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New record of a marine bivalve (Family: Pinnidae) from Chilika Lagoon, Bay of Bengal

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Present study describes the newly reported marine bivalve species *Atrina serrata* from the marine influenced region of Chilika lagoon. This is the first time ever to record an Atlantic bivalve species from the shallow coastal waters of Indian subcontinent. With the paucity of information, the study isn't reached to any conclusion regarding the possible reason of occurrence, since multiple parameters are governing on the distribution of a species. However, this finding will help to understand the changed or changing benthic ecology of shallow water coastal ecosystem such as Chilika after opening of the lagoon inlets.

[**Keywords:** *Atrina serrata*, Bay of Bengal, Bivalve, Chilika lagoon, New record]

Introduction

Pinnidae is a family under the order Pterioidea of class Bivalvia, generally refers to large sized saltwater bivalves. This family represents two existing genera namely *Pinna* Linnaeus 1758 and *Atrina* Gray 1842 including 55 accepted species^{1,2,3}. These are also known as pen shells because of their distinguished morphological similarity with pen. Shells of this family are fragile in nature, triangular in structure and having the ability to produce pearls and mostly translucent. In living conditions the pointed apex is anchored inside the sediment with byssus threads that provides mechanical support. The inner side of the shell is marked with radiantly coloured layer called nacre layer. Nacre is the pearl producing layer also known as mother of pearls which starts from the umbo (the pointed end) to almost middle of the shell laterally. These cryptic organisms are usually seen in the sandy substrates of sea grass meadows, coral reef beds, lower subtidal regions to continental shelf areas and from temperate to tropical waters; ranging from Indo-Pacific to Atlantic and Mediterranean Sea^{1,2}. Most of the shell is found buried in the marine or estuarine sediment and hardly 1 % is exposed to outer environment. Hence, these bivalves are missed by the observers in most of the occasions.

In India, the existing literature exhibits that the family Pinnidae possess only two genera comprised

with seven species⁴. Although, there is a good observational record of the genus *Pinna*, the published literature on genus *Atrina* suggests a scanty representation and distribution throughout the Indian coast line. In general, two species of genera *Atrina* namely *A. vexillum* (Born, 1778) from Andaman and Nicobar Islands^{5,6} followed by Dhanushkodi, Gulf of Manner-off Tamil Nadu⁷ and *Atrina pectinata* (Linnaeus, 1767) from Digha-Shankarpur area of West Bengal⁸ and from Kakinada bay, Andhra Pradesh⁹ hitherto recorded. There is imprecise information available regarding the occurrence of *Atrina* species restricted to Lakshadweep waters^{10,11} of which no detailed information is being available yet.

Nevertheless, during the recent survey to outer channel area of Chilika lagoon, a new record of an *Atrina* species is observed. After comprehensive scrutiny of the morphological characters the species level identification was possible. The observed species usually predominates in the coasts of Atlantic Ocean. However; no authentic report regarding the occurrence from the Indian main land coast as well as from Chilika Lake¹² is available. Under this backdrop the present study is designed to describe the first authentic report of occurrence of *A. serrata* from the lagoon ecosystem of India main land i.e. The Chilika.

Materials and Methods

Study area

Chilika (Lat. 19°28' and 19°54' N; Long. 85°05' and 85°38' E), the largest brackish water lagoon of Asia located at the north west of Bay of Bengal (Fig. 1), is one of the hotspots of biodiversity and provides an exceptional habitat for migratory birds, Irrawaddy dolphins, several other rare, vulnerable and endangered species listed in the IUCN Red List. The lagoon is shallow (average depth 1.2 m), comprising of four hydrographically distinct sectors such as the northern fresh water region, central and southern brackish water region and marine influenced outer channel sector. It is well connected to the Bay of Bengal through couple of tidal inlets. The lagoon has been continuously subjected to various ecological stresses attributable to natural and anthropogenic alterations¹³. The outer channel area is ecologically much diverse as it harbours mangrove vegetation, molluscan shell banks and extensive sea grass meadows at the shoreline¹³.

Sample collection

On the routine survey to the outer channel of Chilika Lagoon live specimens of *Atrina* sp., were first collected from the natural inlet of outer channel i.e. the Shipakuda region (Lat. 19°39'54.51" N & Long. 85°29'13.41" E; first collection date: 23rd March 2009) and observed subsequently along the Chilika lagoon adjoining the Bay of Bengal. After collection, the morphometric measurements were then taken in live condition and then preserved in 10 % formaldehyde solution in the laboratory. The specimens were photographed before preservation



Fig. 1 — Map of Chilika showing lagoon inlet and sample collection site of *Atrina serrata*

(Fig. 2) and were identified after following the standard literatures up to species level¹⁴⁻¹⁵.

Results and Discussion

Identification

The newly observed species bear fan shaped, slightly inflated, and fragile shells. The colour varied from greenish to tan. It also bears translucent pointed beak; long hinge area, straight but concave at the beak; 30-40 no. of radial ribs which gets smoother near the ventral hing; fine saw tooth serrations covering almost full surface of the shell; large spines are closely arranged in the ventral region as compared to dorsal surface; interior muscular scar is placed below the edge of nacreous layer. The nacreous layer is slightly visible on the dorsal side when visualised in front of light. After looking the above features the present specimen is identified as *Atrina serrata* commonly known as saw toothed pen shell (Figs. 2a & b). The observed specimen undergoes to the following systematic positions.

Kingdom: Animalia
 Phylum: Mollusca
 Class: Bivalvia
 Order: Pterioida
 Suborder: Pinnina
 Family: Pinnidae
 Genus: *Atrina*

A. serrata (G. B. Sowerby I, 1825)^(refs. 14-15) (Figs. 2a & b)

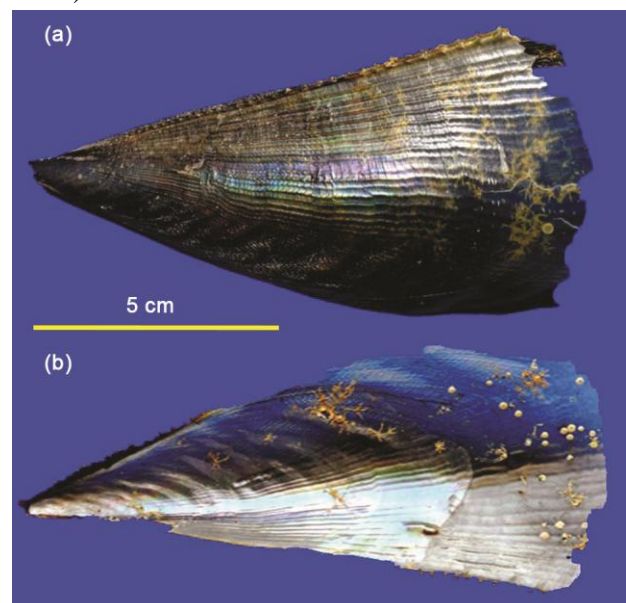


Fig. 2 — a) External portion of *Atrina serrata*, and b) Internal portion

Synonyms:

- Pinna seminuda* Reeve, 1858
- P. serrata* G. B. Sowerby I, 1825
- P. serrata* Lightfoot, 1786
- P. squamosissima* Philippi, 1849

Distribution

The species *A. serrata* is distributed mostly in temperal waters also in the tropics. Often found from the Atlantic Ocean to the Indian Ocean. Mostly at the coasts of United States, Venezuela, Coasta Rica, Mexico, Cuba, Brazil, Panama, Nicargua, Colombia, Australia etc.

Remarks

Genus *Atrina* is quite different from its sister genus *Pinna* in having following characteristic differences. In genus *Atrina*, outer surface of valves are without a median radial keel and the internal nacreous layer is undivided. But, in the case of genus *Pinna*, the outer surface of valves is with a median radial keel and the internal nacreous layer is divided into 2 lobes by a median radial groove (Fig. 3). Further, the presently

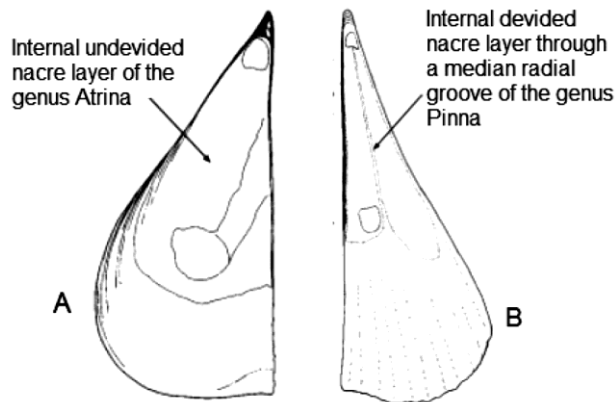


Fig. 3 — Key morphological differences between two genus *Atrina* sp. (A), and *Pinna* sp. (B). Source: <http://www.fao.org/tempref/docrep/fao/009/w7191e/w7191e16.pdf>

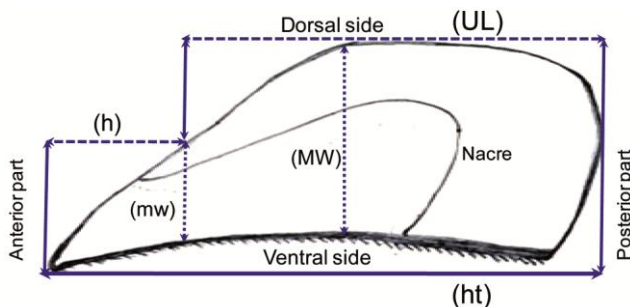


Fig. 4 — Size and measurement of *Atrina serrata* from Chilika lagoon

reported species is also different from the previously described species from the Indian coast namely *Atrina pectinata* and *Atrina vexillum*¹⁶.

The size measurement of the *Atrina serrata* (Fig. 4) can be described as shell height (ht) 14.3 cm; length of the buried part of the bivalve (h) 3.3 cm; length of the unburied part of the bivalve (UL) 11 cm; maximum width of the shell (MW) 7.2 cm; minimum width of the shell (mw) 3.4 cm. From umbo up to the middle of the shell the pearl producing nacre layer is observed as a shining patch containing pearls having irregular shape. Although, scattered all over the shell, the spines varied at different regions (Fig. 5). For example, the spines are small and less pointed at the dorsal region and well developed, more pointed and designed as tooth shaped towards the ventral region. Similarly, most of the spines are compactly arranged in the anterior region as compared to the posterior part (Fig. 5a). Interestingly, the rows also contain spines which are arranged in a wavy manner (Fig. 5b). The unique arrangements of the tooth like spine (Fig. 5c) measured about 1 cm is the characteristic feature of genus *Atrina*. Such design of the shell might be supportive for anchoring facility to the living shell body from the physical forcing such as high waves and support against mechanical force. Being a filter feeder it usually feeds on planktonic community. The rough wavy outer exposed portion containing spines

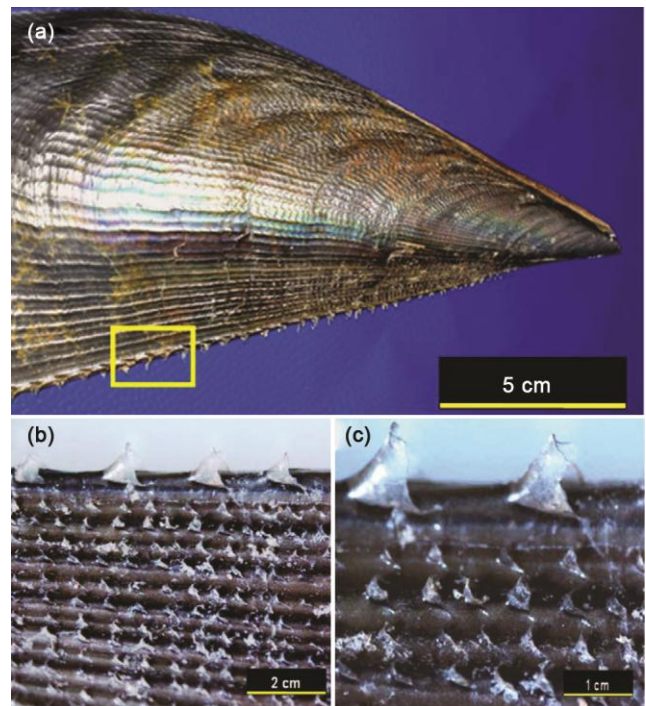


Fig. 5 — Spine arrangement and dentition design of *Atrina serrata*

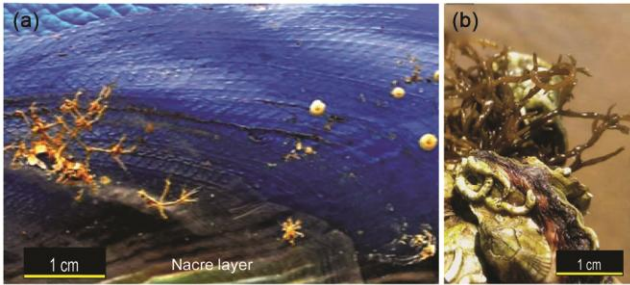


Fig. 6 — a) Sessile macrofauna observed in the inner surface of the shell of *Atrina serrata*; and b) Live benthic communities of marine algae, barnacles and calcareous tube found on the external region of the shell observed from Chilika lagoon

on the shell of *Atrina* acts as the suitable substratum for the settlement of planktonic larvae of most of the sessile macrofauna and flora. Thus, colonization of different marine invertebrates along with marine algae over the shell surface is a common phenomenon as evidenced in Figure 6(a & b). Some of the well-known benthic sessile fauna such as *Obelia dichotoma*, bivalves, barnacles, crab species, *Chiton*, traces of soft coral gorgonids, marine sponge, brittle star etc. are observed frequently. Microscopic imagery further revealed that the dead shells of *Atrina* provide an excellent shelter support to meiobenthic community such as foraminifera, nematodes, harpacticoida copepod, cumacea etc.

Atrina serrata and *Atrina pectinata*¹⁷ have some common identifying features viz. “shell fragile; translucent, moderately inflated and triangularly wedge-shaped in outline; with a highly patchy sculpture. Dorsal margin nearly straight or slightly concave and the posterior margin generally truncate. The ventral margin widely convex posterior and straightest to shallowly depressed anteriorly. Outer surface of valves is arranged with 15 to 30 radial ribs which may be smooth to densely set with short, open spines. Dorsal most radial rib possesses a series of short and sharp spines protruding along the dorsal margin of the shell. Inner surface of shell is with shallow grooves corresponding to the external radial ribs. Internal nacreous layer rather thin, undivided, occupying the anterior 2/3 to 3/4 of valves containing miniature pearls within. Posterior adductor scar completely enclosed within the nacreous area. Colour: outside of shell slightly shiny, translucent olivaceous tan, often tinged with darker purplish brown or grey toward the umbones. Interior of the shell similarly coloured and iridescent on nacreous area¹⁷. But, both the species are different in the size of the specimen.

The *A. pectinata* is much larger and less brittle than the *A. serrata*. The exterior surface of the later species is delicately sculptured with small, sharp, tooth-like spines arranged on the 30 rows.

In contrast, *Atrina vexillum*¹⁸ is characterised with different features such as shell reaching a very large size, thick and solid, inflated, variable in shape from triangular to hatchet-shaped or sub-globular. Outside of valve is with 10 to 17 main radial ribs, often bearing scale-like spines, and with weaker interstitial ribs. Colour: outside of shell usually dark reddish brown to black, shell material semi-translucent, appearing rich reddish purple when viewed with transmitted light, interior of the shell dark brown to black, iridescent on nacreous area¹⁴. This species is much larger as compared to the *Atrina serrata* and *Atrina pectinata*. The *Atrina serrata* is different from the *Atrina vexillum* in terms of colour of the shell, spine arrangements and rows of the ribs. In *A. serrata* the rows of the ribs are almost 30 in number but in *Atrina vexillum*¹⁸ it is restricted to 10 to 17 ribs.

The occurrence of newly observed live specimen of *A. serrata* from outer channel area of Chilika lagoon can be attributed to increased salinity range as a result of opening of the couple of inlets^{13,19-27}. During last couple of decades after the opening of artificial lagoon inlet on 23rd of September 2000, two more lagoonal inlets were opened subsequently during the year 2008 & 2012. This has provided a stable salinity regime in the outer channel area. Consequently, high species diversity among the marine benthic communities has been recorded for the first time those are scientifically well documented^{13,19-27}. An ecological change in shallow coastal ecosystems is a very common phenomenon and it has a direct influence on the existing biota of the region. Additionally, the increasing port activities and ship movements can bring out substantial changes in the local marine & estuarine fauna community by introducing non-native species through ballast water exchange. The presently reported Atlantic bivalve species from coastal areas of Chilika-Bay of Bengal confluence zone might be due to the larval exchange (ballast water) from the on-going port activities, either from the Paradeep port which is located 145 km north of Chilika or from the Vishakhapatnam port, located 325 km south of Chilika lagoon. Henceforward, from Indian main land coast three species of *Atrina* are recorded belonging to three different ecological niches. i.e. *Atrina serrata* in Chilika Lagoon (present study), *Atrina pectinata* in offshore region of

Shankarpur, West Bengal⁸ followed by Kakinada Bay⁹ and *Atrina vexillum* in Gulf of Manner^{16,18}.

Since, there is no definite reason available to explain the occurrence of *A. serrata* in Chilika lagoon, the present study could not conclude with precise reasoning. One of the reasons for the non-availability of literature pertaining to this species can be the fact that very less attention has been paid in the past to explore the benthic communities of coastal habitats in general and to the Chilika lagoon in particular. Therefore, *Atrina serrata* might be the victim of less scientific exploration. Otherwise it may have introduced through the ballast water. However, long term studies are required to infer the findings.

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Conflict of Interest

Authors have declared that no conflicts of interest exist.

Author Contributions

DM: sample collection, analysis, review of literature, manuscript review and editing; BT: identification and authentication of the observed species; and RCP & SP: conceptual design and research methodology.

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