The bloom of invasive alien comb jelly *Beroe ovata* Bruguière, 1789 in the Bay of Bengal

R. Jeyabaskaran*, S. Gomathy, R. Raja Sekar and K. S. S. M. Yousuf

ICAR-Central Marine Fisheries Research Institute,
Madras Regional Station, Chennai 600 028, India

The present study documented a bloom of the comb jelly *Beroe ovata* occurring off Devaneri Kuppam in Mahabalipuram, close to Chennai. The abundance of the *B. ovata* bloom was estimated as 342 ± 21 individuals per cubic metre. A negligible number of hydromedusae specimens mixed with the comb jelly were also observed. The abundance of its predatory fish, the black pomfret (*Parastromateus niger*), the hydrozoan jellyfish (*Aequorea pensilis*), and the scyphozoan jellyfish (*Cyanea nozakii*) would be positively correlated with the sudden disappearance of the bloom of *B. ovata* on 10 October 2024. Following the bloom of *B. ovata*, the abundance of *A. pensilis* and *C. nozakii* led to a depletion of copepods, the main predators of dinoflagellates and diatoms, favouring the bloom of *Noctiluca scintillans*.

Keywords: *Beroe ovata*, comb jelly bloom, *Cyanea nozakii*, hydromedusae, *Noctiluca scintillans.*

CTENOPHORES are gelatinous zooplankton belonging to the phylum Ctenophora found throughout the world's oceans. They are often called 'comb jellies' due to their transparent, soft, delicate and gelatinous bodies with eight comb rows composed of thousands of cilia for movement[1]. To capture prey, ctenophores possess non-stinging 'colloblast' cells[2]. The stinging cells known as 'cnidoblasts' are found in most scyphozoan jellyfish, also known as real jellyfish (Phylum Cnidaria). Ctenophores are divided into 48 genera, 33 families and 9 orders, with 185 extant species and 14 extinct species recognized worldwide. Among these, order Beroida Eschscholtz, 1825, comprises 30 species under 2 genera and 1 family[3]. To date, 19 ctenophores belonging to 7 families and 5 orders have been reported from India[4]. Because of distortion and shrinking, it is particularly challenging to identify preserved specimens. The majority of live specimens are harmed when they are caught in a zooplankton net. The genus *Beroe* has a peculiar character among other ctenophores. It lacks tentacles and feeds exclusively on other ctenophores and mesozooplankton[5]. It closes its mouth using adhesive cells (colloblasts) while moving forward or swimming[6].

Beroe ovata Bruguière, 1789, also known as the comb jelly, is indigenous to the western Atlantic coastline, extending from Argentina to the United States. In 1997, ship ballast waters brought it to the Black Sea, from where it spread to nearby European seas[7,8]. The occurrence of *B. ovata* has been documented in 16 countries worldwide to date[9]. *B. ovata* has an oval body that is often pink and has a broader oral end. The meridian canals with anastomoses between them are the primary identifying characteristics of *B. ovata*[10]. Like other ctenophores, *B. ovata* is a hermaphrodite that can develop into larvae directly, mature quickly, have better fertility and self-fertilize. It can quick reproduce a few individuals can produce a mass population within a month under favourable conditions[11]. Compared to the eggs of ctenophores, the bioluminescent amplitude of *B. ovata* larvae was eight times greater[12]. Complete regenerative powers allow the comb jelly, *Mnemiopsis leidyi*, to reverse age and return to larval stages[13]. Nevertheless, *B. ovata* is restricted to lip development and lacks the capacity to regenerate the entire body[14].

The occurrence of ctenophore swarms or blooms in Indian seas has been reported since 1940. From September 1940 to August 1943, scientists studied plankton at Krusadai Island in the Gulf of Mannar. They found a lot of ctenophore species *Pleurobrachia globosa* Moser, 1903 and hydromedusae from November to February[15]. The bloom of *P. globosa* occurred on the Madaras (Chennai) coast during April–May 1962 (ref. 16). Outbreaks of ctenophore and medusae were reported at Sassoon Dock in Mumbai on 27 October 1959 and linked to a sudden rise in catches of the fish Silver pomfret, *Pampus argentius*[17]. Swarms of ctenophore *P. globosa* and *Sagitta enflata* (Chaetognatha) were reported on the Goa coast (Arabian Sea) on 15 October 1980 (ref. 18). The pH and dissolved oxygen (DO) in the ocean surrounding Port Blair in the Andaman Islands were directly correlated with the quantity of the ctenophore *Pleurobrachia pileus* (O. F. Müller, 1776)[19]. In January 2018, Purushothaman *et al.*[20] reported a swarm of *P. pileus* in the Sundarban coastal waters of the Bay of Bengal. In July 2019, researchers in India reported the bloom of the invasive alien ctenophore *B. ovata* Bruguière, 1789, in the coastal areas of Kollam, Kerala, in the Arabian Sea[21].

The present study documented a bloom of the comb jelly *B. ovata* that occurred off Devaneri Kuppam in Mahabalipuram, close to Chennai. On 7 and 8 October 2024, researchers spotted a bloom in the Bay of Bengal at depths between 6 and 150 m (12°64.803′N, 80°26.352′E). Between 7 and 10 a.m., specimens were collected using a zooplankton net with a 200 μm mesh and a 60 cm diameter mouth dragged horizontally at a depth of 1 m in the sea surface area. The flow meter data facilitated the conversion of *B. ovata* counts into quantities per unit volume. The abundance of the *B. ovata* bloom was estimated as 342 ± 21 individuals per cubic metre. Among these specimens, 21% measured less than 10 mm in length, 60.5% measured between 10 and 20 mm, 11.5% measured between 20 and 40 mm, and 7% measured between 41 and 50 mm. It has been reported that *B. ovata* up to 8.0 mm in length were considered larva, 9–40 mm juvenile, 41–50 mm mature and greater than 50 mm adult[22]. As a result,

*For correspondence. (e-mail: jbcmfri@gmail.com)

only 7% of *B. ovata* were in the mature stage, ready for reproduction and 93% of specimens in the bloom were juveniles. We observed a negligible number of hydromedusae specimens mixed with the comb jellies. Many comb jellies and hydromedusae specimens suffered damage, with some losing their body parts in the zooplankton net collection. Therefore, we randomly collected live specimens using a plastic bucket. We brought approximately 46 live specimens to the laboratory and photographed them (Figure 1). We captured images of three distinct *B. ovata* sizes, shown in Figure 2 *a–c*. We identified the hydromedusae species as *Eirene ceylonensis* Browne, 1905 (Figure 2 *d*), *Zygocanna buitendijki* Stiasny, 1928 (Figure 2 *e*) and *Aequorea pensilis* (Haeckel, 1879) (Figure 2 *e*). Environmental parameters were also collected during the survey: sea-surface temperature (SST), 30.15°C; salinity, 33.85‰; DO, 9.34 mg/l; chlorophyll *a*, 0.37 mg/m^3; nitrate, 0.002 mg/l; phosphate, 0.005 mg/l and silicate, 0.05 mg/l. The bloom of *B. ovata* completely disappeared on 10 October 2024. Instead, the scyphozoan jellyfish *Cyanea nozakii* Kishinouye, 1891, with a diameter ranging from 28 to 52 cm, began to appear in the sea.

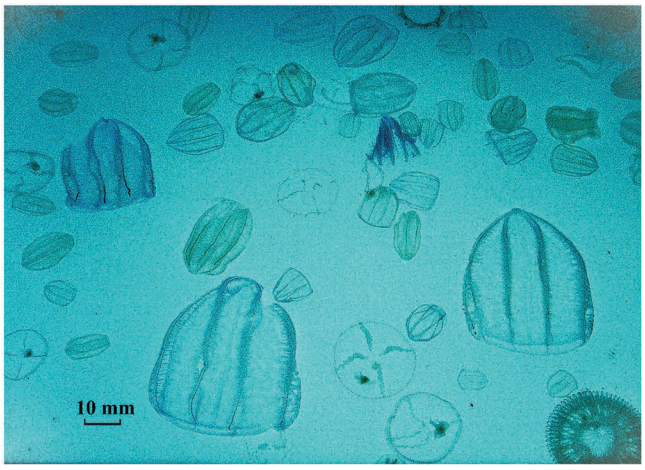

Figure 1. Comb jelly *Beroe ovata* Bruguière, 1789 collected from Bay of Bengal.

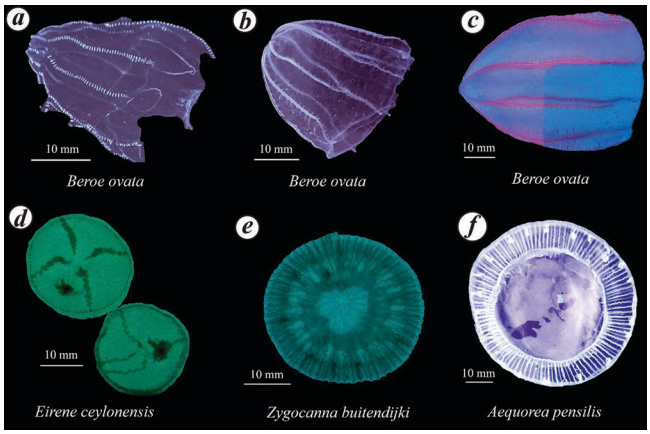

Figure 2. *B. ovata* comb jelly in three different sizes with morphological variation (***a–c***) and species of hydromedusae (***d–f***).

The primary determinants of jellyfish and ctenophores bloom are temperature and salinity. Bloom formation is also influenced by a mix of biological and physical variables, food availability and predation pressures[23]. Ctenophores digested food more quickly when the temperature and salinity rose[24]. Salinity and temperature were recorded as 34‰ and 30°C respectively, when the bloom of *P. globosa* occurred in Chennai during April–May 1962 (ref. 16). Similarly, the bloom of *B. ovata* was caused by an unusual increase in air temperature to 33°C on 4 October, which coincided with a sudden rise in SST and salinity. The comb jelly *B. ovata* is a voracious feeder, with a daily intake of food requirements of more than 20% of its body weight[25]. It mainly feeds on other ctenophores, pelagic fish eggs and larvae, copepods and amphipods. In turn, ctenophores are mostly consumed by fish, jellyfish, seabirds and turtles[26]. In the present study, we hypothesized that the abrupt disappearance of the ctenophore *B. ovata* would have a positive correlation with the abundance of their predatory fish – black pomfret *Parastromateus niger*, hydrozoan jellyfish *A. pensilis*, and scyphozoan jellyfish *C. nozakii*. During the field study, multiple schools of black pomfrets, *P. niger*, were found at a depth of 4 m in the *B. ovata* bloom region. The feeding habits and food of pomfrets in the Bay of Bengal were thoroughly studied by researchers. Gut content analysis showed that ctenophores and medusae ranked second in the Chinese pomfret, *Pampus chinensis*, and third in the black pomfret, *P. niger*[27,28].

The hydrozoan jellyfish (*Aequorea* spp.) is known to consume a wide variety of copepods, ctenophores, siphonophores, salps, fish eggs and larvae[29]. A high density of hydromedusae with 500 individuals/1000 m^3 was recorded off Madras[30]. Generally, *Cyanea* spp. consumes copepods and gelatinous zooplankton, such as ctenophores, hydromedusae and other small scyphozoan medusae. All the specimens of *B. ovata* would have been consumed by *C. nozakii* and *A. pensilis*. Moreover, for reproduction, ctenophores require more than 0.5 mg/m^3 of chlorophyll[31]. However, there was little chlorophyll *a* in the bloom area, which would have stopped adult *B. ovata* from reproducing. On 9 October 2024, we observed a large gathering of ghost jellyfish (*C. nozakii*) along the coast of Tamil Nadu, extending from North Chennai to Rameswaram. Numerous fishermen expressed dissatisfaction over the massive numbers of ghost jellyfish clogging their nets and the decrease in fish catches. Heavy rainfall (15.82 cm) occurred in and around Chennai during 14–17 October 2024, and subsequently, the bloom of heterotrophic dinoflagellate *Noctiluca scintillans* occurred along the coastal areas of the Bay of Bengal from Pulicat (North Chennai) to Puducherry on 18–21 October 2024. At night, the blue-green light emerged and the waves were glowing[32]. The bloom of *B. ovata* is followed by the abundance of scyphozoa jellyfish

(*C. nozakii*) and hydromedusae (*A. pensilis*). This led to the reduction of copepods, the main predators of diatoms and dinoflagellates, favouring the bloom development of *N. scintillans*.

Though the comb jelly *B. ovata* invaded India through the ships ballast water discharge in the Arabian Sea in 2019, it is now reported in the Bay of Bengal. Since Chennai is the major port area, *B. ovata* would have been introduced through ballast water discharge. The invasion of alien species causes serious damage to the marine ecosystem. The ctenophore *M. leidyi* invaded the Black Sea through ship ballast water discharge, resulting in the collapse of pelagic fisheries and an estimated loss of over US$ 200 million (ref. 33). Anil *et al.*[34] identified the introduction of harmful aquatic organisms and pathogens to new environments via ships' ballast water as one of the four greatest threats to the world's oceans. Jellyfish and ctenophores act as vectors of fish pathogens. There were differences between the bacterial community of *B. ovata* and the water column[29,35]. Therefore, a continuous monitoring programme of coastal fishery habitats at the national level is indispensable.

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A report of house rat (*Rattus rattus* L.) damage on phylloclades of dragon plants (*Hylocereus* spp.)

K. V. Saroj[1], M. Lekha[1,*], P. I. Poornima Yadav[2], C. R. Manu[3], R. V. Sindhu[3], P. R. Nithya[4], A. H. Shamsiya[1], Bindu Podikunju[1], S. J. Joy[1] and Bini Sam[1]

[1]ICAR-Krishi Vigyan Kendra, Kerala Agricultural University, Sadanandapuram (PO), Kottarakkara, Kollam 691 531, India
[2]Onattukara Regional Agricultural Research Station, Kerala Agricultural University, Onnamkutty, Kayamkulam, Alappuzha 690 502, India
[3]Farming Systems Research Station, Kerala Agricultural University, Sadanandapuram, Kottarakkara, Kollam 691 531, India
[4]College of Agriculture, Kerala Agricultural University, Vellayani, Thiruvananthapuram 695 522, India

The dragon plant is an exotic fruit crop gaining importance in urban and peri-urban rooftop cultivation for its nutritional and commercial value. It requires minimal inputs for crop husbandry. Of late an unusual feeding pattern was observed in the phylloclades of dragon plants in the experimental unit of ICAR-Krishi Vigyan Kendra, Kollam. A motion-triggered camera was installed to monitor the pest, which was identified as *Rattus rattus* L. It badly damaged the phylloclades leaving the central core resulting in reduced photosynthetic activity and yield. This clearly highlights the infestation of rats on the phylloclades of dragon plants.

Keywords: Dragon plant, pests, phylloclade damage, *Rattus rattus*, rodent.

THE dragon fruit commonly known as Pitaya or Pitahaya is an important tropical fruit belonging to the family Cactaceae, rich in vitamins, minerals, complex carbohydrates, dietary fibres and antioxidants[1]. The genus *Hylocereus* comprises 18 species[2]. Among them, *Hylocereus undatus*, *Hylocereus polyrhizus* and *Hylocereus costariscensis* are widely cultivated in India spanning an area of 3000–4000 ha (ref. 3). In urban and peri-urban horticulture, it is gaining importance and widely cultivated in terrace or rooftops of Kollam district, Kerala, India (Figure 1). Threats of biotic factors like insects, non-insects and mammalian are commonly found feeding on different fruit crops[4]. There have been reports on feeding damage caused by monkeys, rabbits, squirrels and possums on the lower stems of dragon plants. Similarly, feeding of fruits by monkeys, mice, rats and birds has also been reported[5]. However, the present study reports the feeding damage of dragon stem (phylloclades) by rats.

The present study was conducted at the demonstration unit of dragon plants maintained on the terrace of ICAR-Krishi Vigyan Kendra (KVK), Kollam, during October–November 2024. The climate is tropical, having a lat. 8.987°N and long. 76.82°E. The plants in the demonstration unit showed severe feeding damage on the phylloclade without the physical presence of any kind of insect pests even after continuous monitoring during daytime. This prompted further probe on this. The dragon plants were monitored for the pest activity using a HI XECURE, 4G, solar powered, motion-triggered CCTV camera with dual lens connected to an internet connectivity mounted on a wall at a height of 1.4 m from the ground enabling a bird's-eye view, spanning over the experimental plants round the clock. A second camera was fixed to monitor the ground activity of the suspected pest. The visuals were recorded and monitored continuously for a week to confirm the nature of damage, frequency and pattern of the visit of the pest. Camera visuals revealed the presence and feeding activity of rodents in the experimental unit. To confirm and identify the species of the rodent, a live trap was installed in the experimental unit and monitored regularly. Additionally, an extensive survey was conducted among the urban and peri-urban dragon fruit growers, for similar infestation and feeding symptom, with the support of several line departments including Agricultural Technology Management Agency (ATMA), State Horticulture Mission of Department of Agriculture and Farmers Welfare, Government of

*For correspondence. (e-mail: lekha.m@kau.in)