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NEW RECORDS OF FIVE BARBATIA SPECIES FROM ARCIDAE FAMILY (MOLLUSCA: BIVALVIA) FROM SOUTH EAST COAST OF INDIA

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ABSTRACT

New records of five bivalve species are reported in this paper. This is the first report of Barbatia genera of Arcidae family (Bivalvia:Mollusca) from the South east coast of India. Five species of Arcidae from Barbatia genera were obtained from the sea shore of Thiruchandur and Veerapandiyapattinam in Tamil Nadu. These places are come under the Gulf of Mannar Region. Arcidae unites a group of marine bivalves that inhabit rocky substratum as well as sand and mud. They are distributed in warm tropical waters from the midlitoral zone to great depths. The five species namely *Barbatia amygldalumtostum* (Roding, 1798), *Barbatia barbata* (Linnaeus, 1758), *Barbatia foliata* (Forsskal in Niebuhr, 1775), *Barbatia obliquata* (Wood, 1828), and *Barbatia candida* (Helbling, 1779) are classified and described based on their morphological characters. For species level systematic arrangement periostracum characters were considered. Five morphological characters were used for identification. The identified specimens of the family Arcidae (Bivalvia:Mollusca) had deposited in the Marine Biodiversity Museum of CMFRI , Kochi, Kerala, India.

KEYWORDS: Taxonomy, Arcidae, *Barbatia amygldalumtostum, Barbatia barbata, Barbatia foliata, Barbatia obliquata, Barbatia barbata*

Bivalvia is the second largest class of mollusca. It composed of economically important groups of animals. They are present in coastal areas, intertidal areas and attached to rocky or solid substratum, some are burried in sand or mud. Some are living with corals, and commonly found in crypts within massive corals. Arcoidea are dioecious, and the majority produces small eggs and has a planktotrophic development. They are widely distributed in the Indian Ocean. The Molluscan resources are abounded along the coastal region of India. They have a long evolutionary history. They are originated from Ordovician to the present (Cope, 1997, 2000). Modern Arcidae origins in the Jurassic and are believed to have originated from a parallelodont ancestor (Amler, 1989). The order Arcoida composed of Arcidae, Noetiidae, Cucullaeidae, Glycymerididae, Limopsidae and Philobryidae. The species of Arcidae are collectively called as arkshells and blood cockles. The presence of haemoglobin in the haemocoel gave the name, blood cockle (Oliver and Holmes, 2005).

The bivalves included under the Arcidae are predominantly marine and this group is considered with clams. They are an important source of protein in many tropical, subtropical and warm temperature areas (Broom, 1985). Based on the Indopacific Molluscan Database (OBIS, 2005) there are 180 valid species in over 30 genera. 27 species are recorded from the tropical West Africa (Oliver and von Cosel, 1992) and 20 species from West Atlantic (Abbott, 1974; Rios, 1994) and ten from the north-eastern Atlantic (CLEMAM, 2005). Eight deep Atlantic species are reported by Oliver and Allen in 1980's. Based on these, the global species richness of Arcidae family is 300. In this 40 species are extant species belonging to Noetiidae and three are from the Cucullaeidae. However, more than 200 species are reported from different parts of the world and global level maximum species richness is in Indo-West Pacific.

In India a few reports are available about distribution and the type of species and taxonomy of Arcidae. About 5-8 species of Ark-shells are identified from the Indian coast. Apte in 1998 gave a short description about four species belonging to Arca genera; *Arca granosa* Lamark, *Arca bistricata* Dunker, *Arca symmetrica* Reeve and*Arca tortuosa* Linne. Clams are widely distributed species and they are the major exploited bivalve resources of India. Two economically important species belonging to *Anadara genera*; *Anadara granosa* (Linnaeus, 1758) and *Anadara rhombea* (Born, 1780). From southern part of india 4-6 Arca species were already reported.

MATERIALS AND METHODS

Arkshells are collected from six regions in southern India. Collection was made from August- July

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2013. The collection sites are shown in fig.1. The collection sites are Thiruchendur and Veerapandiyapattinam in the south east coast which is in Gulf of Mannar and it is a marine province situated between India and Sri Lanka along the longitude from 78° 08' E to 79° 30' E and latitude from 8° 35'N to 9° 20' N. This area starts from Pamban Island including Rameswaram to Cape Comorin along India's south east coast. The collection sites composed of rocky as well as sandy area. Thick population of Barbatia species were attached on the cervices of rock and dead shells. The shells were collected and washed. After drying by sunlight the photograph were taken. Identifications were done based on conchological characters i.e.; morphology of the shell, position of beaks, examination of cardinal area, peculiarities of hinge and muscle scar.

Figure 1: Collection sites south east coast of India

SAMPLING

Specimens of ark shell were collected from Thiruchendur and Veerapandiyapattinam, Tamil Nadu region (8.4833° N, 78.1167° E) of the south east coast of India. Collected specimens were transferred to the laboratory for further analysis. They are washed and dried by sun light and photographs were taken. Identification was done by using standard keys (FAO) and online data bases.

RESULT AND DISCUSSION

1. *Barbatia amygldalumtostum*

Parent: *Barbatia Gray*, 1842

***Barbatia amygldalumtostum* (Roding, 1798)**

Class: Bivalvia

Subclass: Pteriomorphia

Order: Arcoida

Superfamily: Arcoidea

Family: Arcidae

Genus: Barbatia

Locality: Thiruchendur, Tamil Nadu, India

Habitat: Rocky sea shore

It also has an unaccepted name ***Barbatia fusca* (Bruguiere, 1789).**

Description

Periostracum is light brown in color. Umbo region is white and is seen in anterior third position. White colour from umbo region radiating like white rays. The shell is thin. It is equivalve enumerous radiating thin parallel and concentric nodulated ribs are present. Shell size is 2-3cm. Very small numerous teeth are present. Inside the shell also light brown color and radiating white color is present corresponding to the outer shell. They are

also anisomyarian and muscle scar is chalky white. Cardinal area is nil. Umbos closely attached. Figs.1a and 1b shows the outer and inner part of the shell.

Remarks

It is rare in collected area. It is distributed in Indian Ocean, Red Sea and Tanzania. The voucher specimen was deposited in Marine Biodiversity Museum of CMFRI (Kochi) with accession number ***Barbatia amygldalumtostum*** **(Roding, 1798) DC.3.1.7**.

2. ***Barbatia barbatia***

Parent: ***Barbatia Gray*****, 1842**

Barbatia barbata **(Linnaeus, 1758)**

Class: Bivalvia

Subclass: Pteriomorphia

Order: Arcoida

Superfamily: Arcoidea

Family: Arcidae

Genus: Barbatia

Locality: Veerapandiyapattinam, Tamil Nadu, India

Habitat: Rocky sea shore

Synonyms: *Arca cylindrical Wood, 1828; Arca bonnaniana Risso, 1826; Arca reticulats* Turton*, 1819; Arca magellanica Bruguiere, 1789; Arca barbata Linnaeus, 1758*

Description

Shell is to 6.5cm in length. Suboval shape. It is fragile than the other species. Posteriorly expanded. Cardinal area having a narrow depression black color. Equilateral. Equivalve. costate. Prominent beak is present. Shell surface is dirty white in color having brown hairs only at the margin. Inside the shell is also dirty white in color. Radial ribs are running from the umbo region towards the posterior margin of the shell. They are weakly crenulated. Weakly costated. Dorsal margin and ventral margin are parallel. Hinge is moderately long consisting of small teeth. Dimyarian but the muscle scars are unequal in size. One muscle scar is dotted. Small lines run towards anteriorly from the pallial line. Shell margin is crenulated. Figs. 2a and 2b show the outer and inner part of the shell.

Remarks

It is exploited along with other clams for industrial purposes. It is reported from Italy, Mediterranean Sea, North Atlantic Ocean, Tunisia and Menzel Jemil. This is the first report of the species from Indian coast. The voucher specimen was deposited in Marine Biodiversity Museum of CMFRI (Kochi) with accession number ***Barbatia barbata*** **(Linnaeus, 1758) DC.3.1.4**.

3.*Barbita foliata*

Parent: ***Barbatia Gray*****, 1842**

Barbatia foliata **(Forsskal in Niebuhr, 1775)**

Class: Bivalvia

Subclass: Pteriomorphia

Order: Arcoida

Superfamily: Arcoidea

Family: Arcidae

Genus: Barbatia

Locality: Thiruchendur, Tamil Nadu, India

Habitat: Rocky sea shore

Synonym: *Arca corallicola* Iredale, 1939; *Barbatia hendersoni* Dall, Bartsch and Rehder, 1938 *Arca foliata Forsskal* in Niebuhr,1775*; Arca nivea* Roding,1798; *Arca ovate* Gmelin, 1791; *Arca sinuate* Lamark, 1819; *Barbatia cancellata* Preston, 1908*; Barbatia djiboutiensis* Jousseaume in Lamy,1917

Description

Shell is white in colour. It is equivalve and equilateral. Shell is solid. Brown bristles are present in the periostracum. The shell is 2.1 cm in length and 1.5 cm in width. 45-55 parallel rows are present. Radial ribs are raised into many small, scaly nodules. Below this region dark brown bristles forming a border of the shell. Anterior beaks are present. Periostracum has a concentric ridge just below the umbo region given an extra thickening to the anterior portion of the shell. Towards the posterior region 2-3 concentric lines are present. Byssal gap that occupies almost in half of the shell length Hinge is long. Cardinal area short deep and having a narrow depression in cardinal area inverted' V 'shaped. It is narrow, many small teeth are present in the hinge area, and they are short ridges. It is vertical in central of the hinge but

radially diverging at ends. Interior part is glossy white. Ligament area between umbo and hinge is narrow; roughly equal anterior and posterior adductor scar is present. Pallial line is finely striate inside. Byssal gap that occupies almost in half of the shell length. Figs. 3a and 3b show the outer and inner part of the shell.

Remarks

It is exploited along with other clams for industrial purposes. It is reported from Indian Ocean (Mascarene Basin), Madagascar, Red Sea and Tanzania. This is the first report of the species from Indian coast. The voucher specimen was deposited in Marine Biodiversity Museum of CMFRI (Kochi) with accession number ***Barbatia foliata*** **(Forsskal in Niebuhr, 1775) DC.3.1.5**.

4. ***Barbatia obliquata***

Parent: ***Barbatia Gray*****, 1842**

Barbatia obliquata **(Wood, 1828)**

Class: Bivalvia

Subclass: Pteriomorphia

Order: Arcoida

Superfamily: Arcoidea

Family: Arcidae

Genus: Barbatia

Locality: Thiruchendur, Tamil Nadu, India

Habitat: Rocky sea shore

Synonym: *Barbatia alfredensis* Bartsch, 1915; *Savianyarca Savianyarca Jousseaume,* 1891; Arca *carditae formis* Philippi, 1845; *Arca obliquata* W. Wood, 1828; *Barbatia (Barbatia) obliquata* (W. Wood, 1828)

Description

The shell is submytiliform in shape. Position of the beak is also different from other species. It is placed anterior third of the shell. Posterior part is expanded and dark brown bristles are present in the posterior region gave black thickening to the shell**.** Shell is 3-4 cm in length. Periostraccum is pinkish white or yellowish white. Inner part of the shell is pinkish white. The umbo is closely attached. Umbone separation is slight. 6-8 concentric lines, parallel lines are very thin present giving thickening to the shell. Ligament area is a narrow black line. Very small teeth are present. On the posterior side 5-6 oblique teeth are present. Towards the anterior region the teeth are very small in size. Adductor muscle scar is distinct and unequal in size. Figs.4a and 4b shows the outer and inner part of the shell.

Remarks

It shows more similarities towards ***Savignyarca obliquata,*** but the characters of periostracum, size are different and show more similarities to Barbatia genera. It is exploited along with other clams for industrial purposes. It is reported from Mozambique, east coast of South Africa, South coast of Africa, Madagascar, and Tanzania. This is the first report of the species from Indian coast. The voucher specimen was deposited in Marine Biodiversity Museum of CMFRI (Kochi) with accession number ***Barbatia obliquata*** **(Wood, 1828) DC.3.1.8**.

5. ***Barbatia candida***

Parent: ***Barbatia Gray*****, 1842**

Barbatia candida **(Helbling, 1779)**

Class: Bivalvia

Subclass: Pteriomorphia

Order: Arcoida

Superfamily: Arcoidea

Family: Arcidae

Genus: Barbatia

Locality: Thiruchendur, Tamil Nadu, India

Habitat: Rocky sea shore

Synonym: *Arca caelata Reeve,* 1844*; Arca iamaicensis Gmelin,* 1791*; Barbartia helblingii Bruguiere,* 1789*; Arca candida* Helbling, 1779

Description

Shell is 4.5cm in length 1-2cm in width. Shell is white in colour. Suboval shape posteriorly expanded. 42-52 parallel ribs are present. Radial ribs are raised into many small, scaly nodules. Equilateral. Brown bristles are present on the periostracum which is short and thick. Equivalent. costate. Prominent anterior beak is present. Shell surface is marked by distinct concentric markings. Cheverons narrow. Radial ribs are running from the umbo region towards the posterior margin of the shell. Inner

side of the shell is white in color. Hinge is moderately long consisting of small teeth. In two lateral sides 2-3 teeth are slightly oblique. Interior part is glossy white. Dimyarian. Adductor scar is unequal. Byssal gape is relatively short and narrow. In the inner part small lines run towards anteriorly from the pallial line, it is corresponding to the radial ribs on the shell surface. The space between the pallial line and shell show thickening. It is different from other species by one side of the shell, which is slightly oblique and extra darkened as shown in fig.5c. Figs.5a and 5b shows the outer and inner part of the shell.

Remarks

It is exploited along with other clams for industrial purposes. It is reported from Belize, Caribbean Sea, Colombia, Costa Rica, Cuba Gulf of Mexico, Indian Ocean (Chagos), Jamaica, Madagascar, Panama, Red Sea, Tanzania and Venezuela. This is the first report of the species from Indian coast. The voucher specimen was deposited in Marine Biodiversity Museum of CMFRI (Kochi) with accession number ***Barbatia candida* (Helbling, 1779) DC.3.1.1**

Family Arcidae show some characters. They are taxodont, have anterior beak, muscle scars are present. Chevron-like teeth present. Collected specimens show all these characters. According to FAO identification key, the major difference is that ligament area is wide and almost flat and meeting the commissural plane of the valves nearly at right angle in Arca genera. In *Barbatia,* ligamental area narrow and slanting to commissural plane of the valves. (FAO, 1998). Some literature show considerable distinct character among Arca and Barbatia species. In 2010 Huber, stated that most of the Barbatia species have chevoroned ligament covering the whole interumbonal space, with radially lined periostracum, ovate, usually somewhat distorted, brown-white. In global level only Barbata, novaezealandiae, perinesa, pistachio, and a large undescribed species from Polynesia considered as true Barbatia. Rich bivalve resources are present in India. In rocky areas bivalves are the dominant species because of their special adaptations for attachment. Collected specimen satisfied all these morphological characters.

CONCLUSION

The present study mentioned the new report of five Arcidae species. It reveals the diversity of mollusca in the Gulf of Mannar Region. Hameed and Somasudaram in 1998 reported the presence of 55 species of bivalve. They mentioned four species of Ark shells namely *Scapharca inaequivalvis* (Bruguiere), iS. *Qubernaculum* (Reeve), *Trisidos tortuosa* (Linnaeus) and *Arca complanata* Chemnitz. More studies were conducted in the island regions of Gulf of Mannar, but about the southern tip, valid reports are not available. The present study revealed that more unexploited bivalves are present in these areas. Literature explaining the taxonomy and distribution of bivalves are limited in India. The Gulf of Mannar region is rich in biodiversity. Due to the anthropogenic activities the natural habitat are starting destroyed, and so the species diversity is also decreasing accordingly. Thus although investigation and documentation of these marine fauna is the need of the hour.

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