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ACTINIARIAN SEA ANEMONE FAUNA OF INDIA

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ABSTRACT

The actinarian sea anemones, inhabiting marine and estuarine ecosystems, from upper littoral to abyssal depths, from burrowing to adhesive forms and from free living to commensal types, though accounting for a small part of the diverse marine biota of India, yet from an ecological point of view, these anthozoans represent a thoroughly successful faunal group. Out of 40 species, belonging to 33 genera under 17 families, as many as 13 species are reported here for the first time.

The habitat preference was: 13 brackishwater, 24 marine and 3 cosmopolitan. Dominance of sedentary, both attached and adhesive forms, over the burrowing species was evident. Only two species, namely Bolocerooides mcmurrichi and Boloceractis gopalayi displayed dual habitat of partly sedentary and partly pelagic. While almost all the burrowing species were represented by solitary forms, the gregariousness, whenever observed, was a redeeming feature of most of the attached and adhesive forms, either free living or commensals.

Though marine in origin, many of the burrowing, sedentary and pelagic species of actinarian sea anemones have successfully adapted to unpredictable salinity conditions of brackish water as also to the extreme conditions of desiccation within the tide marks. A distinct substrate specificity, whether for attachment to biogenic and/or any other object or burrowing in bottom deposits, is clearly discernible. Biotic associations, either symbiosis or commensalism is found to have developed to perfection in actinarian sea anemones.)

✓ Inadequacy of knowledge about the magnitude and diversity of sea anemones is a reflection on lack of exploration along and within the extensive marine and estuarine ecosystems of India.

Introduction

The sea anemone fauna of the world oceans, comprising of 42 families, 200 genera and about 800 species, though contributes a very small part of the marine biota as a whole, yet ecologically is a successful group of marine invertebrates (Carlgren 1949). The actinarian fauna of India, but for the contributions of Annandale (1907 & 1915), Panikkar (1936, 1937, 1937a, 1937b, 1938 & 1939) and Parulekar (1966, 1967, 1968, 1969a, 1969b & 1971) has rather discontinuously been investigated and is better known through new species and new genera, rather than the magnitude and diversity of the faunal itself.

Though the term sea anemone encompasses order Actiniaria, Corallimorpha and Ptychodactiaria, however, due to their wide distribution and sheer numbers, especially in the intertidal region, the

actinarian sea anemones are far more better studied than the other two. In recent years, the actinarian sea anemones have received specific attention, for their potential uses in drugs and pharmaceuticals as well as the sentinel organisms for ecological monitoring of estuarine and marine environment (Ross 1967).

As a part of the assessment and evaluation of the biological resources of the Exclusive Economic Zone (EEZ) of India and further under an INDO-US collaborative research programme on bioactive substances from the Indian Ocean, a detailed study on the distribution, abundance, ecology and bioactive characteristics in space and time is being carried out, for the last few years and a lot of information about the sea anemone fauna of India is available by now.

In the present communication, an account of the occurrence, taxonomy and ecobiological features of a number of actinarian sea anemones from estuarine, mangrove, intertidal, coral, oceanic island, shallow and deep water ecosystems of India is presented and reviewed.

Fauna and Species

The present account enumerates 40 species belonging to 33 genera under 17 families (Table 1). The family Actiniidae represented by 10 genera and 15 species is the most common group of actinarian sea anemones.

While 31 species were reported by earlier workers, 9 species, namely Halcampa capensis Carlgren 1938; Alicia sansibarensis, Carlgren 1900; Glyphoperidium bursa, Roule 1909; Glyphostylum calyx, Roule 1909; Parabunodactis (Bunodactis) inflexibilis, Carlgren 1928; Stoichactis (Priapus) giganteum, Forskal 1775; Phymanthus (Ixalactis) Ioligo, H and E Ehrenborg, 1834; Bathydactylus valdiviae, Carlgren 1929, and Paraphellia sanzoi, Colabresi 1926, are recorded for the first time from the Indian seas. Besides the identified 40 species, the material collected presumably contain a large number of species, some of which may be new to science.

The actinarian sea anemone fauna of India was so far known from few places viz. Port Canning (W. Bengal), Chilka lake (Orissa); Adyar backwaters and Krusadai (Tamil Nadu); Cochin backwaters and Ashtamudi lake (Kerala);, Bombay and part of Maharashtra, Goa and northern Karnataka along the Central West coast of India. In last two decades, two new species, namely Edwardsia jonessi, Seshaiya and Cutress 1969 and Paracondylactis sagarensis, Bhattacharya 1979, from Porto Novo along Tamilnadu coast and Sagar Island (Sunderbans) along the West Bengal coast, respectively, have been reported.

Besides a number of unidentified forms from the areas explored so far, 3 sea anemones viz. Bunodeopsis, Cribrinopsis and Aiptasia (Table 1), reported by earlier workers, have still remained undescribed upto species level. Similarly, the status of Boloceractis gopalayi as an independent species than Boloceroides mc murrichi has been seriously doubted (Uchida and Muramatsu, 1958).

Ecological Features

All the 40 species reported here (Table 2) represent diverse ecosystems, like, fringing mangroves, estuaries, coastal lagoon, rocky foreshores, sandy and muddy intertidal area, continental and oceanic islands, neritic and oceanic waters upto abyssal depths. Earlier reports by Annandale (op. cit.), Panikkar (op. cit.) and Parulekar (op. cit.) dealt with only the intertidal and swimming species, majority of which were from brackish water - lagoon and backwaters - and the littoral region of open sea.

In the present report, eight species, inhabiting subtidal regions from shallow to abyssal depths, have been documented. These are Halocampa capensis; 120-300 m; Alicia sansibarensis; 20-40 m; Glyphoperidium bursa: upto 500 m; Glyphostylum calyx: 100-180 m; Bunodactis nicobarica: upto 200 m; Parabunodactis inflexibilis upto 450 m; Bathydactylus valdiviae: 4000 m and Paraphellia sanzoi: upto 40 m depth.

Similarly, some of the species, like Stephensonactis ornata, Phytococopsis ramunii, Bunodeopsis sp., Nevadne glauca, Anemonia indicus, Bunodosoma granulifera, Anthopleura panikkarii, Cribrinopsis robertii and Stoichactis giganteum, which earlier were reported only from the intertidal biotopes, were found to be distributed even in the shallow depths of the subtidal region.

An analysis of the habit and substrate preference, as deduced from Table 2, reveals that 20 species were of burrowing type; 18 species comprised of adhesive and attached forms with 2 amphibious species, exhibiting partly sedentary and partly swimming habit. While majority of the adhesive and attached forms were observed to be restricted to intertidal region, especially at mid littoral and lower littoral tide levels, the burrowing forms were mostly confined to lower littoral and subtidal waters and subtidal waters. Most of the burrowing forms, prefer silty sand substratum, except, Edwardsia jonesii, Metapeachia tropica, Alicia sansibarensis, Actinogeton sultana and Bunodactis nicobarica, which prefer fine to medium grain sand. Further, almost all the burrowing species, comprise of solitary forms.

The substrate preference in adhesive and attached species was varied and diverse (Table 2). While few of the species were found attached, mostly singly or rarely in groups, to rock - crevices and fissures - and boulder, majority of the species display substrate preference for living objects. Two types of associations, namely commensalism and symbiosis, were discernible.

Majority of the attached species, occur in group and in species of genus Anthopleura and Cribrinopsis, distinct tendencies of colony formation are evident. Similarly, most of the species, belonging to family Actiniidae and Stoichactiidae, harbour a number of symbiotic species, both algae and invertebrates. Many of the species live as commensal with diverse partners like, zoantharians: Anthopleura pacifica and Cribrinopsis robertii; corals: Bunodactis nicobarica, Stoichactis giganteum and Phymanthus loligo; bivalve and gastropod molluscs: Anemonia indicus, Anthopleura asiatica, A. panikkarii, Glyphoperidium bursa Cribrinopsis sp. and Aiptasiomorpha luciae; bivalve and barnacles:

Anthopleura panikkarii Cribrinopsis robertii and Acontiophorum bombayensis; gastropod and hermit crab: Aiptasia sp. and Neoaipiasia commensali; sessile and stalked cirripedes; Diadumene schilleriana, Commensalic association with polychaete worms, crabs and fishes is also evident in sea anemones viz. Anemonia indicus, Paracondylactis indicus, P. sagarensis, Stoichactis giganteum and Phymanthus loligo.

All the commensal species, either adhesive or swimming forms, show a preferential behaviour pattern with its association. The sea anemones, essentially non-locomotory, its association with other animals is of more benefit to actiniarian. Most sea anemones pass their life attached to host object and take as food organisms or detritus coming within reach of its tentacles. Ecological records show that most sea anemones occupy preferred location in particular ecological situation. There is now a great deal of evidence that actiniarian sea anemones possess capacities for recognising specific chemical factors associated not only with its commensal or symbiont, but also those occurring in its surroundings (Ross op. cit). This particular aspect has opened up various opportunities for using sea anemones, not only as sentinel organisms but as a promising source of bioactivity.

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Table 1. Actiniarian Sea Anemones of India

Genus & Species	Family
1. <u>Edwardsia tinctoria</u> , Annandale 1915	... Edwardsiidae, Andres, 1880
2. <u>E. jonesii</u> , Seshaiya & Curtress 1969	... " "
3. <u>Metapeachia tropica</u> , Panikkar 1938	... Haloclavidae, Verrill 1899
4. <u>Halocampa capensis</u> , Carlgren 1938	... Halcampidae, Andreas 1883
5. <u>Mena limnicola</u> , Annandlae 1915	... " "
6. <u>Pelocoetes exul</u> , Annandale 1915	... Haliactidae, nov. nom
7. <u>P. minima</u> , Panikkar 1939	... " "
8. <u>Stephensonactis ornata</u> , Panikkar 1936	... " "
9. <u>Phytocoetes gangeticus</u> , Annandale 1915	... " "
10. <u>Phytocoetopsis ramunni</u> , Panikkar 1936	... " "
11. <u>Boloceroides mc murrichi</u> Kwiteriewski 1898	Boloceroidae, Carlgren 1924
12. <u>Boloceractis gopalayi</u> , Panikkar 1937	... " "
13. <u>Bunodeopsis</u> sp.	... " "
14. <u>Nevadne glauca</u> , Annandale 1915	... Nevadneidae, Carlgren 1925
15. <u>Alicia sansibarensis</u> , Carlgren 1900	... Aliciidae (Duerden 1897)
16. <u>Anemonia indicus</u> , Parulekar 1968	... Actiniidae (Gosse 1858)
17. <u>Bunodosoma granulifera</u> , Leseur 1917	... " "
18. <u>Anthopleura midori</u> , Uchida 1958	... " "
19. <u>A. asiatica</u> , Uchida 1958	... " "
20. <u>A. pacifica</u> , Uchida 1958	... " "
21. <u>A. panikkarii</u> , Parulekar 1969	... " "
22. <u>Paracondylactis indicus</u> , Dave 1957	... " "
23. <u>P. sagarensis</u> , Bhattacharya 1979	... " "
24. <u>Glyphoperidium bursa</u> , Roule 1909	... " "
25. <u>Glyphostylum calyx</u> , Roule 1909	... " "
26. <u>Actinogeton sultana</u> , Carlgren 1900	... " "
27. <u>Cribrinopsis robertii</u> , Parulekar 1971	... " "
28. <u>Cribrinopsis</u> sp.	... " "
29. <u>Bunodactis nicobarica</u> , Carlgren 1928	... " "
30. <u>Parabunodactis inflexibilis</u> , Carlgren 1928	... " "
31. <u>Stoichactis giganteum</u> , Forskal 1775	... Stoichactiidae Carlgren 1900
32. <u>Phymanthus loligo</u> , H and E Ehrenberg 1834	Phymanthiidae (Andres 1883)
33. <u>Bathydactylus valdiviae</u> , Carlgren 1928	... Actinostoiidae, Carlgren 1938
34. <u>Acontiophorum bombayensis</u> , Parulekar 1968	Acontiophoriidae, Carlgren 1938
35. <u>Paraphellia sanzoi</u> , Colabresi 1926	... Hormathiidae, Carlgren 1925
36. <u>Metridium senile</u> var <u>fimbriatum</u> (Verrill)	Metridiidae (Cargren 1893)
37. <u>Aiptasia</u> sp.	... Aiptasiidae, Carlgren 1924
38. <u>Neoaipiasia commensali</u> , gen et sp. nov, Parulekar 1969	... " "
39. <u>Aiptasiomorpha luciae</u> , Verrill 1899	... Aiptasiomorphidae (Stephenson 1920)
40. <u>Diadumene schilleriana</u> , Stoliczka 1863	... Diadumeneidae (Stephenson 1920)

Table 2. Ecological Features of the Actinarian Sea Anemones of India.

Sl.No. Species	Habitat	Habit	Distribution
1	2	3	4
1. <u>Edwardsia tinctoria</u>	Estuarine/marine Intertidal-mid to lower littoral	Burrowing-silty-sand solitary form	Chilka lake, Madras, Bombay, Malvan, Goa
2. <u>E. jonesii</u>	Estuarine-Intertidal-Lower Littoral	Burrowing-Fine to Silty sand-solitary form	Porto Novo (Tamil Nadu)
3. <u>Metapeachia tropica</u>	Marine-Intertidal-Lower Littoral	Burrowing-Fine sand-solitary form	Krusadai, Bombay, Malvan, Goa.
4. <u>Halcompa capensis</u>	Marine-Subtidal (100-300 m)	Burrowing-Silty sand Solitary form	Northwest coast of India.
5. <u>Mena limnicola</u>	Estuarine-Intertidal-Lower littoral	Burrowing-silty sand growing in groups	Chilka Lake, Balram-gadhi (Orissa)
6. <u>Pelocoetes exul</u>	Estuarine-Intertidal-lower littoral	Burrowing/Attached-silty sand/concrete structures-solitary but at times found aggregating on jetty pilings	Gangetic delta, Madras Cochin backwaters, Goa estuaries, Malvan, Bombay, Gulf of Cambay.
7. <u>P. minima</u>	Estuarine-Intertidal-mid to lower littoral	Burrowing-silty sand	Madras, Sagar Island
8. <u>Stephensonactis ornata</u>	Estuarine-Intertidal/subtidal-lower littoral/upto 15 m depth	Burrowing-Silty sand-solitary	East & West coast of India.
9. <u>Phytococetes gangeticus</u>	Estuarine-Intertidal	Burrowing/Attached-silty sand/concrete structures-solitary to aggregation	East & West coast of India.

1	2	3	4	5
10.	<u>Phytocoetops ramunni</u>	Estuarine-Intertidal/subtidal	Burrowing-silty sand-solitary	Central west coast of India
11.	<u>Bolocerooides mc murrichi</u>	Estuarine/marine-pelagic	Sedentary/swimming-Hard substratum/Pelagic-solitary	Central west coast of India
12.	<u>Boloceractis gopalayi</u>	Estuarine-pelagic	Sedentary/swimming-Hard substratum/Pelagic-solitary	Madras, Cochin backwaters, Asthamudi Lake
13.	<u>Bunodeopsis</u> sp.	Estuarine-Intertidal/subtidal	Burrowing-silty sand-solitary	Madras
14.	<u>Nevadne glauca</u>	Estuarine-Intertidal/subtidal	Burrowing-silty sand/slushy mud-solitary	Chilka Lake, Goa estuaries
15.	<u>Alicia sansibarensis</u>	Marine-subtidal (20-40 m)	Burrowing-fine sand-solitary form	Southwest & Central West coast of India
16.	<u>Anemonia indicus</u>	Marine-Lower littoral/subtidal	Adhesive form-attached to bivalve shells, polychaete tubes of <u>Onuphis</u> sp. and concrete structures-solitary to gregarious	Coast of Maharashtra & Goa, North Karnataka & Gulf of Kutch.
17.	<u>Bunodosoma granulifera</u>	Marine-Lower littoral/subtidal	Adhesive form-found attached in crevices/fissures of rock solitary	Bombay
18.	<u>Anthopleura midori</u>	Marine-mid littoral to lower littoral	Adhesive form-attached to rock or underside of boulders & stones-gregarious in habit	Maharashtra, Goa and north Karnataka coast.
19.	<u>A. asiatica</u>	Marine-Lower littoral	Adhesive form-firmly attached, singly to rock or oyster shell in rock pools	Bombay, Malvan, Anjidiy Island

1	2	3	4	5
20.	<u>A. pacifica</u>	Marine-mid-littoral to lower littoral	Adhesive form-found in shallow rock pools -solitary	Bombay, Malvan, Goa.
21.	<u>A. Panikkarii</u>	Marine-lower littoral to subtidal	Adhesive form-attached in large numbers to rocky slopes also crevices alongwith barnacles and oysters	Maharashtra, Goa, north Karnataka coast, Vizhinjam (Kerala), Port Blair (Andaman-Nicobar).
22.	<u>Paracondylac indicus</u>	Marine/Estuarine-intertidal lower	Burrowing-silty sand/slushy mud/silty clay delta. -solitary	Bombay, Sikka, Gangetic delta.
23.	<u>P. sagarensis</u>	Estuarine-intertidal	Burrowing-slushy mud -solitary	Sagar Island (Sunderbans).
24.	<u>Glyphoperidium bursa</u>	Marine-subtidal (upto 500 m depth)	Adhesive form-attached singly or in group to molluscan shell debris	Off southwest coast of India & Lakshadweep sea
25.	<u>Glyphostylum calyx</u>	Marine-subtidal (100-180 m depth)	nial-attached to shell and coral debris	Cuffe Parade (Bombay).
26.	<u>Actinogeton sultana</u>	Marine-Intertidal-Lower littoral	Burrowing-fine sand-solitary	
27.	<u>Cribrinopsis robertii</u>	Marine-Lower littoral	Adhesive form-attached to oyster (C. cucullata) and barnacle shells. Also found in association with live corals	Maharashtra & Goa coast Mandapam, Tuticorin.
28.	<u>Cribrinopsis</u> sp.	Marine-intertidal-mid littoral to lower littoral	Adhesive form-attached to rock and oyster shells-solitary to group	Bombay.
29.	<u>Bunodactis nicobarica</u>	Marine-subtidal (upto 200 m depth)	Burrowing-fine to medium sand/coral debris-solitary	Andaman Sea.

- 30. Parabunodactis inflexibilis
Stoichactis giganteum
 Marine-subtidal (upto 450 m depth) to fine sand-solitary Burrowing-silty sand Andaman Sea.
 Marine-Intertidal- Adhesive form-found Gulf of Kutch & Gulf of Mannar
 Lower littoral to attached singly to Mannar
 subtidal live corals
- 31. Phymanthus loligo
 Marine-Intertidal- Adhesive form at Gulf of Kutch & Gulf of Mannar.
 mid to lower times found burrowing
 littoral in coral sand-solitary
- 32. Bathydactylus vaividivae
 Marine-subtidal- Burrowing-silty clay- Off west coast of India
 abyssal depth of solitary (previously reported
 4000 m from the northern sector of the Southern ocean).
- 33. Acontiphorum bombayensis
 Marine-Intertidal- Adhesive form-found Bombay, Malvan, Karwar.
 upper to mid lit- attached singly or in group to boring bivalve, Martesia sp. and barnacle shells
- 34. Paraphellia sanzoi
 Marine-subtidal- Burrowing-silty clay- Gulf of Kutch
 upto 40 m depth solitary
- 35. Metridium senile var fimbriatum
 Marine-Intertidal- Adhesive form attached West & East coast of India, Fort Blair
 lower littoral ed in groups inside rock crevices, fissures and to concrete structures
- 36. Aiptasia sp.
 Marine-Intertidal- Adhesive form-attach- Bombay
 lower littoral at ed singly or in pair
 times mid littoral to gastropod shells inhabited by hermit crabs

1	2	3	4	5
38.	<u>Neoaipiasia commensali</u>	Marine-Intertidal-Lower littoral	Adhesive form-attached singly or even upto 4 individuals to a gastropod shell viz <u>Babylonia spirata</u> inhabited by hermit crab with coinhabitant, <u>Ergoea walshii</u> and polynoid <u>Gatyana deludens</u>	Bombay, Gulf of Kutch, Central & Southwest coast of India.
39.	<u>Aiptasiomorpha luciae</u>	Marine/Estuarine-Intertidal-Lower littoral	Adhesive form-attached generally in pair to gastropod shell <u>Nassarius ornata</u> , rarely <u>Cerithidium fluviatilis</u>	West coast of India, Tuticorin, Mandapam, Chandipore, Digha.
40.	<u>Diadumene schilleriana</u>	Marine-Pelagic/mid littoral	Adhesive form-attached to drifting wood in association with stalked barnacle, <u>Lepas</u> sp. Also found attached to barnacle shells	