

Status of Dugong (*Dugong dugon*) in Gulf of Mannar and Palk Bay, Tamil Nadu, India

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Received 07 November 2013; revised 11 February 2014

Present study consists the survey conducted in coastal villages from Dhanushkodi to Kanyakumari in the Gulf of Mannar (GoM) and from Dhanushkodi to Kodikkarai in the Palk Bay for understanding status of dugong. Survey provided sightings, distribution and population status of dugong in the GoM and the Palk Bay. Dugong was found to be distributed from Dhanushkodi (Ramnathpuram District) to Idinthakarai village (Tirunelveli District) in the GoM and from Dhanushkodi (Ramnathpuram District) to Adirampattinam (Thenjavur districts) in the Palk bay. Likely maximum population of dugong was estimated 78 and 80 individuals in GoM and Palk Bay respectively.

[Key words: Dugong, Distribution, fishermen's interview survey, Palk Bay, Gulf of Mannar (GoM)]

Introduction

The Dugong (*Dugong dugon*) or Sea cow is the only marine mammal of the order Sirenia that is found in the coastal habitats of Indo-Pacific region including India¹¹. This herbivore belonging to the family Dugongidae, is threatened by various anthropogenic and natural causes¹¹. It is listed as a "Vulnerable" species according to IUCN Red List of Threatened Species 2013 [Version 2013.1].

The present study assessed the status of dugong in the Gulf of Mannar (GoM) and the Palk Bay in Tamil Nadu mainly by conducting fishermen interview surveys for about ninety days between 2007 and 2009. The assessment was carried out as a part of countrywide dugong status assessment from 2007 to 2009, mainly through fishermen interviews. The significance of this study lies in the fact that it provided latest information on distribution of dugong and their likely maximum population in Tamil Nadu (GoM and Palk Bay). In the recent time-frame (*i.e.* in 2000s), no other study has attempted intensive surveys in Tamil Nadu. Even the latest research note published on dugong in GoM², has provided information (on aspects such as its major distribution and threats to it in India) based on literature of old records up to 1990s only. Therefore the present study has played an important role of understanding dugong's status in the GoM and the Palk Bay in the recent times (*i.e.* 2007-2009).

Materials and Methods

The study covered GoM and Palk Bay (Tamil Nadu) that are well known for the luxuriant seagrass beds (dominated by *Halophila*

ovalis) and in turn, their high significance as feeding grounds of dugong¹¹.

The GoM covers a part of southern portion of Tamil Nadu coastline between Dhanushkodi (9°09'34"N, 79°26'53"E) in north and Tuticorin (8°48'29" N 78°09'44"E) in south. The shoreline of the GoM is mainly spread over two districts of Tamil Nadu, viz., Ramnathpuram and Tuticorin. However, coastal areas of Tirunelveli and Kanyakumari districts are also located in the vicinity of this Gulf. The GoM, with an area of about 10,500 sq.km, encompasses a group of 21 islands surrounded by seagrass meadows dominated by *Halophila ovalis*⁹. These islands are located in the area ranging from Rameshwaram to Tuticorin that is important for dugong⁶. According to Jones⁷, these islands



constituted the main area for dugong catching in the GoM.

Fig.1- Survey area in Gulf of Mannar (Dhanushkodi to Kanyakumari) and Palk Bay (Dhanushkodi to Kodikkarai), Tamil Nadu, India.

During the study, more than 300 km shoreline of GoM between Dhanushkodi (9°09'34"N, 79°26'53"E) to Kanyakumari (8°04'59"N, 77°33'07"E) was surveyed.

A total of 13 species of seagrasses have been recorded in the GoM which include *Cymodocea rotundata*, *C. serrulata*, *Enhalus acoroides*, *Halodule pinifolia*, *H. wrightii*, *H. uninervis*, *Halophila ovalis* (sub-species *ovalis* and *ramamurthina*), *H. baccarii*, *H. decipiens*, *H. ovata*, *H. stipulacea*, *Syringodium isoestifolium* and *Thalassia hemprichii*^{8,14}.

The Palk Bay is also located in southern portion of the Tamil Nadu coastline and north of the GoM between Ramnathpuram and Nagapattinam districts. Shoreline of the Palk Bay is spread over 5 districts, namely, Ramnathpuram, Pudukottai, Thanjavur, Thiruvarur and Nagapattinam. Unlike the GoM, it is devoid of any islands.

Illangakoon *et al.*⁶ had reported the area of Thondi to Rameshwaram as an important area for dugong in Palk Bay. Badrudeen *et al.*³ reported the occurrence of dugong in Rameshwaram Bay, Olaikuda, Devipattinam, Thondi, Sundarapattinam and Adirampattinam in Palk Bay. Jones⁷ reported that in the Palk Bay, the main area for dugong catching was between Devipattinam and Pamban (Rameshwaram island). Villages that were surveyed were located in more than 250km shoreline of Palk Bay from Dhanushkodi (9°09'33.9"N, 79°26'53.2"E) to Kodikkarai (10°16'32.3"N, 79°49'24.5"E).

In the Palk Bay, 11 species of seagrasses are reported, and include *Cymodocea rotundata*, *C. serrulata*, *Enhalus acoroides*, *Halodule pinifolia*, *H. uninervis*, *Halophila ovalis*, *H. wrightii*, *H. ovata*, *H. stipulacea*, *Syringodium isoestifolium* and *Thalassia hemprichii*^{8,14}.

The research team carried out surveys for three months covering both the GoM and the Palk Bay. Prior to the fishermen interview surveys, the research team collected the list of the coastal villages of Tamil Nadu from the Fisheries Census-2005 published by Department of Fisheries.

Majority of fishermen were cooperative, knowledgeable and trustworthy during the interviews aimed at information gathering pertaining to dugong. Only a small number of fishermen were reluctant, untrustworthy and/or unwilling in giving feedback to the interview questions.

In the GoM (from Dhanushkodi to Kanyakumari), the research team carried out surveys between December 2008 and January 2009. The team interviewed 1,396 fishermen in 65 villages along the GoM.

The coastal fishing villages in the Palk Bay (from Dhanushkodi to Kodikkarai) were

visited for the fishermen interviews between September 2008 to October 2008 and the team interviewed 2,061 fishermen in 96 villages along the Palk Bay shoreline.

The study mainly relied on fishermen interview surveys for collecting data pertaining to the dugong. Only male fishermen were interviewed because usually women of the fisher community do not indulge in fishing traditionally. In addition, information was also collected through a survey of literature to obtain a baseline and/or past information on dugong in GoM and Palk Bay. Officers of the local Forest Department, Fisheries Department and institutions like Central Marine Fisheries Research Institute (Mandapam, Tamil Nadu) and Wildlife Institute of India (Dehradun) were also contacted to seek authentic information through personal communication and literature. A few boat surveys in the offshore area covering Periapattinam to Pamban, Krusadi Island, Poomarichan Island, Talaiyari Island, Mulli Island, Appa Island and Valimunay Island, were undertaken mainly to obtain a qualitative assessment of seagrass and to aim for opportunistic sightings of dugongs. These areas were selected based on the suggestion of Dr. Dandapani, Former Scientist of Zoological Survey of India (ZSI).

Results and Discussion

The present study has thrown light on the aspects of village wise/island wise sightings of dugong, distribution of dugong, 'Important Dugong Area'(IDA) and likely maximum population of dugong in the GoM and the Palk Bay.

We categorized the dugong sightings reported by fishermen of the GoM and the Palk Bay as mentioned below:

a) 'Within a year sightings' with respect to the fishermen's interview dates: These were the sightings that occurred within 1 year from the dates of the fishermen's interview that were conducted in January 2009 in the GoM and in October 2008 in the Palk Bay; and

b) 'Over a year sightings' with respect to the fishermen's interview dates: These were the sightings that occurred between 2 to 5 years from the dates of fishermen's interviews that were conducted in the months and years mentioned in a) for the GoM and the Palk Bay.

c) 'Old sightings' with respect to the fishermen's interview dates: All other sightings recorded even before 'Over a year sightings' were considered as

'old sightings' and were not used in any data analysis.

Through the fishermen's interview, some interesting and important information regarding dugong had emerged. Fishermen informed that dugong is locally known as 'Avolia', 'Kadalpashu' and 'Kadalpanni' (Sea pig). In the recent times, sighting of dugong has become very rare but in past it was very common. Moreover, in the recent times, largely sighting of a single dugong has become almost a norm, but in the past, the species was commonly seen in groups. They also mentioned that accidental catch of dugong has also decreased in the recent times. As per the fishermen, anthropogenic causes [as per 94.4% of interviewed fishermen in the GoM and 87.7% in the Palk Bay] such as hunting, trawling, accidental catch in nets, increased fishery and dynamite fishing and natural causes [as per 5.64% of interviewed fishermen in the GoM and 12.35% in the Palk Bay] such as tsunami, cyclone, decreasing seagrass and diseases can be the reasons attributed to the decline of the dugong. It may, however, be noted that fishermen could not give any precise information on impact of the tsunami or diseases on dugong population. Nevertheless, tsunami is known to cause direct harm physically and indirect harm by degrading/destroying seagrass. As far as diseases in dugong are concerned, it may be noted that Dugong is known to be susceptible to a wide range of diseases including parasitic infestations. Since 1996, 30% of the 80 animals reported to the Queensland Parks and Wildlife Service (Australia) died from disease¹¹.

Dugong sightings by fishermen in the GoM

Dugong sightings were reported by fishermen in the waters near 75 sites (*i.e.* 61 coastal villages and 14 islands). It may be noted that 61 coastal villages with dugong records constituted 93.8% of all the villages covered for fishermen interviews ($n=65$) and 14 islands constituted 66.7% of total 21 islands in GoM. In other words, dugong's occurrence was reported for 87.2% of all the sites in GoM as total 86 sites (65 coastal villages and 21 islands) were covered for getting information about dugong's occurrence. In the waters near 26 sites (*i.e.* in 20 coastal villages and 6 islands) of Ramnathpuram, Tuticorin and Tirunelveli districts, "within a year sighting" of dugong (*i.e.* between January 2007 to December 2008) were recorded *with respect to the interview period* (January 2009). For 38 sites (*i.e.* 32 coastal villages and 6 islands) of the same districts (*i.e.* Ramnathpuram, Tuticorin and

Tirunelveli districts), "over a year sightings" of dugong (*i.e.* dugong sightings occurred between January 2003 and December 2007) were recorded.

'Old sightings' of dugong for the GoM were recorded even before 'over a year' time-frame and considering that these information may be less reliable due to likely memory limitations of the fishermen, they were excluded from any further analysis.

Dugong sightings by fishermen in the Palk Bay

Dugong sightings were reported by fishermen in waters near 83 out of total 96 (*i.e.* 86.5%) villages surveyed for the fishermen interviews. Of these, in the seawaters of 42 villages of Ramnathpuram, Pudukottai and Thanjavur districts, dugong was seen (and reported) by fishermen within the time-frame of one year before the fishermen interview. This means, for 42 villages, "within a year sighting" of the dugong was recorded through the fishermen's interviews. On the other hand, in the seawaters of 21 villages in Ramnathpuram, Pudukottai and Thanjavur districts, 'over a year sighting' of dugong was recorded as these sightings were made between September 2002 and August 2007 (interviews in the Palk Bay were carried out in October 2008). Other sightings such as 'Old sightings' were recorded even before the time-frame of 'over a year sightings' and therefore they were not considered for further analysis.

Comparative account of dugong sightings in the GoM and the Palk Bay

Sightings of dugong were recorded in the seawaters of 87.21% sites (coastal villages/islands) in GoM were almost the same as in the Palk Bay (86.46% sites). This means though the GoM is currently a Marine Protected Area (MPA), the Palk Bay also deserves some legal protection.

Distribution of dugong

Prior to the present study, information about distribution of dugong in India was available only at broader level in the Gulf of Kachchh (Gujarat state), GoM and Palk Bay (Tamil Nadu state) and in Andaman and Nicobar Islands^{3, 4, 10, 12}. However, information at such a micro-level *i.e.*, at village/island level for the GoM and the Palk Bay was largely unknown. For chalking out and implementing focused conservation strategies for dugong, micro-level information gap is undesirable. The present study

has contributed to fill up this information gap as shown in figures 2 and 3.

For inferring the distribution of dugong in the GoM and the Palk Bay, researchers used records of dugong sightings (by fishermen) of two time-frames i.e. ‘within a year sightings’ and ‘over a year sightings’ which provide distribution of dugong in GoM and Palk Bay during 2000s. Through this study a novel term ‘Important Dugong Area’ (IDA) has been coined. It may be noted that the term ‘Important Dugong Area’ (IDA) is the area wherein dugong was sighted by fishermen ‘within a year’ time frame with respect to the interview date. Thus, IDA refers to the area that might be important from the view point of dugong conservation efforts.

Distribution of dugong in GoM

Considering Inigonagar as the central location of the GoM shoreline (Fig.1), the GoM’s shoreline can be divided into an ‘upper shoreline’ (Dhanushkodi to Inigonagar) and ‘lower shoreline’ (Inigonagar to Kannyakumari). During the time-frame covering 6 years with respect to the date of fishermen’s interview, dugong occurred in the seawaters along the entire ‘upper shoreline’ covering 155km stretch[from Dhanushkodi (9°9’34.00”N 79°26’53.00”E) to Inigonagar (8°47’26.30”N 78° 9’40.00”E)]. This area also included 13 islands such as Mulli, Muyal, Valli, Appa and Van (Fig.2). As the dugong has occurred in this portion of the GoM during the 2000s (i.e., January 2003 to December 2007) it can be considered as distribution of dugong in 2000s and any dugong conservation/management efforts can be focused on this portion. Their distribution along this portion of the shoreline of the Gulf, may be correlated to the development of seagrass beds in the area³(Fig. 4).



Fig.2 - Villages wise sightings and distribution of dugong and Important Dugong Area in GoM

Note: In the Map, the sighting of dugong is marked exactly opposite to the relevant village. However, according to fishermen the dugong can be sight anywhere within 1 to 5 km from the seashore.

In the seawaters along the ‘lower shoreline’ of the GoM, dugong occurred in the coastal waters located between Rachanyapuram village (8°40’15.6”N 78°06’11.1”E) of Tuticorin district and Idinthakarai village (8°09’34.2”N 77°38’52”E) of Tirunelveli district covering 80km stretch (Fig. 2). It may be interesting to note that dugong’s occurrence in this portion of the GoM was revealed only during the present study. Notably, this portion of GoM is not included in the Gulf of Mannar Biosphere Reserve. Unlike in the “upper zone”, there is no island in this coastal stretch.

For the area/stretch of lower shoreline between Rachanyapuram to Idinthakarai (Fig.2), no published record of dugong’s occurrence is available. However, during the fishermen’s surveys, the occurrence of dugong was revealed in this area too. There is certainly a need of further detailed field investigations using scientific methods to determine the current distribution scenario of dugong.

Unfortunately, no dugong were recorded during our boat survey.

Distribution of dugong in the Palk Bay

Considering Arsanagaripattinam as the central location of coastal shoreline of the Palk Bay, the Palk Bay shoreline can also be divided into an ‘upper shoreline’ [Kodikkarai to Arsanagaripattinam] and ‘lower shoreline’



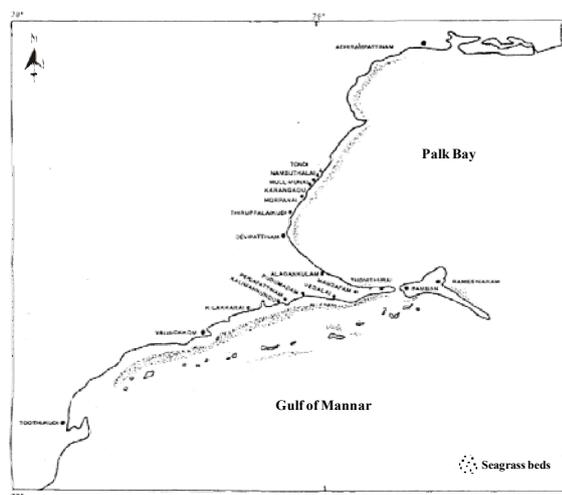
(Arsanagari pattinam to Dhanushkodi) (Fig. 3).

Fig.3 - Villages wise sightings and distribution of dugong and Important Dugong Area in Palk Bay

Note: In the Map, the sighting of dugong is marked exactly opposite to the relevant village. However, according to fishermen the dugong can be sight anywhere within 1 to 5 km from the seashore.

During the time-frame covering 6 years (1 year of “within a year” + 5 yr of “Over a year”) from the interview date (i.e., in 2000s), dugong occurred in the seawaters along the portion of the ‘upper shoreline’ between Adirampattinam (Karaiyur Street) in Thanjavur district and Arsanagaripattinam village in Pudukottai district covering a stretch of 72km (Fig. 3). It is relevant to note that the villages of Thiruvarur district are located quite away from the sea-shore. They fish in the creek areas and sea-shore (open sea) also but few of them have sighted dugong only near sea-shore (open sea - East to the offshore area of Adirampattinam) as shown in map. As dugong have occurred in this portion of the Palk Bay during 2000s, any conservation/management efforts can be focused in this portion. It is relevant to note that along this portion of the shoreline, seagrass beds are known to be well-distributed³ (Fig.4).

In the seawater along the ‘lower shoreline’ of the Palk bay, dugong occurred in the coastal waters between Arsanagaripattinam village of Pudukottai district to Thiruppalaikudi village of Ramnathpuram district covering the stretch of 39km, dugong has also occurred on the seacoast near Devipattinam, Palanivalsai, Panaikulam, Vallundi, and Rameshwaram to Dhanushkodi of Ramnathpuram district (Fig. 3). It is interesting to note that along this portion of the sea-shoreline, seagrass beds are known to be well-distributed (Fig.4).



(Source: Badruddin *et al.*, 2004⁸)

Fig.4 - Distribution of seagrass beds in Gulf of Mannar and Palk Bay, Tamil Nadu

Likely population status of dugong

It was estimated that before 2000s there were approximately 30,000 dugongs in the whole of Indo-Pacific¹. Unfortunately, recent data on Indian population of dugong is not available. However, it is beyond doubt that since late 1990s, dugongs are so scarce that only single individuals are occasionally caught¹.

Estimating the dugong population in the present study was a challenging task because the study was not based on techniques like aerial surveys that can facilitate enumeration of dugongs over the vast area of the sea. This study heavily relied on interviewing fishermen. Therefore, though reliable information on sightings of dugongs was available from fishermen, the information on population was difficult to derive. This is because just on the basis of sightings of dugongs by fishermen, a reliable estimate of dugong population in the GoM or the Palk Bay could not be made due to the possibility of the repeated sightings of the same individual by fishermen at different locations on different days (Dr.P. Dhandapani; *ex-scientist ZSI, Pers. Comm.*).

Badruddin *et al.*³; Illangakoon *et al.*⁶, Illangakoon and Tun⁵ had conducted dugong surveys in GoM during different time-frames using more or less similar strategy to that of the present study. They too could not provide an estimate of population status of dugongs. Anandharaj *et al.*² too have not provided any population estimate for dugong in the recent time. Only Das and Dey⁴, through their dugong studies in the Andaman and Nicobar Islands in 1999 had provided population estimate of dugong population through the fishermen interview surveys in addition to snorkelling and diving.

Though, it is difficult to provide an estimate of the population for this underwater marine Sirenian, it is not desirable to completely ignore this aspect. This is especially important when developing/implementing a dugong recovery plan or other focused, area-specific conservation strategies for the dugong. Based on fishermen interviews during the present study, it appears that over seventy five but less than hundred dugongs occur in the GoM and Palk Bay each. We have come to this educated guess by using number of single dugong sightings, group sightings and mother-calf sightings of dugongs by fishermen and number of villages with respective types of sightings in the following simple mathematical expression:

$$\text{Likely maximum dugong population} = [(N_{v_s})(D_s)] + [(N_{v_{dg}})(D_{dg})] + [(N_{v_{mc}})(D_{mc})]$$

Where,

N_{v_s} = Number of villages/islands with single dugong sighting by fishermen in the time-frame of “within a year” and “over a year”

D_s = Number of dugongs sighted singly in the seawaters of/near a village or an island with single dugong sighting=1

$N_{v_{dg}}$ = Number of villages/islands with group sighting by fishermen in the time-frame of “within a year” and “over a year”

D_{dg} = Average number of dugongs sighted in groups at/near a village or an island

$N_{v_{mc}}$ = Number of villages/islands with mother-calf dugong sighting by fishermen in the time-frame of “within a year” and “over a year”

D_{mc} = Number of dugongs in mother-and-calf sightings per village (=2)

[A serious limitation of this simple mathematical expression is that for all villages/islands with single/grouped/mother-calf dugong sighting, it is premised that at each such village/islands, a unique single/grouped/mother-calf dugong was/were sighted. But in reality, possibility of duplication, especially for single dugong sighting cannot be ignored and that is the reason why we have used the term ‘maximum’ for our simple mathematical expression to propose the likely numbers of dugong.]

As the dugong population of Tamil Nadu state is concentrated in the GoM and the Palk Bay, it is logical to combine the dugong population in these two areas to determine the state’s likely maximum dugong population. As the likely maximum population of dugong estimated 78 individual in Palk Bay and 80 individual in GoM, it can be inferred that the likely maximum population of dugong in Tamil Nadu state may not be more than 158 individuals¹³.

Conclusions

As per the present study, the current distribution of dugong in the coastal waters of the GoM ranges from Dhanushkodi to Idinthakarai. Moreover, the coastal waters between Dhanushkodi and Nallathanii Island and its nearby coastal villages constitute an Important Dugong Area (IDA) in the GoM. The study has also indicated that in the coastal waters of the Palk Bay, the dugong is currently distributed

from Dhanushkodi and Adirampattinam. Moreover, the coastal waters of Thiruppalaikudi to Adirampattinam and Panaikulam of Ramnathpuram district constitute an Important Dugong Area (IDA) in the Palk Bay. Major portion of this IDA identified in this study (conducted between 2007 and 2010) has also been considered important by Sivakumar and Nair¹⁵ as the Critical Dugong Habitat. Based on fishermen’s interviews of the present study, the maximum likely population of dugong in Tamil Nadu coast might not be over 158 individuals¹³.

Acknowledgements

Authors are thankful to the Ministry of Environment and Forests (M.o.E.F.), Government of India for financially supporting the present study. Authors are also thankful to Forest Department of Tamil Nadu for encouragement and support. They are thankful to Dr. P. Dhandapani, Retired scientist of ZSI, Tamil Nadu who have provided valuable guidance and support. The first author is thankful to Dr. Bharat Jethva, former scientist, GEER Foundation for his kind support and guidance for conducting fishermen’s interview surveys. The first author is also thankful to Mr. Parimal Solanki, former Junior Research Fellow of GEER Foundation who worked along with the first author for conducting fishermen’s interview surveys and for intensive literature survey. Special thanks to Mr. Rajendrankumar, Mr. Sirajudeen and Mr. Mohmmad Vadudhu, field assistants from Tamil Nadu who become important intermediaries between the fishermen and research team. Support rendered by the Remote sensing unit of the GEER Foundation is also sincerely acknowledged.

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