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Records on Stranding Events of Cetaceans and Illegal Trade of Dolphins in South Kerala, India

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Abstract

This paper reports cetacean stranding events along Kerala coast during 2017 to 2019 of Bryde's whale (*Balaenoptera edeni*), blue whale (*Balaenoptera musculus*), killer whale (*Orcinus orca*) and Indo-Pacific finless porpoise (*Neophocaena phocaenoides*) identified through morphological approach. DNA barcoding using mitochondrial COI gene confirmed the identification of *B. edeni* and *B. musculus*. The bushmeat trade involving striped dolphins (*Stenella coeruleoalba*) is also photo documented here. The paper affirms the need to form cetacean stranding response programs to build a scientific baseline for cetacean conservation and research, monitor threats to cetaceans and curtail the cetacean meat trade.

Keywords: Marine mammal, *Balaenoptera edeni*, *Balaenoptera musculus*, *Orcinus orca*, *Neophocaena phocaenoides*, *Stenella coeruleoalba*, Bushmeat, DNA barcode

1. Introduction

Marine mammals are a charismatic and diverse group of marine vertebrates and among these, cetaceans, including whales, dolphins and porpoises, are the most commonly distributed groups (Berta *et al.*, 2015). Marine mammals play a pivotal and irreplaceable role in the marine ecosystem and are considered marine engineers (Roman *et al*., 2014; Albouy *et al*., 2020) as apex predators in the trophic marine food web (Jefferson *et al.*,1993; Zhao *et al*., 2017). Out of the 85 species reported globally, 40 species occur in the Indian Ocean and based on the stranding and sighting records, around 30 species are reported from Indian waters (Jefferson *et al.*, 2008; Perrin *et al.*, 2009; Vivekanandan and Jayabaskaran, 2012). The species composition may vary according to the oceanic condition and biological composition (Walker *et al.*, 2005). Strandings of cetaceans are a global phenomenon, washed ashore either dead, ill or alive (Geraci and Lounsbury, 2005; Alvarado-Rybak *et al.*, 2020). The primary reasons for cetacean stranding include natural causes such as the alteration in climatic events, oceanic conditions, loss of habitat, disease and infections and anthropogenic reasons such as ship strikes, pollution, acoustic disturbances, hunting, bycatch and the incidental and intentional activities of fisheries (Berman-Kowalewski *et al.*, 2010; Bogomolini *et al.*, 2010; Groom and Coughran, 2012; Trianni and Tenorio, 2012; Bengil *et al.*, 2020). These threats cause direct effects such as mortalities and injuries as well as indirect effects like long term physiological and behavioural changes (Avila *et al.*, 2018). According to Coombs *et al.* (2019), stranding events have increased annually since 1980.

Even though marine mammals are protected under Indian Wildlife (Protection) Act of 1972, many species of cetaceans, especially dolphins, are intentionally hunted for bushmeat, bait and medicine (Yousuf *et al.*, 2009; Porter and Lai, 2017). Anderson *et al.*, (2020) estimated that just in the Indian Ocean Tuna gillnet fisheries, caught an estimated cumulative total of 4.1 million small cetaceans between 1950 and 2018, with Indian gillnet fisheries being in the top three of the nine Indian ocean countries incidentally catching cetaceans. In India, the estimated number of cetaceans bycaught annually is between 9,000-10,000 (MoEFCC, 2021), demanding better management of stranding of these marine mega fauna.

This paper describes four cetacean stranding events and bushmeat trade that occurred during 2017 to 2019 along Kerala coast with a confirmation of identification for a blue whale and Bryde's whale through DNA barcoding, and also describes illegal trade of dolphin meat for local consumption.

2. Materials and Methods

2.1 Coastal and Market Visits

All the major fishing harbours and selected fish landing centers of Kerala coast were visited to observe if the meat trade of cetaceans was taking place. Coastal NGOs and active fishermen in the area were also involved to obtain information on the dolphin bushmeat trade (Table 1). A network of informants was created along the coastal villages to inform about cetacean strandings. Any cetaceans landed were photo-documented. Species were identified by assessing the body shape, size, position and shape of dorsal fin, colour patterns and shape of the head, flippers, and fluke. The key characters and the morphometric measurements and meristic characteristics of the stranded species were recorded (Jefferson *et al*., 1993, 2008; Geraci and Lounsbury, 2005). Tissue samples were collected and preserved in ethanol for molecular analysis, wherever possible.

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2.2 DNA barcoding protocol

DNA barcoding by sequencing of the mitochondrial marker gene cytochrome oxidase 1 (CO1) was used to confirm baleen whale species identification. Genomic DNA was isolated from the tissues using NucleoSpin® Tissue Kit (Macherey-Nagel) following instructions from the manufacturer, and cox1 gene was amplified using universal primers LCO (GGT CAA CAA ATC ATA AAG ATA TTG G) and HCO (TAA ACT TCA GGG TGA CCAAAA AAT CA) (Folmer *et al.*, 1994). PCR product was visualised on 1% agarose gels, and the most intense products were selected for sequencing. The sequencing reaction was done in a PCR thermal cycler (GeneAmp PCR System 9700, Applied Biosystems) using the BigDye Terminator v3.1 Cycle Sequencing Kit (Applied Biosystems, USA). The sequence quality was checked using Sequence Scanner Software v1 (Applied Biosystems). Sequence alignment and editing of the obtained sequences were carried out using Geneious Pro v5.1 (Drummond *et al.*, 2010).

Basic Local Alignment Search Tool (BLAST) was used for sequence similarity search and species identification using GenBank DND sequence data bank (Altschul *et al.*, 1990). Phylogenetic and molecular evolutionary analyses were done by MEGA version 7 (Kumar *et al.*, 2016). Maximum likelihood tree for the cox1 gene was constructed with a bootstrap value of 1000 times to get percentage bootstrap values for branch points.

3. Results

3.1 Morphological Studies

The cetaceans in the Thiruvananthapuram district of Kerala coast recorded during 2017 to 2019 include two species of baleen whales, one Indo-Pacific finless porpoise, one killer whale and two striped dolphins landed for bushmeat (Table 1). The examination of morphology and meristic characters confirmed the baleen whale from Puthukurichi region is a Bryde's whale (*Balaenoptera edeni*) (Fig. 1 A, B; Table 2). The cetacean carcass in Veliyaveli region of Thiruvananthapuram coast was tentatively identified as the blue whale (*Balaenoptera musculus*) (Fig. 1 C, D; Table 3) and later confirmed through molecular studies. The morphological and morphometric studies confirmed that the cetacean stranded at Perumathura region is killer whale (*Orcinus orca*) (8°37'04.5"N, 76°47'52.8"E) (Fig. 2 A-C; Table 4), and the second cetacean from Veliyaveli is Indo-Pacific finless porpoise (*Neophocaena phocaenoides*) (Fig. 2 D; Table 5).

3.2 Molecular analysis

The mitochondrial marker gene, CO1 was successfully amplified and sequenced for both baleen whales. The blast analysis of the sequences of MW564080 and MW564081 showed 99% similarity with sequence of *Balaenoptera musculus* and that of MW571086 showed 99% similarity with *Balaenoptera edeni* available in GenBank, re-confirming the identity of these strandings. The correlation of sequences obtained during this study was inferred using the Maximum Likelihood (ML) method. Furthermore, it was grouped with the sequence of identical species *Balaenoptera musculus* sequence (NC_001601, X72204) and *Balaenoptera edeni* (JN_190944) obtained from NCBI-GenBank.

The genetic distance of the sequences obtained during the study and the identical species of *Balaenoptera musculus* sequences in GenBank is 0.002 to 0.004. In Maximum Likelihood tree of cox1 gene, it is aligned with *Balaenoptera musculus* sequence (NC_001601, X72204) from the GenBank and form a separate clade with the sequence of other species of the same genus. The sequences of *Balaenoptera edeni* in the present study has been aligned with similar species with GenBank accession numbers AB_201258, JN_190945, MT_895690, JN_190944, and MT_895691, with a genetic distance of 0.00 to 0.002. The DNA sequencing thus confirmed the identity of two stranded cetacean species as *Balaenoptera musculus* and *Balaenoptera edeni*.

3.3 Dolphins as Bushmeat

Along with cetacean stranding events, the landings of cetaceans also occur for meat consumption along Kerala coast. Our survey documented several cases of dolphin meat trade in Thiruvananthapuram district of Kerala coast, involving Indian Ocean humpback dolphin and Indo-

Table 1. The details of stranded cetaceans along Kerala coast recorded during 2017 to 2019

No	Species ID	Location	Date	Size	Sex	No. of individuals	District, State
1	*Balaenoptera edeni*	Puthukurichi (8°36'15.4"N, 76°48'32.1"E)	25-09-2018	11.30 m	-	1	Thiruvananthapuram, Kerala
2	*Orcinus orca*	Perumathura (8°37'04.5"N, 76°47'52.8"E)	04-08-2019	4.65 m	Male	1	Thiruvananthapuram, Kerala
3	*Neophocaena phocaenoides*	Veliyaveli (8°30'33.1"N, 76°53'07.5"E)	16-08-2019	0.86 m	Female	1	Thiruvananthapuram, Kerala
4	*Balaenoptera musculus*	Veliyaveli (8°30'33.1"N, 76°53'07.5"E)	29-08-2019	16.50 m	-	1	Thiruvananthapuram, Kerala
Market							
5	*Stenella coeruleoalba*	Vizhinjam Fishing Harbour	03-03-2017	1.10m (approx.)	-	2	Thiruvananthapuram, Kerala

Fig. 1. Stranding of cetaceans in Thiruvananthapuram district, Kerala: **A, B.** *Balaenoptera edeni;* **C, D.** *Balaenoptera musculus*

Pacific finless porpoise during 2017-2019 period. The sale of two striped dolphins (*Stenella coeruleoalba*) caught by the local fishermen in the local market at Vizhinjam fishing harbour was photo documented (Fig. 4 A-E) on 03.03.2017. The observations and interaction with NGOs and fishermen revealed that the demand for dolphin meat is common in the local fish market and the individuals caught were immediately processed by cutting off their head, flippers and fluke to avoid visual identification (Fig. 4 A-E).

In Vizhinjam and Kovalam there are middlemen involved in the business of bushmeat trade and the frequent transport of dolphins to illegal markets near Kollengode in Kerala-Tamil Nadu border have also been observed during the survey. The middlemen and the fishermen are always on the vigil and stop any unknown person in the coast with a camera. Since the demand for bushmeat is in southern Kerala most of the products are sold in the local market itself. In general, fishermen are aware of the endangered status of dolphins and other marine mammals, and there are instances of fishermen releasing the species caught in the nets back to the sea.

Table 2. Morphometry of a Bryde's whale (*Balaenoptera edeni)* washed ashore at Puthukurichi, Thiruvananthapuram district, Kerala

No.	Measurement	Metre
1	Length, total (tip of the upper jaw to the deepest part of the notch between flukes)	11.3
2	Length, tip of the upper jaw to centre of eye	3.1
3	Length of gape (tip of the upper jaw to angle of gape)	4.78
4	Length, tip of upper jaw to blowhole along midline	4.32
5	Length, tip of upper jaw to anterior insertion of flipper	5.96
6	Length, tip of upper jaw to tip of dorsal fin	8.53
7	Length of flipper (anterior insertion of tip)	2.43
8	Width, flipper (maximum)	0.65
9	Height of dorsal fin (fin tip to base)	1.33
10	Fluke span	3.98
11	Width of flukes (distance from nearest point on anterior border of fluke notch)	1.27

Table 3. Morphometry of a blue whale (*Balaenoptera musculus*) washed ashore at Veliyaveli, Thiruvananthapuram district, Kerala

No.	Measurement	Metre
1	Length, total (tip of the upper jaw to the deepest part of notch between flukes)	16.5
2	Length, tip of the upper jaw to centre of eye	-
3	Length of gape (tip of the upper jaw to angle of gape)	-
4	Length, tip of upper jaw to blowhole along midline	-
5	Length, tip of upper jaw to anterior insertion of flipper	-
6	Length, tip of upper jaw to tip of dorsal fin	13.5
7	Length of flipper (anterior insertion of tip)	2.15
8	Width, flipper (maximum)	0.78
9	Height of dorsal fin (fin tip to base)	0.44
10	Fluke span	2.26
11	Width of flukes (distance from nearest point on anterior border of fluke notch)	0.96

Table 4. Morphometry of Killer whale (*Orcinus orca***)** washed ashore at Perumathura, Thiruvananthapuram district, Kerala

No.	Measurement	Metre
1	Length, total (tip of the upper jaw to the deepest part of notch between flukes)	4.65
2	Length, tip of the upper jaw to centre of eye	0.86
3	Length of gape (tip of the upper jaw to angle of gape)	0.74
4	Length, tip of upper jaw to blowhole along midline	0.98
5	Length, tip of upper jaw to anterior insertion of flipper	1.37
6	Length, tip of upper jaw to tip of dorsal fin	-
7	Length of flipper (anterior insertion of tip)	1.1
8	Width, flipper (maximum)	0.68
9	Height of dorsal fin (fin tip to base)	-
10	Fluke span	-
11	Width of flukes (distance from nearest point on anterior border of fluke notch)	-

Table 5. Indo-Pacific Finless Porpoise (*Neophocaena phocaenoides*) washed ashore at Veliyaveli, Thiruvananthapuram district, Kerala

No.	Measurement	Metre
1	Length, total (tip of the upper jaw to the deepest part of notch between flukes)	0.86
2	Length, tip of the upper jaw to centre of eye	0.085
3	Length of gape (tip of the upper jaw to angle of gape)	0.065
4	Length, tip of upper jaw to blowhole along midline	0.18
5	Length, tip of upper jaw to anterior insertion of flipper	0.19
6	Length, tip of upper jaw to tip of the dorsal fin	0
7	Length of the flipper (anterior insertion of the tip)	0.18
8	Width, flipper (maximum)	0.095
9	Height of dorsal fin (fin tip to base)	0
10	Fluke span	0.14
11	Width of flukes (distance from nearest point on anterior border of fluke notch)	0.065

Note: The porpoise has signs of rope/net around the girth of its neck, showing that it could have got entangled in a multifilament large mesh net such as shark nets.

- Not measured

Fig. 2. Stranding of cetaceans in Thiruvananthapuram district, Kerala: **A-C:** *Orcinus orca*; **D:** *Neophocaena phocaenoides*

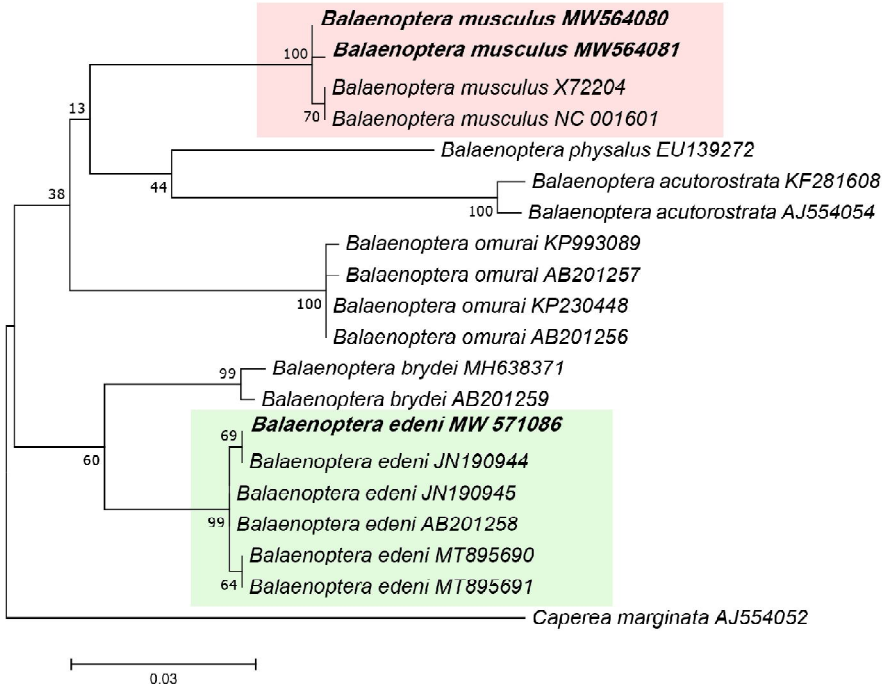

Fig. 3. Molecular phylogenetic analysis of *Balaenoptera* species stranded in Kerala coast by Maximum Likelihood method

Fig. 4. Processing of striped dolphins (*Stenella coeruleoalba*) in the local market at Vizhinjam, Kerala coast, India

4. Discussion

In our study the reasons for the stranding are unknown and seems complicated to access the cause of death from the carcasses due to the highly decomposed condition, making it impossible to carry out a necropsy. Our paper shows that small sized dolphins such as Indian Ocean humpback dolphin, Indo-Pacific finless porpoise, and Striped dolphins and perhaps other *Stenella* species are being consumed as bushmeat locally. In the case of the Indo-Pacific finless porpoise that was washed ashore, the sign of entanglement is evident. But more often than not, cause of death and species identification are difficult due to high level of decay and decomposition of body parts (Aneesh Kumar *et al*., 2019). Of the four specimens in this paper only the Indo-Pacific finless porpoise could be used for complete morphometric and meristic characters. In the case of blue whale and Byrde's whale, the specimens were in highly putrefied in condition, and the morphometric data are insufficient in confirming the species identification. In this scenario, the sequencing of mitochondrial marker gene, cox 1, provided a reliable species identification tool in the study. The stranding of *Balaenoptera edeni* has been confirmed earlier also from Kerala coast through DNA barcoding (George *et al.*, 2010; Biju Kumar *et al.*, 2012).

The bushmeat trade of cetaceans is small, facilitated by a minority of fishermen but supported by the middlemen and so continues in southern Kerala. The ongoing illegal trade of dolphin bushmeat in south Kerala is a matter of great concern and requires urgent intervention of social scientists and policy makers.

Past records of marine mammal strandings show the presence of three species of baleen whales, including blue whales and Bryde's whales along the Kerala coast, with dead and live stranding and live sightings reported (Sutaria *et al.*, 2016, 2017; Sutaria, 2018, 2019; Marine Mammal Research and Conservation Network of India, 2020). Based on past records, confirmed report of Killer whale is for the first time from Kerala coast in the present study; there were eight earlier records of blue whale and seven reports of Bryde's whale strandings from Kerala coast (Table 6). Nameer (2016) updated marine mammal (cetacean and sirenian) list of Kerala and considered 31 species under seven families and two orders (Sirenia and Cetacea).

Killer whale (*Orcinus* orca) is a cosmopolitan species widely distributed, migrating in all the seas and oceans (Ford, 2002). Along the west coast of India, they are sighted every year between February and June in recent years (Marine Mammal Research and Conservation Network of India, 2020). Studies have shown that there is movement of individuals between Sri Lanka and northwest Arabian Sea. Maintaining sighting data or tissue samples from strandings will help elucidate the migratory path of the different killer whale stocks in the northern Indian Ocean. Bryde's and blue whales are present all through the year in the coastal waters of the west coast, with a possibility of resident populations in the region.

Indo-Pacific finless porpoise strandings have been recorded all along the Indian coast, and are the most frequently caught for meat (Kumarran, 2012; Monalisha and Patterson, 2014; Marine Mammal Research and Conservation Network of India, 2020). In the present study, the obtained dead specimen was a calf or juvenile female individual and the cause of death is prolonged entanglement in the fishing net.

Peltier *et al.* (2013) reported that there would be a seasonal periodicity in the stranding events. An isolated population of the blue whale is observed year-round in Indian and Sri Lankan waters (Mikhaley, 2000). Usually, South-west monsoon currents induce upwellings in India's southwest region, which leads to plankton blooms, attracting marine mega fauna such as whales, especially blue whales and Bryde's whales (Anderson *et al.*, 2012). During the present study, all the carcasses were recorded in the months August – November just after the South-west Monsoon showing that the southern coast of India could be influenced by the currents bringing ashore dead animals.

The ecological reasons for stranding and mortalities vary and include global warming, changes in the bottom topography, coastal configuration, oceanographic events, extreme conditions in the environment and biological reasons such as infectious diseases and senescence (Perrin and Geraci, 2002; Williams, 2018). Global warming alters the habitat, foraging grounds and prey composition of cetaceans which adversely affect their survival and leads to the loss of functional diversity (Albouy *et al.*, 2020). Deaville and Jepson (2011) reported starvation due to decreased food supply and malnutrition, leading to the death of cetaceans and leading to mass stranding. The gas embolic syndrome due to the sudden movements across the depth, especially by rapid ascent and decompression sickness as an impact of sonar, also leads to fatal damages, which leads to the stranding of cetaceans (Jepson *et al.*, 2003; Fernandez *et al.*, 2005). All these sources of sound pollution led to impaired hearing which affects in receiving the echolocation signals and also in social vocalisation and pose a threat for their survival (Gomez *et al.*, 2016). Exposure to biotoxins from the harmful algal blooms (HAB) also adversely affects the cetacean survival (Fire *et al.*, 2011). Various oceanographic disturbances such as storm and currents, may lead to disorientation and exhaustion, leading to cetacean stranding (MacLeod *et al.*, 2004; Bogomolni *et al.*, 2010).

Commercial fisheries is a significant threat, due to target catch and bycatch (Ozturk *et al.*, 2001; Bengil *et al.*, 2020). Coastal fisheries, particularly gillnets, purse seine, and discarded ghost nets, lead to the entanglement of small cetaceans like dolphins. On some occasions, baleen whales also entangled in the nets, leading to incidental mortality. The escaped individuals with the remnants of debris may face locomotion problems and foraging efficiency (Agrawal and Alfred, 1999; Reeves *et al.*, 2013). According to Anderson (2014), small cetaceans like dolphins fail to detect gillnets and get entangled, which is a common issue. Reeve *et al.* (2013) and Muralidharan (2018) reported that fishermen consider cetaceans to be nuisances because of the problems they create for the artisanal fisheries and the unintentional bycatch damages the fishing gear, while the dead cetaceans are discarded at sea. There are no proper systems to monitor cetacean bycatch, or mitigation measures to reduce this, and thus there I inefficiency in accounting the impact of fisheries on cetaceans.

Pollution and plastic contamination, especially the ingestion and entanglement of marine debris, have also been attributed to cetacean death and subsequent stranding (Simmonds, 2012; Baulch and Perry, 2014).

Laist *et al.* (2001) and Berman-Kowalewski *et al.* (2010) suggest that whales are the most affected species of ship strikes and severely impacted on whales with a restricted population status. According to New *et al.* (2015) many cetacean species, especially whales, respond to the ship with surface-active such as breathing or basking and the avoidance behaviours and sometimes it may lead to ship strike. There is limited knowledge about the actual conflicts between cetaceans and shipping interactions (VanWaerebeek *et al.*, 2007).

Around the world, in coastal areas reported there is an overlap between strandings and high productivity which supports both cetacean diversity as well as the human livelihood, and leads to increase in human- marine mammal conflicts. Similarly, the overlap between shipping lanes and cetacean habitat leads to increased strike rates (Branch *et al.*, 2007; De Vos *et al.*, 2016).

Regarding the demand of meat of dolphins, thousands of small cetaceans are directly hunted in the Southeast and East Asian countries (Altherr *et al.*, 2018). In India, cetacean species are protected under the Wildlife (Protection) Act of 1972. With vigorous enforcement of law towards the conservation of marine mammal species,

Table 6. Historical reports of baleen whales and killer whale along Kerala coast

Name of person submitted observation	Date of record	Species
Biju Kumar, A.	04-08-2019	**Killer whale**
Nisanth, H.P.	29-08-2019	Unidentified baleen whale
Nameer, P.O.	26-04-2019	Unidentified baleen whale
Biju Kumar, A.	25-09-2018	**Bryde's whale**
Nisanth, H. P.	17-09-2018	Unidentified baleen whale
Sutaria D.	12-07-2016	**Bryde's whale**
Baby, K.G.	29.05.2014	Unidentified Baleen whale
Panicker, D.	19-05-2013	**Bryde's whale**
Kumaran Sathasivam	2010	**Bryde's whale**
Shanis, R., Akhilesh, K.V. and Prakashan, D.	27-02-2010	**Blue Whale**
George, S., Meenakshi, K. and Bijukumar, A.	27-09-2009	**Bryde's whale**
Sathasivam, K.	25-06-2009	**Bryde's whale**
Sathasivam, K.	18-10-1996	**Blue whale**
Baby, K.G.	1996	Unidentified baleen whale
Baby, K.G.	29-10-1995	**Blue whale**
James, P.S.B.R., Menon, N.G. and Pillai, N.G.K.	02-05-1993	**Blue whale**
Lal Mohan, R. S.	29-09-1988	**Blue whale**
Somasekharan Nair, K.V. and Jayaprakash, A.A.	02-09-1985	**Blue whale**
Joel J.J. and Joseph,M.	24-04-1981	Unidentified baleen whale
Lal Mohan, R.S.	02-07-1979	**Bryde's whale**
Venkatraman, G. and Girijavallabhan, K.G.	25-05-1966	**Blue whale**
Chacko, P.I. and Mathew, M.J.	10-12-1954	Unidentified baleen whale
Chacko, P.I. and Mathew, M.J.	01-09-1951	Unidentified baleen whale
Chacko, P.I. and Mathew, M. J.	01-04-1949	Unidentified baleen whale
Moses, S.T.	01-05-1947	Unidentified baleen whale
Jacob, P.K. and Devidas Menon, M.	28-01-1947	Unidentified baleen whale
Poduval, R.V.	04-02-1937	Unidentified baleen whale
Moses, S.T.	01-03-1935	Unidentified baleen whale
Moses, S.T.	1934	Unidentified baleen whale
Moses, S.T.	1927	**Blue Whale**
Moses, S.T.	1926	Unidentified baleen whale
Moses, S.T.	1924	Unidentified baleen whale
Moses, S.T.	1858	Unidentified baleen whale
Moses, S.T.	1848	Unidentified baleen whale

(Sources: http://www.marinemammals.in/database/sightings-and-strandings/; http://www.cmfri.org.in/MammalStrandingWithClustering16/StrandingWithClustering16.html#5/16.046/78.157)

the poaching of cetaceans is frequent in the coast of Kerala and is mainly associated with demand from the local markets.

According to Kumarran (2012), small cetaceans like Indian Ocean humpback dolphin and Indo-Pacific finless porpoise, are frequently consumed. This study also recorded the meat trade involving Indian Ocean humpback dolphin and Indo-Pacific finless porpoise, though photo documentation and case study was limited to the bushmeat trade of *Stenella coeruleoalba*. Given that Kerala has reported greater diversity of small dolphins in the past, it is worrisome that only striped dolphins seem to be landed and consumed frequently; and this could be a sign of decreasing diversity and population sizes of other *Stenella* species in southern waters of India.

Millions of these small cetaceans are hunted annually worldwide for meat for human consumption, bait use in fisheries and oil for medicine despite the minimal protection, which increases the human- marine mammal conflicts and also the bushmeat trade become the major anthropogenic threat to many of the small cetaceans (Clapham and Waerebeek, 2007; Mintzer *et al.*, 2018). The present study highlights the trade of the striped dolphins in the open markets of southern Kerala. The unusual practice is of processing of meat by chopping off its fluke, flippers, fin and head at the landing centre and selling of the processed meat as fish meat which clearly shows that the fishermen know that the cetacean hunting is illegal.

All these pressures will affect marine mammal population adversely, and as a result, most of the species are currently included in the threatened category (Perrin *et al.*, 2009). As one of the apex predators which plays a crucial role in maintaining biomass and stability marine ecosystem (Bowen, 1997), providing baseline information regarding stranding events and the evaluation of the cause of

mortalities along with the trends in population plays a crucial component in the assessment of the status of the cetaceans (De Oliveira *et al.*, 2012). Knowledge regarding the status and population trends is feeble (Evans *et al.*, 2012). The information from the stranding data will play a reasonable role in assessing the knowledge gaps and monitoring the various aspects of marine mammal life.

The single species stranding events frequently occur along the coasts of Kerala. In most of the cases, the reasons for stranding are unknown. However, stranding events shows that the Arabian sea supports the lives of marine mammal species and the stranding events highlight the need for undertaking the extensive studies regarding the distribution and behaviour of the cetacean species which is still unclear in the Indian scenario. Along with the stranding events, the cases of trade and local demand for cetacean meat also shows an urgent need for the implementation of laws and the need for creating awareness in public regarding the importance of cetaceans. Very recently Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India has released guidelines for the stranding management of marine mega fauna in India, with a proposal to improve inter-sectoral collaboration and coordination between Government and civil society for sharing of data, research and conservation. The proposal also include establishment of National Stranding Centre (NSC), State Stranding Centre (SSC), Local Stranding Networks, and Rapid Response Team.

We suggest developing a mobile app for reporting the occurrence and stranding of marine mammals along Kerala coast and for reporting any incidence of bushmeat trade. The possibility of using the Biodiversity Management Committees (BMCs) of State Biodiversity Boards may also be explored to inform stranding and trade of scheduled species in coastal villages. The services of fisherfolk and citizen scientists may be better utilized in survey and monitoring of marine mammals and other protected marine species along Indian coast. Above all, there is an urgent need to strengthen awarenss and media campaign on protected marine species of India.

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