संकट

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सारांश

कच्छ की खाड़ी भारत के पश्चिमी तट पर केवल ऐसा क्षेत्र है, जहाँ डूगोंग पाया जाता है किन्तु कच्छ की खाड़ी में सिरेनियन से संबंधित सूचना सीमित है। इसलिए मुख्यतः मछुवारों से साक्षात्कार सर्वेक्षण के जरिए 2007 से 2009 तक एक अध्ययन किया गया ताकि कच्छ की खाड़ी में डूगोंग की प्राप्ति से संबंधित सूचना प्राप्त की जा सके। अध्ययन ने दर्शाया कि कच्छ की खाड़ी में डूगोंग मुख्यतः ओखा और पिरोटन द्वीप के मध्य पाया जाता है। अध्ययन से इस संबंध में मछुवारों की धारणा को समझकर कच्छ की खाड़ी में डूगोंग के लिए संकटों पर सूचना भी प्राप्त की गई। मछुवारों की धारणा के अनुसार औद्योगिक प्रदूषण, मछली पकड़ने के बड़े जाल और बोट ट्रैफिक कच्छ की खाड़ी में डूगोंग के लिए मुख्य संकट हैं।

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