

**Research Article**

## **ECOLOGICAL STATUS OF *PIRENELLA CINGULATA* (GMELIN, 1791) (GASTROPOD: POTAMIDIDAE) IN MANGROVE HABITAT OF GHOGHA COAST, GULF OF KHAMBHAT, INDIA**

**Devendra Solanki, Jignesh Kanejiya and \*Bharatsinh Gohil**

*Department of Life Sciences, Maharaja Krishnakumarsinhji Bhavnagar University, Bhavnagar 364 002*

*\* Author for Correspondence*

### **ABSTRACT**

Studies on mangrove associated organisms were one of the old trends to studying mangrove ecosystems and their productivities. Seasonal status and movement of *Pirenella cingulata* according to habitat change studied from mangroves of Ghogha coast from December 2014 to November 2015. The maximum density (4.4/m<sup>2</sup> area) of *Pirenella cingulata* reported during winter and lowest during monsoon (0.20/ m<sup>2</sup> area). This mud snail was observed dependent on the mangrove during adverse climatic conditions during summer and monsoon seasons. Temperature and dissolved oxygen levels influence the density of *P. cingulata*.

**Keywords:** *Pirenella cingulata*, Mangroves, Seasonal Conditions, Ghogha Coast

### **INTRODUCTION**

Indo-West Pacific oceans are popular for the molluscan diversity, but despite more than two centuries of malacology, the basic knowledge about mangrove associated biota is still inadequate (Kiat, 2009). The mangroves are not only trees but itself an ecosystem comprises associated fauna, the biotope surrounded by the trees extensions like soil, stem, substrate, shade, tidal range etc., and are influential to the distribution of malacofauna (Lozouet and Plaziat, 2008).

Indian coastline comprises three gulfs, namely Gulf of Kachchh and Gulf of Khambhat in west side while Gulf of Mannar in southeast side. Gulf of Khambhat covers a coastal area of about 3,120 km<sup>2</sup> and an intertidal area of about 62,400 million m<sup>3</sup>, principally of muddy coasts, estuaries, mangroves and some of the rocky stretches. The gulf area supplemented by numerous inlets of the Arabian Sea and creeks made by the rivers like Shetrunji, Sabarmati, Tapi, Mahi, and Narmada. These rivers form estuaries and add the huge amount of sediments into Gulf (Ramnathan *et al.*, 2002).

*P. cingulata* is an opportunistic and fast-growing snail. It considered as a pest in brackish water and ponds where the less number of predators and competitors, that in turns of their great population explosion (Zvonareva and Kantor, 2016). *P. cingulata* is the very common and abundant gastropod of estuaries, mangrove habitats, muddy inland creeks and open mudflats (Rao *et al.*, 1987; Printrakoon *et al.*, 2008; Mitra *et al.*, 2010; Zvonareva & Kantor, 2016). These snails are dark brown in color and commonly known as 'Horn Shells'. A shell is large, elongated and thick, can grow up to 50 mm in length, and comprises 13-15 whorls which are separated by shallow sutures (Rao, 2003). This widely distributed species reported throughout Indian coastline (Mitra *et al.*, 2010), generally India to Southeast Asia, Vietnam (Zvonareva & Kantor, 2016), from northeast coast to southern delta, W Indonesia (Reid and Ozawa, 2016). *P. cingulata* is the obligate deposit feeder, chiefly uptakes macro algae, bacteria, and diatoms as a food source (Kamimura & Tsuchiya, 2004; Raut *et al.*, 2005). Prabhakara Rao and Prasada Rao (1983a, 1983b) has done great work on *P. cingulata* considering almost all the aspects its ecology, some of were an effect of temperature and oxygen tension on it. *P. cingulata* has the great tolerance towards the salinity (Vohra, 1970). The breeding season of *P. cingulata* begins in winter and extends up to pre-monsoon with a peak period in any months of this extended seasonal period. Eggs are laid in jelly strings (Shukla, 2014). It develops with the planktonic Trocophore and Veliger larvae forms (Ruppert *et al.*, 2004). The mangrove forest is rich in terms of organic matter and nutrients (Pramudji, 2001); it provides substrate shelter and food to the members of Potamididae family (Vannini *et al.*, 2008). According to Reid & Ozawa, (2016), the mangrove habitats are under threat in many areas and the fewer

## Research Article

members from Cerithiidae are consequently considered to be endangered. Joseph & Ramesh (2016) worked on heavy metal concentration in Potamididae Snails. *P. cingulata* found infected by Trematode larvae in estuarine areas (Al-Kandari *et al.*, 2000; Sritongtae *et al.*, 2015). These snails are useful to provide information on the bioavailability of contaminants in ecosystems and used as bioaccumulation indicators (Joseph & Ramesh, 2016) and even small-scale responses by biota to the alterations in the physical environment of subtropical mangrove ecosystem can lead to noticeable effects on the abundance and diversity of benthic fauna (Skilleter & Warren, 2000), and it helps for making of conservational strategies.

Present research work reveals the status of *P. cingulata*, seasonal effects on their distribution and their ecological conditions in the mangroves of Ghogha coast, Gulf of Khambhat, India.

## MATERIALS AND METHODS

### Study Site

The observational and population assessment study of *P. cingulata* was carried out from mangrove ecosystem of Ghogha coast during a year period. Ghogha is the small coastal town and famous port situated eastern side of Bhavnagar. The coastline of Ghogha is about 4 km long ( $21^{\circ}40'32''$  to  $21^{\circ}41'18''$  N and  $72^{\circ}17'5''$  to  $72^{\circ}16'48''$  E) (Figure 1), highly muddy especially from post monsoon to summer, comprises small mangrove forest of *Avicennia marina* at ro-ro ferry side (Solanki *et al.*, 2016).

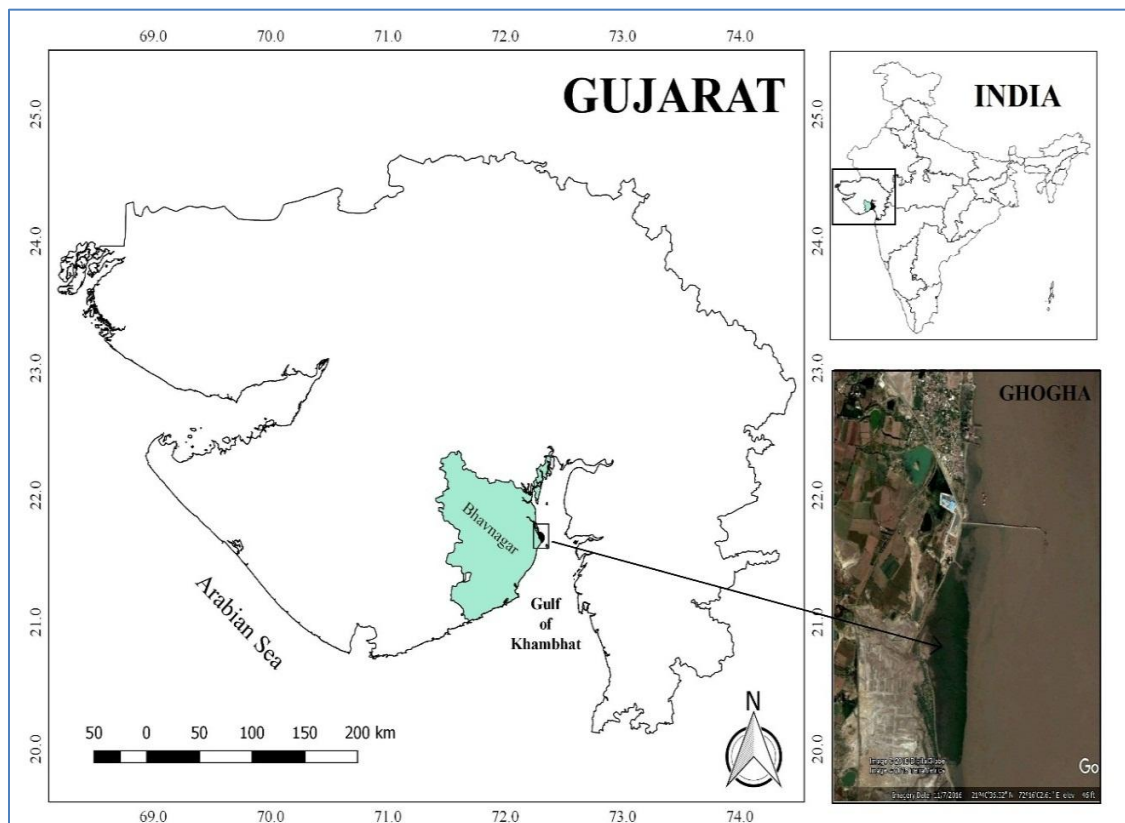


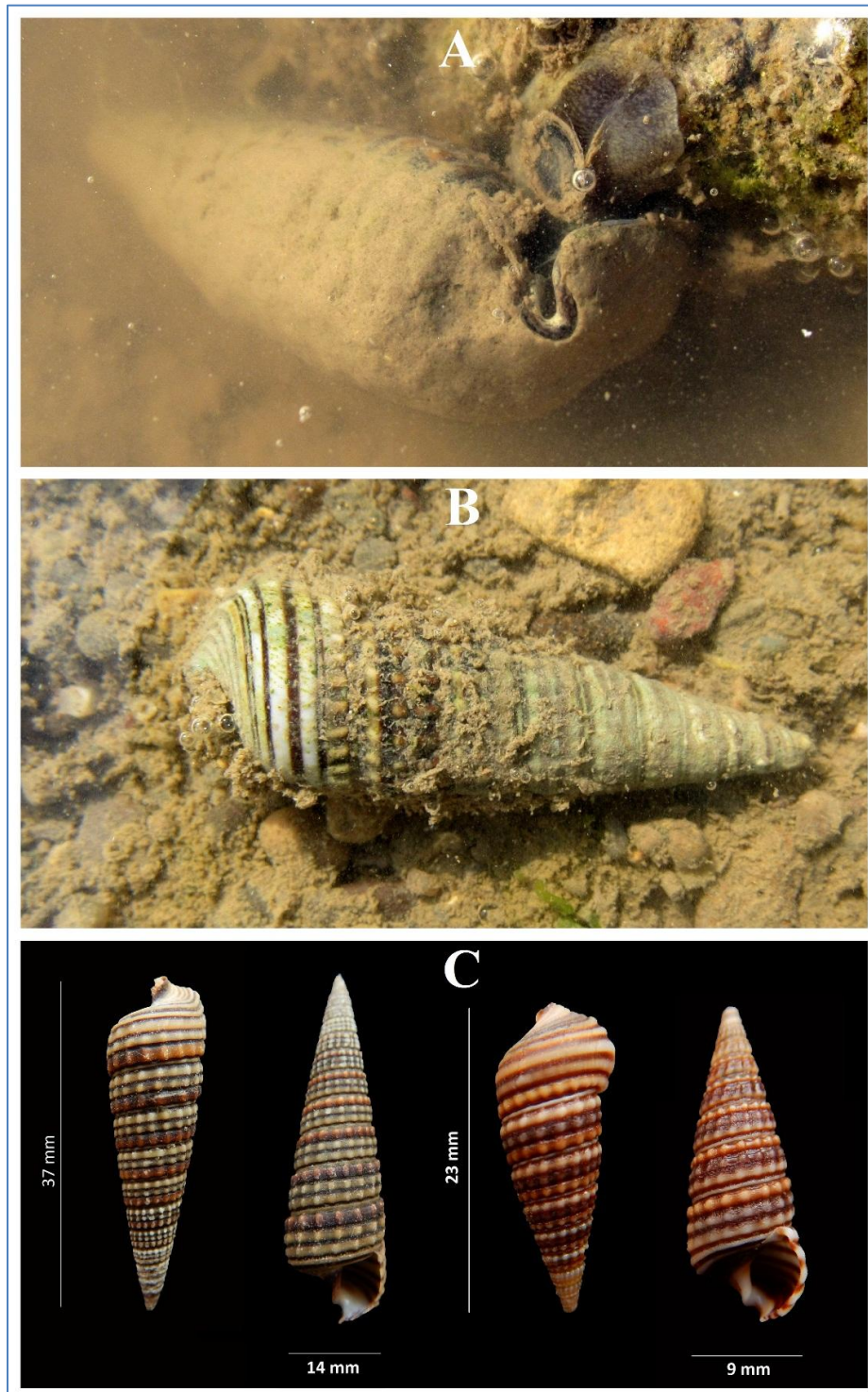
Figure 1: Sampling Site, Mangrove Habitat of Ghogha Coast, Gulf of Khambhat

### Methodology

Selected sampling area was visited on monthly during the year December 2014 to November 2015. The year was divided into four seasons according climatic conditions, winter (December-February), summer (March-May), monsoon (June-September) and post-monsoon (October-November). Line transects and Quadrate methods have used to evaluate the population data. Dead shells were collected by hand picking

**Research Article**

method washed by dilute acid to obtained morphological traits. Analysis of Physico-chemical properties of sea water was done following standard methods and equipment. Graphs and correlation analysis have done by using MS excel and map prepared by using QGIS.



**Figure 2 A: *Pirenella Cingulata* in Natural Conditions B. Grazing on Algae C. Morphology of Juvenile and Adult Shell**



## Research Article

### RESULTS AND DISCUSSION

In the studied site, *P. cingulata* was found on mud and sandstones with algal associations in the upper intertidal (UIZ) and mid-intertidal (MIZ) zones in mangrove plantation as well as in natural mangroves, occasionally in extremely high densities at Ghogha coast. It reported occurring in fewer numbers in the area of sparse and small mangroves plants, and very less density in the shade of the dense canopy of *A. marina*. The highest density of *P. cingulata* reported during winter season  $4.4 \pm 3.5$  while lowest during monsoon  $0.6 \pm 0.2$  (Figure 3) per  $m^2$  area. Physical conditions of sea water of selected site, pH showed slight fluctuation while temperature ranges  $38.42 \pm 25.6$  °C (Figure 5). The salinity of the sea water merely stable throughout the year, it ranges from 32.9 to 35 ppt. Highest salinity was recorded during summer and lowest during monsoon. The dissolved oxygen content in sample water varied from 3.21 (Milligram /Liter) mg/L to 7.6 mg/L. The maximum value was noticed during winter and the minimum during monsoon (Figure 6), which shows significant impact on the snails and the strong positive correlation value between DO and seasonal mean density of *P. cingulata* was (.93). Biological oxygen demand measures about  $3.65 \pm 1.02$  mg/L. There was a strong negative correlation between temperature and *P. cingulata* density (-.84).

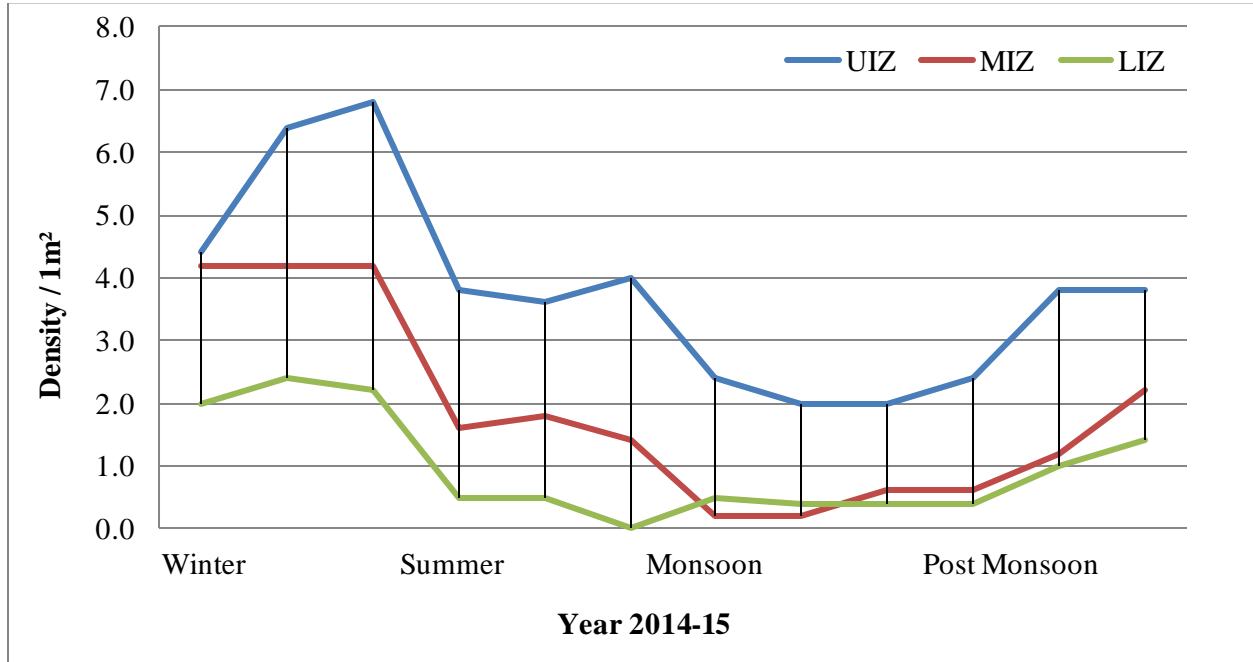


**Figure 3: Habitat Conditions and Movement of *Pirenella Cingulata* in Different Seasons along the Mangroves of Ghogha A: Winter, B: Summer and C: Monsoon**

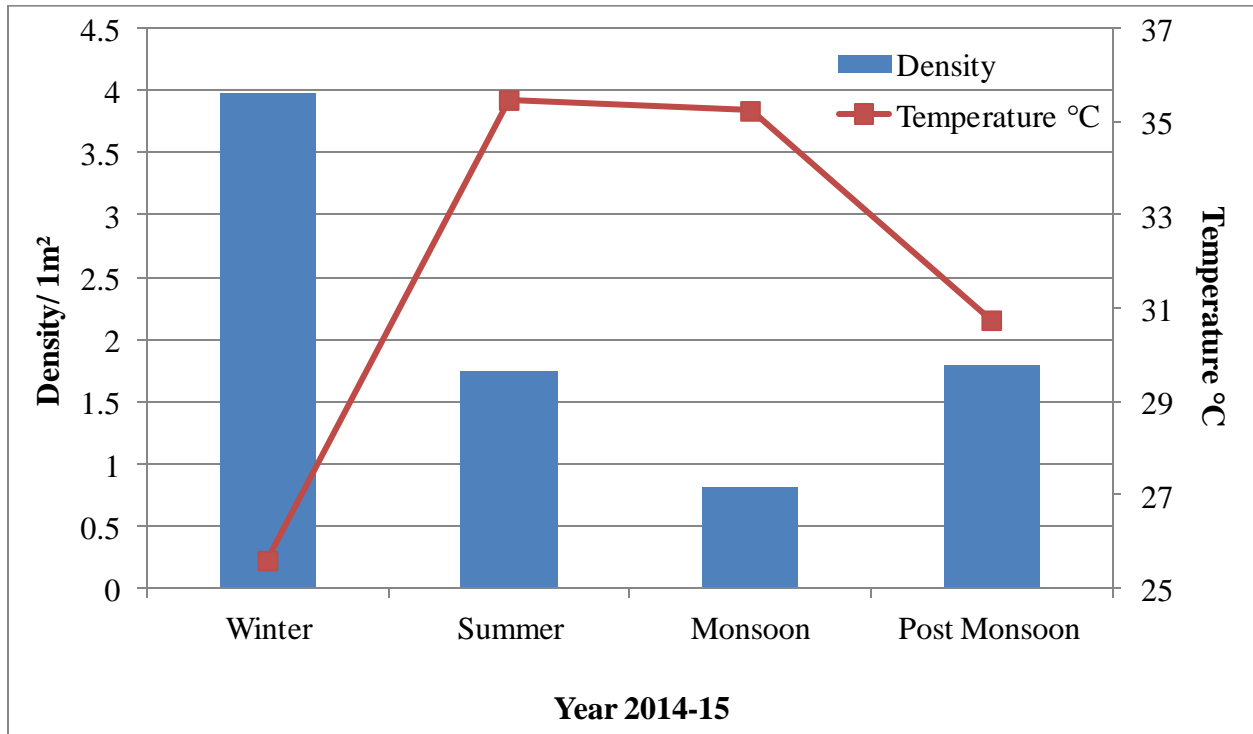
*P. cingulata* was noticed in different dispersal patterns according to seasonal change (Figure 3). The common scenario of muddy coasts of Gulf of Khambhat is, mud got eroded out in the monsoon (Kanejiya *et al.*, 2017), but due to high siltation during the winter season, the mud gets increased. During summer (March-June) the brackish water become dry, *P. cingulata* strongly adapted by means of physiology and it can starve up to 28 days (Rao *et al.*, 1987). During summer, the mud becomes dry at the mangrove site of Ghogha, the mangroves play an important role to keep the soil as it prevents the erosion of mud, due to which the wet mud was clubbed at mangrove root (Figure 3B). According to Shukla, (2014), there is no

**Research Article**

correlation between the abundance of *P. cingulata* and substrate organic matters but the size of it differs according to substrate used by it but this study indicated, *P. cingulata* like to prefer muddy habitat generally but, during and summer the monsoon mud was restricted to mangrove roots so these snails was observed at base of the mangroves.



**Figure 4: Density of *Pirenella Cingulata* in Three Distinct Zone of Intertidal Area of Mangrove Habitat, Ghogha**



**Figure 5: Temperature and Mean Density of *Pirenella Cingulata***

### Research Article

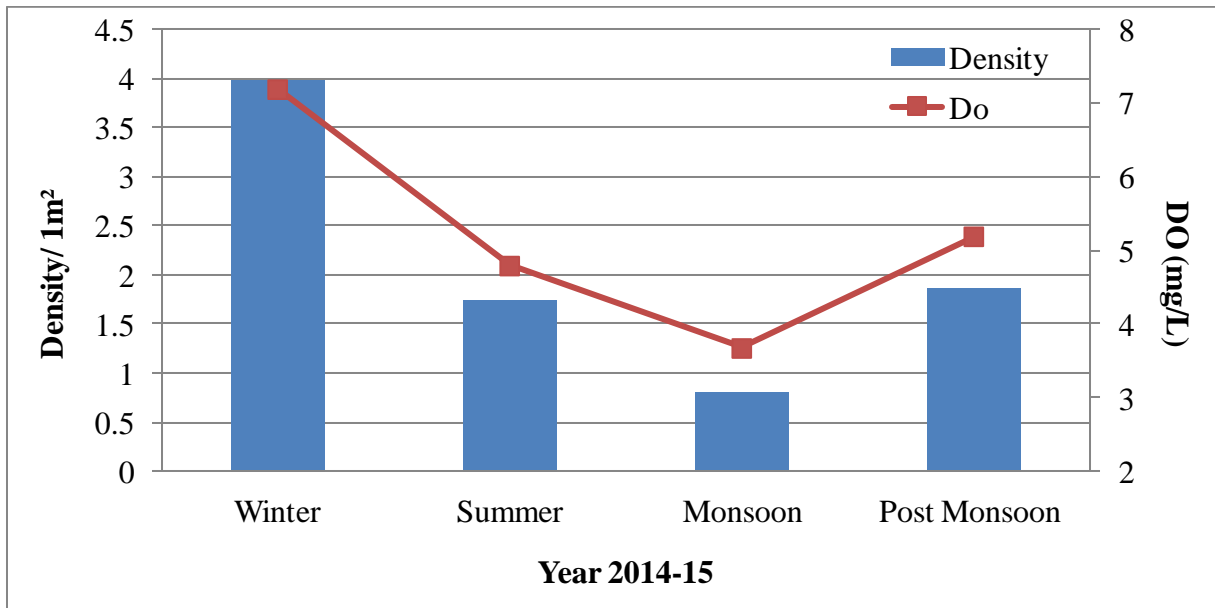


Figure 6: The Amount Dissolved Oxygen and Mean Density of *Pirenella Cingulata*

### Conclusion

A mangrove of Ghogha coast serves the best habitat to the *P. cingulata*. This species is not fully mangrove dependent or associated species; however, the great abundance of *P. cingulata* has been recorded in mangrove ecosystems only. The relationship with mangrove is of eurybiotic type i.e. it may use mangrove as substratum only. The sea water temperature have a significant effect on the health of water body and benthic fauna and it has proven that the higher the temperature leads to lower dissolved oxygen levels and species abundance. The temperature made a significant impact directly on habitat conditions and which forced the *P. cingulata* migrate to wet areas or mangrove roots.

### ACKNOWLEDGEMENTS

Authors are thankful to Professor and Head, Department of Life Sciences, Maharaja Krishnakumarsinhji Bhavnagar University, for providing research facilities. We are heartily thankful to Professors and friends from Sir P.P Institute of Sciences, of the same university for encouragement and guidance. First author thankful UGC for financial help in the form of Rajiv Gandhi National Fellowship.

### REFERENCES

- Al-Kandari WY, Abdul-Salam J and Meakins R (2000). Temporal variations in the infection of a population of *Cerithidea cingulata* by larval trematodes in Kuwait Bay. *Journal of Helminthology* **74**(1) 17-22 DOI: <https://doi.org/10.1017/S0022149X00000032>.
- Joseph TUR and Ramesh KB (2016). Heavy Metal Risk Assessment in Bhavanapadu Creek Using Three Potamidid Snails – *Telescopium telescopium*, *Cerithidea obtusa* and *Cerithidea cingulata*. *Journal of Environmental and Analytical Toxicology* **6** 385 DOI: 10.4172/2161-0525.1000385.
- Kamimura S & Tsuchiya M (2004). The effect of feeding behavior of the gastropods *Batillaria zonalis* and *Cerithideopsis cingulata* on their ambient environment. *Marine Biology* **144** 705–712. <http://dx.doi.org/10.1007/s00227-003-1238-x>
- Kanejiya J, Solanki D and Gohil B (2017). Population status of mudskippers in mangrove and non-mangrove area of Ghogha coast, Bhavnagar, Gujarat, India. *Flora and Fauna* **22**(1) 26-35.
- Kiat TS (2009). A Book Review, Mangrove Environments and Molluscs: Abatan River, Boholand Panglao Islands, Central Philippines by Pierre Lozouet & Jean Claude Plaziat. *The Raffles Bulletin of Zoology* **57**(1) 231–232.

**Research Article**

- Lozouet P and Plaziat JC (2008).** *Mangrove Environments and Molluscs: Abatan River, Boholand Panglao Islands, Central Philippines*, (ConchBooks, Hackenheim, Germany) 1-155
- Mitra S, Misra A and Pattanayak JG (2010).** Intertidal Macrofauna of Subarnarekha Estuary (Balasore: Orissa). *Record of the Zoological Survey of India*, Occasional Paper No 313 1-135.
- Prabhakara Rao Y and Prasada Rao DGV (1983).** Effect of temperature on aquatic and aerial oxygen consumption of *Cerithidea (Cerithideopsisilla) cingulata* (Gmelin 1790) and *Cerithium coralium* Kiener 1841, *Monitore Zoologica Italiano* **17** 113-119.
- Prabhakara Rao Y and Prasada Rao DGV (1983).** End products of anaerobic metabolism in *Cerithidea (Cerithideopsisilla) cingulata* (Gmelin 1790) and *Cerithium coralium* Kiener 1841. *Canadian Journal of Zoology* **61** 1304-1321.
- Pramudji (2001).** The role of mangrove forest ecosystems as habitat for marine organisms. *Oseana* **26**(4) 13-23.
- Printrakoon C, Wells FE and Chitramvong Y (2008).** Distribution of molluscs in mangrove at six sites in the upper gulf of Thailand. *Raffles Bulletin of Zoology* **18** 247-257.
- Ramnathan V, Vincent D, Sundermoorthy S and Sunmugaraj T (2002).** ICMAM (Integrated coastal and marine area management). Critical habitat information system for Gulf of Khambhat, Gujarat, DOD, GEC 1-34.
- Rao SNV (2003).** Indian Seashells (Part-I): Polyplacophora and Gastropoda. *Record of the Zoological Survey of India* **192**(I-X) 1-416.
- Rao YP, Uma Devi V and Prasada Rao DGV (1987).** Starvation Metabolism in the cerithiids *Cerithidea (Cerithideopsisilla) cingulata* (Gmelin) and *Cerithium coralium* Kiener. *The Veliger* **30**(2) 173-183.
- Raut D, Ganesh T, Murty NVSS and Raman AV (2005).** Macrobenthos of Kakinada Bay in the Godavari Delta, East coast of India: comparing decadal changes. *Estuarine, Coastal and Shelf Science* **62** 609-620.
- Reid DG & Ozawa T (2016).** The genus *Pirenella* Gray, 1847 (= *Cerithideopsisilla* Thiele, 1929) (Gastropoda: Potamididae) in the Indo-West Pacific region and Mediterranean Sea. *Zootaxa* **4076**(1) 1–91. DOI: <http://dx.doi.org/10.11646/zootaxa.4076.1.1>
- Ruppert EE, Fox RS and Barnes RD (2004).** *Invertebrate Zoology. A Functional Evolutionary Approach*, 7th edition, (Thomson Brooks/Cole, Belmont, CA, USA) 990.
- Shukla ML (2014).** A Comparative Study of Macro Faunal Community of Natural and Restored Mangrove Sites between Mahi and Dhadhar River Estuaries of Gulf of Khambhat, PhD Thesis, M.S University, Baroda.
- Skilleter GA and Warren S (2000).** Effects of habitat modification in mangroves on the structure of mollusc and crab assemblages. *Journal of Experimental Marine Biology and Ecology* **244** 107–129.
- Solanki D, Kanejya J, Belem I and Gohil B (2016).** Checklist of intertidal marine fauna in mangrove ecosystem, Ghogha coast, Gulf of Khambhat, India. *Journal of Entomology and Zoology Studies* **4**(4) 1281-1284.
- Sritongtae S, Namchote S, Krailas D, Boonmekam D and Koonchornboon T (2015).** Cercarial infections of brackish water snails on the east coast of southern Thailand. *Joint International Tropical Medicine Meeting Proceedings* **3** 1-15.
- Vannini M, Cannicci S, Mrabu E, Rorandelli R and Fratini S (2008).** Random walk, zonation and the food searching strategy of *Terebra liapalustris* (Mollusca: Potamididae) in Kenya. *Estuarine, Coastal and Shelf Science* **80** 529-537.
- Vohra FC (1970).** Some studies on *Cerithiidae cingulata* (Gmelin 1790) on a Singapore sandy shore. *Journal of Molluscan Studies* **39** 187–202.
- Zvonareva S & Kantor Y (2016).** Checklist of gastropod molluscs in mangroves of Khanh Hoa province, Vietnam. *Zootaxa* **4162**(3) 401–437.