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Short Communication

Swarms of ctenophore *Pleurobrachia pileus* (O. F. Müller, 1776) in the waters of Sundarban: A menace to the fisheries?

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An unusual swarm of *Pleurobrachia pileus* (O. F. Müller, 1776) was recorded in the Sundarban coastal waters of Bay of Bengal, Northern Indian Ocean during the winter monsoon season of 2018. The species occurred in the Sundarban waters with an average abundance of 6,766 individual m^{-3} which in turn diminished the population of other zooplankton and fish. The hydrographical characters observed in the swarm stations favoured the proliferation of *Pleurobrachia pileus* and the unique factors were low temperature (18.9 – 20.9 °C), high salinity (~24 psu) and associated high biological production. The phenomenon of *P. pileus* swarm has not been reported earlier from the coastal waters of Sundarban, therefore, our incidental observation provides further insight to explore the study area.

[**Keywords**: Bay of Bengal, Ctenophora, *Pleurobrachia pileus,* Sundarban, Swarming]

Introduction

Gelatinous zooplankton comprise a diverse group of organisms with jelly-like tissues that contain a high percentage of water. They are mostly represented by different taxonomic groups such as ctenophores, cnidarians, chaetognaths and pelagic tunicates. The population size of gelatinous zooplankton fluctuates widely with changes in ocean climate and often experience sudden outbursts known as ‘blooms’ followed by population crashes[1]. Jellyfish and ctenophores are important consumers of zooplankton, including ichthyoplankton[2,3]. Therefore, they pose as potential competitors of fish as well as plankton predators at the secondary and tertiary consumer levels of the marine food chain[3].

Sundarban is the world’s largest mangrove forest with rich biodiversity. It is located in the estuarine phase of the tidal Hooghly river in the west (21° N, 88° E), with an area of 9630 km^2, extending southward into the Bay of Bengal[4]. During 2018, a winter monsoon survey in the coastal waters as part of the project entitled, ‘Seasonal dynamics of microzooplankton and its role in the pelagic food web of northern coastal waters of Bay of Bengal’ was conducted in the Sundarban, in the mouth of four rivers namely, river Thakuran, river Saptamukhi, river Matla and river Hooghly and their associated distributaries draining into the Bay of Bengal. The winter survey yielded an interesting observation of a massive occurrence of ctenophores in the coastal waters off Sundarban delta on 19th and 25th January 2018 in 4 stations. Such an excessive abundance can be termed as “swarm” or “bloom”. The zooplankton samples, consisting of a good share of noticeable individuals of ctenophores, were collected using bongo net (mesh size: 300 µm). They were also obtained in various size stages using fishing nets (mesh size: 50 mm). They were identified in the laboratory as *Pleurobrachia pileus* (O. F. Müller, 1776), a ctenophore species belonging to family Pleurobrachiidae and order Cydippida of phylum Ctenophora. We observed a high abundance of ctenophores in four stations (Table 1) reaching an abundance of more than 6,766 individuals m^{-3} (Fig. 1). The average sea surface salinity (SSS) measured at the swarm stations was 24.64 psu and the sea surface temperature (SST) was 18.89 °C (Table 1), which was comparatively high saline and low temperature than other stations (20.42 – 22.81 psu; 20.5 – 21.37 °C) of Sundarban coastal waters. As part of this study, we had also measured chlorophyll-*a*, phytoplankton composition, and microzooplankton community structure. Our preliminary analysis showed that the average chlorophyll-*a* concentration in swarm stations was about 0.63 µg/L (Table 1) and in the non-swarm stations was about 1.33 µg/L. The dominant diatoms observed were *Chaetoceros* spp., *Coscinodiscus* spp., *Biddulphia* spp., and *Thalassionema* spp. Microzooplankton groups recorded in the swarm stations were dinoflagellates, ciliates, foraminiferans, and rotifers. The major microzooplankton species in these swarm stations were *Protoperidinium depressum*, *Leprotintinnus nordqvistii*, *Leprotintinnus simplex* and *Favella ehrenbergii.* The high abundance of *Pleurobrachia pileus* in the coastal waters of

Table 1 — Details of the station, depth and environmental characteristics observed in the swarm stations of Sundarban

Latitude (°N)	Longitude (°E)	Depth (m)	Sea surface temperature (°C)	Sea surface salinity (psu)	Dissolved oxygen (ml/l)	Chlorophyll-*a* (µg/L)
21˚42' 18.10"	88˚ 30' 51.00"	20	18.89	24.37	4.9161	0.66
21˚39' 18.00"	88˚ 28' 13.90"	10	20.90	24.69	5.4193	0.54
21˚37' 35.90"	88˚ 26' 15.04"	10	20.76	24.84	5.4192	0.59
21˚35' 47.10"	88˚ 23' 35.10"	15	18.92	24.83	5.4192	0.73

Sundarban confirms that certain factors are unique to Sundarban area that lead to the aggregation of *P. pileus* in the surface waters. The unique factors may be the low temperature and high salinity influence and the associated high biological production. The phenomenon of swarming by *P. pileus* has not been reported earlier from the coastal waters of Sundarban; therefore, our incidental observation provides further insight to explore the study area. Anthropogenic activities (which lead to eutrophication and rise in sea surface temperature) and climatic changes (that alter salinity and ocean currents) were some of the crucial factors behind such dense swarms[5,6]. We believe such swarming might have a negative influence on fish abundance in this region. It has been observed that swarming behaviour of ctenophore has devastating results on fisheries and tourism[5] and indicate that ctenophores are tolerant to adverse hydrological parameters[7]. The local fisherman community had also informed us that the phenomenon of 'Sadafut' (colloquial name) or swarming of ctenophore is recurring during winter monsoon and their observation suggests substantial reduction in fish catch. Due to the clogging of fishing nets (Fig. 2) by *P. pileus*, the quantity of fish catch may be significantly reduced.

Ctenophores are known to be voracious feeders and prey on a diverse group of plankton such as copepods, crustaceans, phytoplankton, cnidarians, annelids and their larvae, echinoderm larvae, Thaliacea, Appendicularia, fish eggs and larvae[8]. The diet of ctenophore overlaps with the diet of commercially important zooplanktivorous fish like anchovies, herrings, and sardines[9]. Ctenophores feed on fish larvae which might often lead to a reduction in fish population[10]. A similar observation was also reported and well-supported by the gelatinous predator hypothesis[8], which states that ctenophores consume copepods thereby decreasing food available for fish. The resource use competition hypothesis[8,10,11] also concludes that gelatinous predators will affect the amount of food available for fish larvae. For example, the amphipods especially belonging to family Oxycephalidae are frequently found in association with

Fig. 1 — Ctenophore swarms in the study area of Sundarban

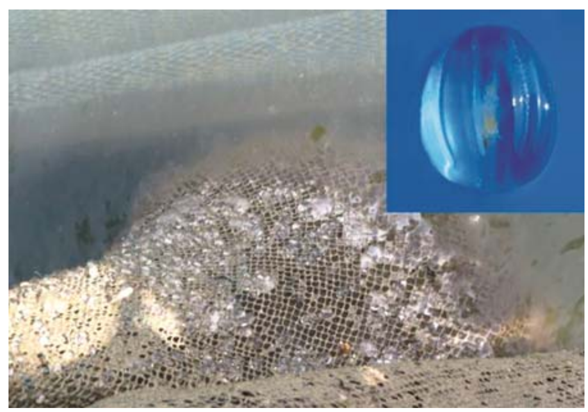

Fig. 2 — Ctenophores entangled in fishing nets

ctenophores[12]. Ctenophores can exhibit positive and negative interaction with the ecosystem. Some harmful effects are predation on fish eggs and larvae, competition for food between ctenophores and zooplanktivorous fish, and acting as intervening host for fish parasites. The beneficial effects for fish are predation on ctenophore by fish and commensalism between fish and gelatinous zooplankton[9]. If *P. pileus* continues to be found in the Sundarban, its feeding preference should primarily impact the mesozooplankton community, since they primarily feed on copepods[13]. The presence of *P. pileus* in high densities will result in the reduction of zooplankton in the ecosystem and after the reduction of zooplankton due to voracious feeding they may switch their feeding interest to eggs and larvae of fish which in turn will affect the population of fish in the area[1,14,15,16]. It can be speculated that *P. pileus* may live in water with fluctuating salinity, and therefore may be able to enter into the riverine areas of the Sundarban delta. The studies from Black Sea and Seine estuary have also shown that the vertical and horizontal distribution of *P. pileus* is influenced by salinity[17,18]. However, it is unknown if *P. pileus* could live and reproduce in the Sundarban from a one-time observation. But the various size stages of *P. pileus* obtained in the net illustrate that this aggregation may be a reproductive aggregation. The earlier studies revealed that the large mesh size of the net used for this study (300 µM and 50 mm) did not retain the youngest stages[19], as the larvae of *P. pileus* are less than 100 µM. If *P. pileus* becomes a permanent inhabitant of the Sundarban ecosystem, it could influence the biological production as well as pelagic food web of this ecosystem.

In the past, a bloom of ctenophores was observed in the Arabian Sea off Mumbai[20] and it coincided with a rise in pomfret catches. But in the Bay of Bengal, ctenophore aggregations were not reported and the ctenophore species recorded from the Bay of Bengal were *P. globosa*, *P. pileus*, *Beroe* sp., *Mnemiopsis* sp.[7, 21]. The seasonal abundance of *P. pileus* may be due to the change in water current in the ocean or a feeding aggregation. Moreover, anthropogenic activities in the coastal waters or the associated eutrophication may aid the increase in jelly population by making zooplankton food available to them and by removing their predators[2]. Ctenophores (and all other jellies) affect fishing operation by clogging fishing net and killing fish in net during aquaculture practices[22]. In conclusion, swarming of ctenophore in the Sundarban region may be due to the environmental degradation[4] and associated production which leads to a temporary outburst for reproductive or feeding aggregations. So, a further study in this regard is essential to delineate the causative factors behind this type of episodic events in such a productive ecosystem.

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Conflict of Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

Author Contributions

JP: Conceived the idea presented herein, participated in the above mentioned survey and collected the samples, identified the ctenophore species, wrote a part of the manuscript, supervised the findings of this work, was in-charge of overall direction and planning. AS, AB and SM: Identified the ctenophore species, identified and calculated abundance of zooplankton and ctenophore samples, wrote a part of the manuscript, contributed to the final version of the manuscript. KC: Supervised the findings of this work and provided critical feedbacks. NB and MAV: Sorted the zooplankton samples into various taxonomic groups. All authors have contributed in making of this manuscript.

References

1 Madin L P & Harbison G R, Gelatinous Zooplankton, In: *Encyclopedia of Ocean Sciences,* edited by J Steele, S Thorpe & K Turekian, (Academic Press, London) 2001, pp. 1120–1130.

2 Purcell J E, Climate effects on formation of jellyfish and ctenophore blooms: a review, *J Mar Biol Assoc U K*, 85 (2005) 461–476. doi: 10.1017/S0025315405011409.

3 Sahu B K & Panigrahy R C, Jellyfish bloom along the south Odisha coast, Bay of Bengal, *Curr Sci*, 104 (2013) 25.

4 Mondal P, Reichelt-Brushett A J, Jonathan M P, Sujitha S B & Sarkar S K, Pollution evaluation of total and acid-leachable trace elements in surface sediments of Hooghly River Estuary and Sundarban Mangrove Wetland (India), *Environ Sci Pollut Res*, 25 (2018) 5681–5699. doi: 10.1007/s11356-017-0915-0.

5 Purcell J E, Jellyfish and ctenophore blooms coincide with human proliferations and environmental perturbations, *Ann Rev Mar Sci*, 4 (2012) 209–235. https://doi.org/10.1146/annurev-marine-120709-142751.

6 Richardson A J, Bakun A, Hays G C & Gibbons M J, The jellyfish joyride: causes, consequences and management responses to a more gelatinous future, *Trends Ecol Evol*, 24 (2009) 312–322. doi: 10.1016/j.tree.2009.01.010.

7 Santhanam P & Perumal P, Diversity of zooplankton in Parangipettai coastal waters, southeast coast of India, *J Mar Biol Assoc India*, 45 (2003) 144–151.

8 Fraser J H, The ecology of the ctenophore *Pleurobrachia pileus* in Scottish waters, *ICES J Mar Sci*, 33 (1970) 149–168.

9 Purcell J E & Arai M N, Interactions of pelagic cnidarians and ctenophores with fish: a review, *Hydrobiologia*, 451 (2001) 27–44. doi: 10.1023/A:1011883905394.

10 Van der Veer H W & Sadée C F M, Seasonal occurrence of the ctenophore *Pluerobrachia pileus* in the Western Dutch Wadden Sea, *Mar Biol*, 79 (1984) 219–227.

11 Frank K T & Leggett W C, Effect of prey abundance and size on the growth and survival of larval fish: an experimental study employing large volume enclosures, *Mar Ecol Prog Ser*, 34 (1986) 11–22.

12 Harbison G R & Madin L P, The associations of Amphipoda Hyperiidea with gelatinous zooplankton; associations with Cnidaria, Ctenophora and Radiolaria, *Deep Sea Res*, 24 (1977) 465–472.

13 Greve W & Reiners F, Plankton time—space dynamics in German Bight—a systems approach, *Oecologia*, 77 (1988), 487-496.

14 Yip S Y, The feeding of Pleurobrachia pileus Mueller (Ctenophora) from Galway Bay, Proceedings of the Royal Irish Academy, *Section B: Biological, Geological, and Chemical Science*, 1984.

15 Attrill M J, A rehabilitated estuarine ecosystem: The environment and ecology of the Thames estuary, *Springer Science & Business Media*, (1998) pp. 124.

16 Travis J, Invader threatens Black, Azov Seas, *Science*, 262 (1984) 1366-1367.

17 Wang Z T & Dauvin J C, Spring abundance and distribution of the ctenophore *Pleurobrachia pileus* in the Seine estuary. Advective transport and diel vertical migration, *Mar Biol*, 124 (1995) 313-324.

18 Mutlu E & Bingel F, Distribution and abundance of ctenophores and their zooplankton food in the Black Sea, *Pleurobrachia pileus*, *Mar Biol*, 135 (1999) 589-601.

19 Remane A, Zur Bioloqe des Jugendstadiums der Ctenophore *Pleurobrachia pileus* (O. F. Muller), *Kieler Meeresforsch*, 12 (1956) 72-75.

20 Chopra S, A note on the sudden outburst of ctenophores and medusae in the waters of Bombay, *Curr Sci*, 10 (1960) 392–393.

21 Sahu G, Mohanty A K, Singhasamanta B, Mahapatra D, Panigrahy R C, *et al*., Zooplankton Diversity in the Nearshore waters of Bay of Bengal, Off Rushikulya Estuary, *The IUP J Environ Sci*, 4 (2010) 61–85.

22 Dong Z, Liu D & Keesing J K, Jellyfish blooms in China: dominant species, causes and consequences, *Mar Pollut Bull*, 60 (2010) 954–63. doi: 10.1016/j.marpolbul.2010.04.022.