New distributional records of Actiniarian sea anemones from Andaman and Nicobar Islands

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Abstract

Two species of actiniarian sea anemones Actinodendron arboreum (Quoy & Gaimard, 1833) and Diadumene leucolena (Verrill, 1866) under the families Actinodendronidae and Diadumenidae respectively were recorded as new addition of sea anemone fauna to India from Andaman and Nicobar Islands. Earlier literature indicated that the occurrence of A. arboreum from Asia-Pacific region while D. leucolena known from east and west coast of North America. The diagnostic features of the presently recorded species along with distributional details are provided.

Keywords: Sea anemone, Actinodendron arboreum and Diadumene leucolena, New records, Andaman

Introduction

The sea anemones are considered to be a lesser known group in India as only 6.5% of species revealed from Indian water against their global diversity of 1109 species (WoRMS, 2014). Studies on sea anemones was initiated date back the beginning of the 19th century. The first sea anemones were reported from South Africa by Lesson (1830), who described two species from the ‘Cape of Good Hope’. In Indian waters, exploration of sea anemones was started in the year 1869 which was attributed by Stolicza. Since 1966 to 1990, Parulekar made a significant contribution on this group and recorded around 40 species of sea anemones from India (Parulekar, 1990). Parulekar (1990) also made first attempt to study the sea anemone in Andaman and Nicobar Islands with the description of a new species Anthoplerua panikkarii along with 3 new records: Metridium senile (Linnaeus, 1761); Parabunodactis inflexibilis Carlgren, 1928 and Bunodactis nicobarica Carlgren, 1928. Subsequently, Madhu and Madhu (2007) identified 10 species of sea anemones from these regions. Since 2007 onwards Zoological Survey of India has paid attention towards reporting of sea anemones from the coral reef region of Andaman and Nicobar Islands resulting with a record of 28 species against 71 species from Indian seas (Raghunathan et al., 2014; Choudhury et al., 2015; Choudhury et al., in press).

The genus Actinodendron de Blainville, 1830 representing five species (Fautin, 2015a) is found in littoral to infra littoral and the tropical to subtropical regions of world waters. In India, Raghunathan et al. (2014) reported the same genus with a record of Actinodendron glomeratum Haddon, 1898 from Andaman and Nicobar Islands. Whereas, the genus Diadumene Stephenson, 1920 counts 9 named species globally (Fautin, 2015b) and are predominantly occurred in east and west coast of North America. Among them Diadumene schilleriana Stoliczka, 1863 and Haliplanella lineata (Verrill, 1870) = Diadumene lineata (Verrill, 1873) were reported from Indian waters (Annandale, 1915; Parulekar, 1990; Mitra and Pattanayak, 2013). Furthermore, Carlton (1997) described Diadumene franciscana Hand, 1956 may be originated from the southern Pacific or Indian Ocean, rather than from the Atlantic, where the anemone fauna is better known. In this context, the present study provides a description about the newly recorded Actinodendron arboreum (Quoy & Gaimard, 1833) and Diadumene leucolena (Verrill, 1866) from Andamans with its external morphology, cnidocysts and their geographical distribution.

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Material and Methods

The specimens were collected by hand picking from intertidal to subtidal region of Neil Island, Oliver Island and Chouldari of Andaman (Figure 1) at a maximum depth of 15m during April 2014 to December 2015. SCUBA diving devices were used to collect the specimens. In situ pictures of the sea anemones were taken before collecting specimens. Collected specimens were relaxed by adding magnesium chloride crystals with seawater, later fixed with 10% phosphate buffered formalin (PBF) and then preserved in 70% ethyl alcohol following the method of Hausserman (2004).

Results

Systematics

Phylum CNIDARIA Verrill, 1865
Class ANTHOZOA Ehrenberg, 1884
Subclass HEXACORALLIA Haeckel, 1896
Order ACTINIARIA Hertwig, 1882
Family ACTINODENDRIDAE Haddon, 1898
Genus Actinodendron de Blainville, 1830
Actinodendron arboreum (Quoy & Gaimard, 1833), Figure 2.

Synonyms

Actinia arborea Quoy & Gaimard, 1833 (Original description)
Acremodactyla ambonensis Kwietniewski, 1897
Actinodendron ambonense (Kwietniewski, 1897)
Actinodendron ambonensis (Kwietniewski, 1897)
Actinodendron arborea Quoy & Gaimard, 1833
Actinodendrum arboreum de Blainville, 1830

Material Examined: One specimen collected from Neil Island (Lat. 11°50.939’N; Long: 93°01.207’E), at the depth of 10 m on 18.VIII.2015. Registration No. ZSI/ANRC-14114.

Description: The pedal disc is well developed with 7.5 mm diameter. Column is smooth. When fully expanded, the oral disc is spread with long tentacles (11.73 mm in length and 2 mm in width), about 12-36 number with complexly branched (Figure 2a). The specimen resembles like a bush or broccoli (Figure 2a). The tentacles are hexamerously arranged in three cycles (6+12+18=36) (Figure 2a). The branching tentacles are more erect and also covered with numerous acrosphers (0.85 mm in length) (Figure 2b &c). The oral disc diameter is about same length as extended tentacles. The acrosphers and tip of the tentacles are dense with long Basitrich forming nematocyst batteries. The column is buried in the substrate surface leaving only the crown of tentacles branching. Longitudinal muscles of (Humason, 1967).

The cnidocysts derived from various parts of A. arboreum and D. leucolena such as tentacles, vesicles, actinopharynx, acontia and mesenterial filaments (Carlgren, 1945 and 1949; Fautin et al., 2009; Fautin 2015a &b) were examined. Identification of the cnidocysts was done based on the keys of Carlgren (1949) and Mariscal (1974).
tentacles and radial muscles of oral disc are ectodermal. Two broad siphognaths are present. Retractor muscles are very strong. Hence, in case of predator, may disappear in fractions of a second retreating completely into the substrate through a strong contraction. The colour of the specimen is tan or light brown. The vesicles are light brown in colour while, the stalk of tentacles are light green or grey in colour.

**Cnidocysts**

Cnidocysts contain spirocysts and nematocysts which include microbasic p-mastigophores, basitrichs which were derived from various organs of *A. arboreum* (Table 1) and all are illustrated in Figure 3.

**Table 1.** Morphometric measurement of cnidocysts in different body organs of *A. arboreum*

<table>
<thead>
<tr>
<th>Organ</th>
<th>Type of Cnidocysts</th>
<th>Length (µm)</th>
<th>Width (µm)</th>
<th>n</th>
<th>N</th>
<th>Frequency</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tentacle</td>
<td>Spirocysts G (Figure 3a)</td>
<td>12.8 - 21.6</td>
<td>2.3 - 3.8</td>
<td>26</td>
<td>3</td>
<td>C</td>
<td>Unfired</td>
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<td></td>
<td>Basitrich (Figure 3b)</td>
<td>37.5 - 61.8</td>
<td>2.3 - 4.1</td>
<td>74</td>
<td>3</td>
<td>A</td>
<td>Unfired</td>
</tr>
<tr>
<td>Vesicles</td>
<td>Basitrich (Figure 2c)</td>
<td>39.0 - 64.3</td>
<td>2.3 - 4.1</td>
<td>68</td>
<td>3</td>
<td>A</td>
<td>Unfired</td>
</tr>
<tr>
<td></td>
<td>MPM (Figure 3d)</td>
<td>18.5 - 20.3</td>
<td>3.0 - 4.3</td>
<td>12</td>
<td>3</td>
<td>R</td>
<td>Unfired</td>
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<tr>
<td></td>
<td>Spirocysts G (Figure 3e)</td>
<td>11.3 - 22.5</td>
<td>2.6 - 4.1</td>
<td>34</td>
<td>3</td>
<td>C</td>
<td>Unfired</td>
</tr>
<tr>
<td>Column</td>
<td>Basitrich (Figure 3f)</td>
<td>33.8 - 69.5</td>
<td>1.5 - 3.8</td>
<td>41</td>
<td>1</td>
<td>A</td>
<td>Unfired</td>
</tr>
<tr>
<td></td>
<td>Spirocysts G (Figure 3g)</td>
<td>13.5 - 21.0</td>
<td>2.3 - 3.8</td>
<td>20</td>
<td>1</td>
<td>C</td>
<td>Unfired</td>
</tr>
</tbody>
</table>

n= Number of nematocyst measured; N = Number of individuals; Frequency indicated by A= abundant C= common, R= rare, MPM= Micro basic p-mastigophores; Spirocyst (G) = gracile spirocyst.
Habitat: This species mainly lives singly in sandy and rubbles covered bottoms on coral reef (Fautin et al., 2009). The specimen reported from Neil Island was found in sandy area and subsequently it was observed from Oliver Island (Lat. 12°59.731’ N; Long. 092°59.918’ E) in the same substratum.

Distribution: This species is found in Singapore (Ardelean, 2003); Marshall Islands, New Caledonia, Australia, Solomon Islands, New Guinea, Indonesia, Okinawa, Philippines (Fautin, 2008; Fautin et al., 2009), Japan (Uchida and Soyama, 2001).

India: Neil Island, South Andaman and Oliver Island, North Andaman.

Remark: New record to Indian waters

Family DIADUMENIDAE Stephenson, 1920
Genus Diadumene Stephenson, 1920
Diadumene leucolena (Verrill, 1866), Figure 4
New distributional records of Actiniarian sea anemones from Andaman and Nicobar Islands

Synonyms

*Sagartia leucolena* Verrill, 1866 (Original description)
*Clyista leuconela* (Verrill, 1866)
*Sagartia (Thoe) leucolena* Verrill, 1866
*Diadumene kameruniensis* (Carlgren, 1927)

Material Examined: Five specimens were collected from the intertidal regions of Chouldari (Lat. 11°37.224’N; Long. 92°40.285’E), South Andaman on 9.I.2015. Registration No. ZSI/ANRC -13005.

Description: The pedal disc is well developed with 5.94 mm in diameter (Figure 4a). Column is 15 mm length which is divisible into scapus and capitulum (Figure 4b & d). The column appears smooth from a distance, but is studded with small dark bumps when looked at closely. The double stripes are prominently seen on the column (Figure 4a & c). Mouth is present with prominent lips (Figure 4e). The capitulum is smooth. The scapus is with cinclides (Figure 4f). The tentacles are about 66 number, hexamerously arranged in four cycles (12+12+18+24 = 66) (Figure 4a). The tentacles are long, tapered, numerous, more regularly arranged, which are not retractile (Figure 4a). All of the inner tentacles are typically thicker than the outer tentacles (Figure 4a). Acontia is well developed. The retractor muscles are observed (Figure 6a). Gametogenic tissues are well observed (Figure 6a &b). Parietobasilar and basilar muscles are weak (Figure 6c).

The columns of the individuals observed in the field were slightly pinkish or salmon or orange in colour (Figure 4a) and transparent with a tinge of green near the upper part of the column. The mesenteries were visible as 24 white double stripes on the column. The colour of tentacles are off white (Figure 4a).

Cnidocysts

Cnidocysts contain spirocysts and nematocysts such as micro basic p-mastigophores, basitrichs and micro basic amastigophores were derived from various organs of *D. leucolena* (Table 2) and all are illustrated in Figure 5.

Figure 5. Cnidocysts of *Diadumene leucolena* [a. Spirocyst (G) from tentacle; b. Large basitrich from tentacle; c. Microbasic amastigophores from tentacles; d. Small basitrich from Mesenterial filaments; e. Large basitrich from Mesentral filaments; f. Microbasic p- mastigophore from Mesentral filaments; g. Spirocyst (G) from Mesentral filaments; h. Basitrich from Actinopharynx; i. Spirocysts (G) from Actinopharynx; j. Microbasic amastigophores from Actinopharynx; k. Basitrich from Acontia; l. Microbasic p- mastigophore from Acontia].
C. Raghunathan and Smitanjali Choudhury

Table 2. Morphometric measurement of cnidocyst in different body organs of *D. leucolena*

<table>
<thead>
<tr>
<th>Organ</th>
<th>Type of Cnidocysts</th>
<th>Length (µm)</th>
<th>Width (µm)</th>
<th>n</th>
<th>N</th>
<th>Frequency</th>
<th>State</th>
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<tr>
<td>Tentacle</td>
<td>Spirocysts (G) (Figure 5a)</td>
<td>10.1 - 29.9</td>
<td>2.2 - 4.0</td>
<td>43</td>
<td>3</td>
<td>A</td>
<td>Unfired</td>
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<td></td>
<td>Basitrich (Figure 5b)</td>
<td>14.4 - 23.0</td>
<td>1.44 - 3.6</td>
<td>74</td>
<td>3</td>
<td>A</td>
<td>Unfired</td>
</tr>
<tr>
<td></td>
<td>MIA (Figure 5c)</td>
<td>21.8 - 33.8</td>
<td>3.0 - 4.1</td>
<td>40</td>
<td>3</td>
<td>C</td>
<td>Unfired</td>
</tr>
<tr>
<td>MF</td>
<td>Small Basitrich (Figure 5d)</td>
<td>2.5 - 4.3</td>
<td>1.44 - 1.44</td>
<td>8</td>
<td>3</td>
<td>R</td>
<td>Unfired</td>
</tr>
<tr>
<td></td>
<td>Large Basitrich (Figure 5e)</td>
<td>7.9 - 16.6</td>
<td>1.44 - 2.1</td>
<td>65</td>
<td>3</td>
<td>A</td>
<td>Unfired</td>
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<td></td>
<td>MPM (Figure 5fF)</td>
<td>8.6 - 28.1</td>
<td>3.6 - 4.7</td>
<td>52</td>
<td>3</td>
<td>C</td>
<td>Unfired</td>
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<td></td>
<td>Spirocysts (G) (Figure 5g)</td>
<td>6.9 - 18.0</td>
<td>1.44 - 2.9</td>
<td>11</td>
<td>3</td>
<td>R</td>
<td>Unfired</td>
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<tr>
<td>Actinopharynx</td>
<td>Basitrich (Figure 5h)</td>
<td>15.8 - 23.8</td>
<td>1.8 - 2.9</td>
<td>70</td>
<td>3</td>
<td>A</td>
<td>Unfired</td>
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<td></td>
<td>Spirocysts (G) (Figure 5i)</td>
<td>6.5 - 15.1</td>
<td>1.44 - 1.8</td>
<td>20</td>
<td>3</td>
<td>R</td>
<td>Unfired</td>
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<tr>
<td></td>
<td>MIA (Figure 5j)</td>
<td>20.3 - 30.8</td>
<td>3 - 4.1</td>
<td>30</td>
<td>3</td>
<td>C</td>
<td>Unfired</td>
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<tr>
<td>Acontia</td>
<td>Basitrich (Figure 5k)</td>
<td>9.4 - 19.4</td>
<td>1.8 - 2.2</td>
<td>58</td>
<td>3</td>
<td>A</td>
<td>Unfired</td>
</tr>
<tr>
<td></td>
<td>MPM (Figure 5l)</td>
<td>20.9 - 44.0</td>
<td>3.6 - 4.9</td>
<td>39</td>
<td>3</td>
<td>C</td>
<td>Unfired</td>
</tr>
</tbody>
</table>

n = Number of nematocyst measured; N = Number of individuals; Frequency indicated by A= abundant C= common, R= rare, MPM= Microbasic p-mastigophores; Spirocyst (G) = gracile spirocyst; MIA = microbasic amastigophores

Habitat: It is common to abundant along the bay margin, estuaries and sheltered waters, in fouling communities where it grows on oysters, rocks, seaweeds, pilings, and floats. It can also occur in sheltered tide pools, and is especially tolerant of variable salinities (Carlton 1979; Cohen and Carlton 1995).

The specimen reported here was found in mud flat area of shallow water occurring at depth of 1m.

Distribution: This Atlantic anemone, occurring from at least Cape Cod to South Carolina, was first reported from the Oakland estuary by Sander (1936), although it may have been present in the Bay since the 19th century (Cohen and Carlton, 1995). Hand (1956) described it in detail from the Bay of central California. It was recorded from Atlantic coast oyster beds (Wells, 1961) as ship fouling or in ballast water. It has also been reported from southern California bays and from Coos Bay, Oregon (Carlton, 1979; Cohen and Carlton, 1995).

India: Chouldari, South Andaman.

Remark: New record to Indian waters

Figure 6. Cross section of *Diadumene leucolena* [a. Middle portion of column showing mesenteries; b. Non-muscular gametogenic region of fertile mesenteries; c. Weak basilar muscles].
Discussion

The family Actinodendronidae consists of five species under the genera *Actinodendron* (Fautin, 2015a), all of which are found only in the tropical waters of the Indo-Pacific. Until now, only one species *Actinodendron glomeratum* Haddon, 1898 was known from India (Raghunathan et al., 2014). The newly recorded species *D. leucolena* is native to the east coast of North America spanning from Georgia, USA to New Brunswick, Canada (Sander, 1936; Hand, 1956). Later, it has been introduced with oyster shipment to Puerto Rico, the Canary Islands, Morocco, Cameroon, the Pacific coast of Panama, the west coast of North America, and Hawaii (Carlton, 1979; Carlton and Eldredge 2009; Ocana and den Hartog, 2002). It is also observed that this species is especially tolerant of variable salinities and it is mesohaline (Cohen and Carlton, 1995). There are no reports of negative impact of this species in its introduced range. The occurrence of this species in Andaman Sea, northeastern Indian Ocean may be due to transport by ship fouling or in ballast water as well as this region provides the presence of suitable substrata, temperature and salinity for its survival and growth.

The size ranges of most of cnidocysts mentioned for both species in this study are agreed with the data from Carlgren (1949), Hand (1956) and Fautin et al. (2009). However, number of tentacles observed in the presently studied specimen of *A. arboreum* is comparatively less (36) as 48 tentacles found in the species described by Fautin et al., 2009 in Kusu Island, Singapore. Variation in number of tentacles might be due to the size of the specimens observed. The records of presently noticed two species of sea anemones enhanced the total number of actiniarian sea anemones in Indian seas to 73. Further exploration on this lesser known faunal group may bring out more species in Indian context.

Acknowledgements

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C. Raghunathan and Smitanjali Choudhury


