

## Actiniarian fauna of Andaman and Nicobar Islands with an updated checklist

Smitanjali Choudhury\* and C. Sivaperuman

Zoological Survey of India, Andaman and Nicobar Regional Centre  
Port Blair - 744 102, Andaman and Nicobar Islands

\*Corresponding author

### Abstract

The knowledge on actiniarian fauna is remarkably inadequate and intermittent in India and in Andaman and Nicobar Islands, both spatially and taxonomically. This study provides an updated inventory of actiniarian fauna in different habitats (*i.e.* rocky areas, mud flats, coral reefs, mangrove swamp, sea grass bed and sandy bottoms). However, the compiled list of actiniarian fauna reveals a total of 28 species belonging to 20 genera under 13 families. The family Stichodactylidae represents as the dominant compared to other families and species composition. An aspect of its habitat preference, *Bolocerooides mcmurrichi* settles in all substrates such as loose stone, coral debris, boulder coral, sea grass, sand, dead coral and rock due to its swimming behaviour. The species *Nemanthus annamensis* and *Calliactis polypus* only restrict association to one substrate, black coral (*Cirrhopathes* sp.) and hermit crab (*Dardanus* sp.) respectively.

**Keywords:** Actiniaria, distribution, habitat, Andaman and Nicobar Islands

### Introduction

The Order Actiniaria is considered as the true sea anemones, belonging to the class Anthozoa and Phylum Cnidaria. This actiniarian fauna is common in different marine habitats from the intertidal zone to the hadal zone; from the tropics to the Arctic and Antarctic. The most favourable and fascinating associations are observed between sea anemones and macro benthos such as anemone fishes, hermit crabs, barnacle and shrimps. Bengtson *et al.* (1990) found the records of petrified sea anemone from the era of 510 to 497 million years back of Burgess Shale of Canada. However, the studies on actiniarian fauna are flimsy and infrequent in India as well as in Andaman and Nicobar Islands as it received very petite attention. Stoliczka (1869) introduced the actiniarian fauna of Indian water by describing *Sagaritta schilleriana*. Later, studies on this fauna of Indian water were made by Annandale (1907 and 1915), Carlgren (1925 and 1928), Panikkar (1935, 1936, 1937a-c, and 1938a&b), Seshaiya and Curtress (1969), Parulekar (1967, 1968, 1971, 1990), England (1990), den Hartog and Vennam (1993). Taxonomical study of actiniarian fauna has sporadically been studied relatively than diversity and distribution of this fauna. In the late 20<sup>th</sup> century, the most remarkable

complete review of this taxon was published by Parulekar (1990) who catalogued 40 species of Actiniaria fauna of Indian waters. Recently, Raghunathan *et al.* (2014) provided a review of Indian fauna with 54 species known.

In Andaman and Nicobar Islands, it is not known until 1928, when Carlgren contributed his knowledge on sea anemones by describing *Bunodactis nikobarica* and *Parabunodactis inflexibilis*. Later, Parulekar (1990) included two more species from this region. Perusal of literature revealed that little or nothing was so far known about the taxonomy and distribution of sea anemones species from Andaman and Nicobar Islands except the few literature (Carlgren, 1928; Parulekar, 1990; Madhu and Madhu, 2007; Raghunathan *et al.*, 2014; Choudhury *et al.*, 2015a&b; Raghunathan and Choudhury, 2017; Choudhury and Raghunathan, 2018). This paper summarises the data on the region wise distribution along with depth, habit and habitat occurrence of 28 sea anemone species.

### Methods

#### Specimen Collection

Surveys on the occurrence of sea anemones along the fringing reefs of North Andaman, Middle Andaman,

South Andaman, Little Andaman and Nicobar group of Islands in Andaman and Nicobar Islands were conducted from the intertidal to the subtidal region up to the depth of 40 meters. The individuals of sea anemones were collected by using scalpel, hammer and chisel from the intertidal zones and by SCUBA diving. Photographs were taken *in situ* condition to comprehend about the colour pattern of tentacles, oral disc and column, shape, habit and habitat by the digital camera (Canon PowerShot G15) with underwater housing. The habit and habitat of sea anemones were thoroughly examined and photographed.

### Species identification

Soon after collection the specimens were relaxed by adding magnesium chloride crystals with seawater in the field and later fixed in 10% phosphate buffered formalin (PBF) and were then preserved in 70% ethyl alcohol in the laboratory. Measurements provided for pedal disc, column, oral disc and tentacles were obtained from living, relaxed and preserved specimens under stereo zoom

microscope (Leica M205A) in the laboratory. All sea anemone specimens were identified up to the species level (Carlgren, 1949; Dunn, 1981; England, 1992; den Hartog, 1995; Fautin *et al.*, 2008, 2009 and 2015). Cnidocysts were extracted from various body organs of preserved specimen and examined using compound microscope Labovision AXR20 under oil immersion 100x. The length, width and mean of cnidae were measured by ocular scale. The terminology for cnidae were followed by Carlgren (1940 and 1945), Dunn (1981), England (1991) and Ostman (2000).

### Results

The present checklist reveals 28 species of Actiniarian sea anemones distributed in Andaman and Nicobar Islands based field studies and also consulted the available published literature (Carlgren, 1928; Parulekar, 1990; Sachithanandam *et al.*, 2011; Raghunathan *et al.*, 2014; Choudhury *et al.*, 2015a&b; Raghunathan and Choudhury, 2017; Choudhury and Raghunathan, 2018).

**Table 1: Distributions of Sea anemones in Andaman and Nicobar Islands**

Species Name	Study Areas								Depth (m)	Habit & Habitat
	NA	MA	SA	RA	MGMNP	LA	NC	GN		
Phylum CNIDARIA Verrill, 1865										
Class ANTHOZOA Ehrenberg, 1884										
Subclass HEXACORALLIA Haeckel, 1896										
Order ACTINIARIA Hertwig, 1882										
Suborder ENTHEMONAE										
Family ACTINODENDRIDAE Haddon, 1898										
<i>Actinodendron arborerum</i> (Quoy and Gaimard, 1833)	•	•	•		•			•	8 - 21	LS, G, S (Burrowing)
<i>Actinodendron glomeratum</i> Haddon, 1898	•	•	•						10 - 25	LS, G (Burrowing)
Family BOLOCEROIDIDAE Carlgren, 1924										

<i>Bolocerooides mcmurrichi</i> (Kwietniewski, 1898)	• • • • • • •	5 - 40	C, LS, SG, R, S, CB, G (sedentary/ swimmer)
Family AIPTASIIDAE Carlgren, 1924			
<i>Aiptasia mutabilis</i> (Gravenhorst, 1831)	•	0 -0.1	C (Attached)
Family HORMATHIIDAE Carlgren, 1932			
<i>Calliactis polypus</i> (Forsskal, 1775)	• •	0 - 15	DS & HC (Attached)
Family ANDVAKIIDAE Danielssen, 1890			
<i>Telmapaptis decora</i> (Hemprich & Ehrenberg in Ehrenberg, 1834)	• • • • •	0 - 30	CB, R (Attached)
Family NEMANTHIDAE Carlgren, 1940			
<i>Nemanthus annamensis</i> Carlgren, 1943	• •	10 - 20	TC (Attached)
Family ACTINIIDAE Rafinesque, 1815			
<i>Entacmaea quadricolor</i> (Leuckart in Rüppell & Leuckart, 1828)	• • • • • • •	5 - 35	C, R, CB (Attached)
<i>Anthopleura panikkarii</i> Parulekar, 1968	•	0 - 2	R, C (Attached)
<i>Anthopleura handi</i> Dunn, 1978	• • • •	0-15	CL, R (Attached)
<i>Bunodactis nikobarica</i> Carlgren, 1928		• 296	CD, S (Burrowing)
<i>Parabunodactis inflexibilis</i> Carlgren, 1928		• 296	S (Burrowing)
<i>Macrodactyla doreensis</i> (Quoy & Gaimard, 1833)	• •	8 - 25	LS, G, S (Burrowing)
Family HALIACTINIDAE Carlgren, 1949			
<i>Pelocoetes exul</i> (Ammandale, 1907)	•	0 - 0.6	CL (Burrowing / Attached to CL)
Family CAPNEIDAE Gosse, 1860			
<i>Actinoporus elegans</i> Duchassaing, 1850	•	12	S (Burrowing)
Family PHYMANTHIDAE Andres, 1883			

<i>Phymanthus pinnulatus</i> Martens in Klunzinger, 1877	•	•	•	•					0 - 20	C, LS, G (Burrowing)
Family STICHODACTYLIDAE Andres, 1883										
<i>Heteractis aurora</i> (Quoy and Gaimard, 1833)	•	•	•	•	•	•	•	•	10 - 40	LS, G, S (Burrowing)
<i>Heteractis crista</i> (Hemprich & Ehrenberg in Ehrenberg, 1834)	•	•	•	•	•	•	•	•	5 - 30	R, SG, S, CB (Attached)
<i>Heteractis magnifica</i> (Quoy and Gaimard, 1833)	•	•	•	•	•	•	•	•	0 - 40	R, CB, DC (Attached)
<i>Heteractis malu</i> (Haddon & Shackleton, 1893)	•	•						•	7 - 35	LS, R (Attached)
Genus <i>Stichodactyla</i> Brandt, 1835										
<i>Stichodactyla gigantea</i> (Forsskål, 1775)	•	•	•	•	•	•			0 - 15	G, C, R, S, SG (Attached)
<i>Stichodactyla haddoni</i> (Saville-Kent, 1893)	•	•	•	•					10 - 40	S, G, LS (Burrowing)
<i>Stichodactyla mertensii</i> Brandt, 1835	•	•	•	•				•	5 - 25	C, CB, G, R (Attached)
<i>Stichodactyla tapetum</i> (Hemprich & Ehrenberg in Ehrenberg, 1834)	•	•						•	10 - 20	CD, R (Attached)
Family THALASSIANTHIDAE Milne Edwards, 1857										
<i>Cryptodendrum adhaesivum</i> (Klunzinger, 1877)	•	•	•	•	•	•	•	•	0 - 30	C, R, DC (Attached)
<i>Thalassianthus aster</i> Rüppell & Leuckart, 1828		•							10	DC (Attached)
<i>Heterodactyla hemprichii</i> Ehrenberg, 1834	•								12 - 15	CB, C (Attached)
Family METRIDIIDAE Carlgren, 1893										
<i>Metridium dianthus</i> (Ellis, 1768)			•						0 - 1	C, R (Attached)
Species	20	15	22	7	11	10	9	13		
Genera	13	10	14	6	7	8	5	9		
Families	9	6	12	6	6	6	4	6		

NA= North Andaman; MA= Middle Andaman; SA= South Andaman; RA= Ritchie's Archipelago; LA= Little Andaman; NI = Nancowry Group of Islands; GN = Great Nicobar Islands; MGMNP= Mahatma Gandhi Marine National Park

[Habitat type codes: C= crevices; CB = boulder corals; CD = coral debris; CL= clay matter; DC = dead coral; DS = dead shell; HC = hermit crab; G =gravel or pebbles or small stones; LS = loose stones or cobbles; R =rock; S = sand; SG= sea grasses; TC = tree coral]

## Species diversity

The present study revealed a total of 28 sea anemones belonging to 20 genera under 13 families in Andaman and Nicobar Islands. South Andaman region signifies the high diversity with 22 species under 14 genera and 12 families, whereas, Ritchie's Archipelago represents less diversity of sea anemones *i.e.*, seven species under six genera and six families (Fig. 1). Among the reported species, *Cryptodendrum adhaesivum*, *Heteractis crispa*, *H. magnifica* and *Entacmaea quadricolor* inhabits in all regions of Andaman and Nicobar Islands. Only *Heteractis aurora* inhabits in all regions except Ritchie's

Archipelago and *Bolocerooides mcmurrichi* occurs except Nancowry Group of Islands. The distribution of nine species only restrict to one particular region, such as *Aiptasia mutabilis*, *Anthopleura panikkarii*, *Pelocoetes exul* and *Metridium dianthus* exclusively observed in South Andaman; *Thalassianthus aster* in Middle Andaman; *Heterodactyla hemprichii* and *Actinoporus elegans* in North Andaman; *Bunodactis nikobarica* and *Parabunodactis inflexibilis* observed in Great Nicobar. The Stichodactylidae represent the high species diversity in Andaman and Nicobar Islands which is comparable to other families and species composition.

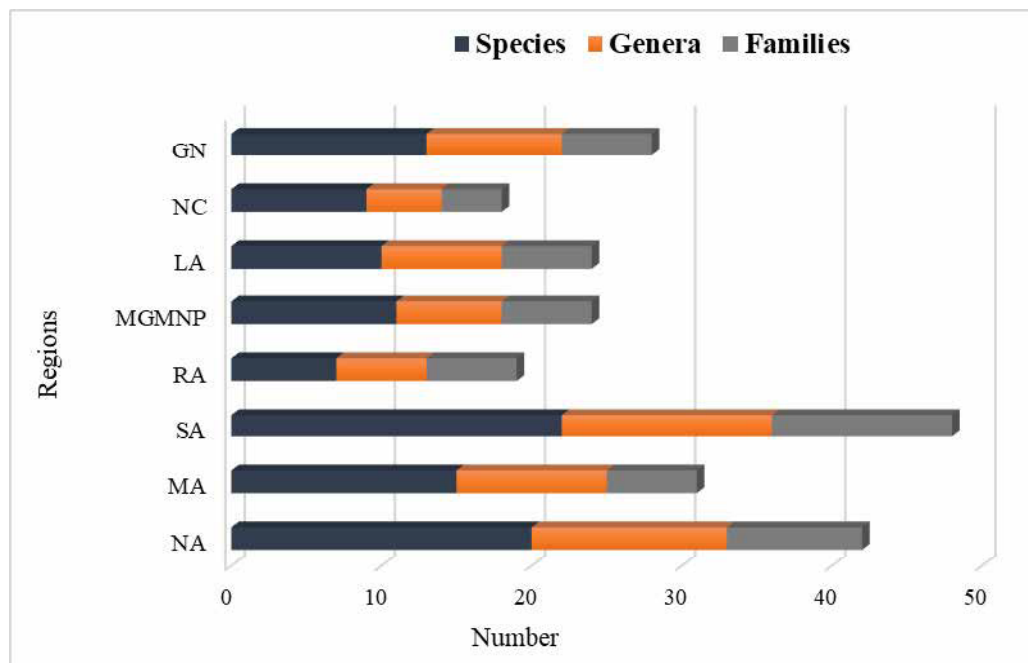


Fig. 1: Species distribution in different regions of Andaman and Nicobar Islands

## Habitat wise distribution

The present study revealed that 10 species were observed in crevices or fissure of rocks, 13 species in rocky slope, nine species in gravels or pebbles or small stones, eight species in loose stones or cobbles, seven species in boulder corals, 10 species in sandy environment, four species in dead coral and three species in sea grass ecosystem of the sea bottom (Fig. 2). The habitat like coral debris and clay matter, each represent two species. *Pelocoetes exul* and *Anthopleura handi* are found in clay matter, whereas, *Stichodactyla tapetum* and

*Bunodactis nikobarica* are reported from coral debris. The habitat like dead shell, hermit crab and tree coral, each represent only one species such as, *Calliactis polypus* and *Nemanthus annamensis* respectively. It was observed that the settlement of *Calliactis polypus* only occurs on the surface of dead shell in which a hermit crab lives which is a unique mutual relationship between this sea anemone and hermit crab (*Dardanus* sp.). While, *Nemanthus annamensis* restricts its association to one substrate, *i.e.*, tree coral or black coral (*Cirrhopathes* sp.) and this inter specific relationship was observed as parasitism.

Interestingly, *Bolocerooides mcmurrichi* is settled in all substrates due to its exceptional swimming behaviour. The attachment of *Calliactis polyopus* and *Nemanthus*

*annamensis* on their substrate is unique pattern and formed due to their special features of pedal disc (concave shaped).

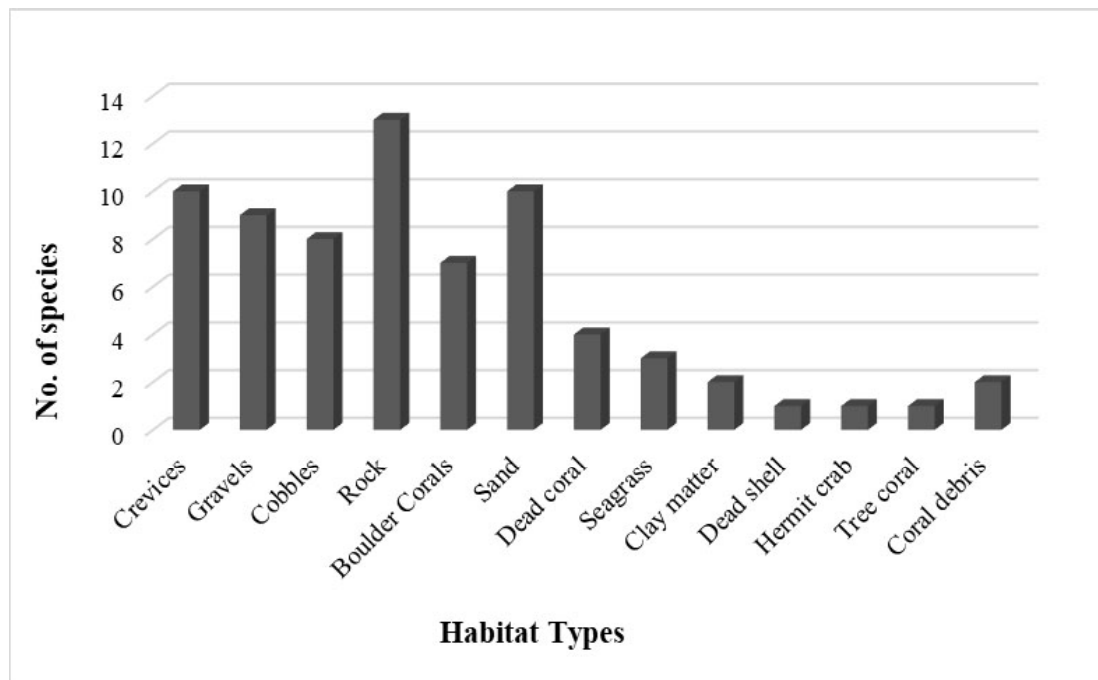


Fig. 2: Species distribution of sea anemones in different habitats

### Depth wise distribution

The depth-wise distribution pattern of sea anemones was depicted on the Table 1. The depth range of the compiled sea anemones varied from 0 to 296 m. It revealed that only two species *Bunodactis nikobarica* and *Parabunodactis inflexibilis* were recorded at abyssal depth of 296 m. Ten species were observed from the intertidal to subtidal region up to 40 m depth, of which *Pelocoetes exul*, *Metridium dianthus* and *Aiptasia mutabilis* only restrict in the intertidal region. It is noticed that *Stichodactyla haddoni* is found singly at depth range (10- 40m) on soft sandy bottoms. Only four species such as *Stichodactyla haddoni*, *Heteractis magnifica*, *H. aurora* and *Bolocerooides mcmurrichi* are found at depths of 40 m.

### Discussion

Globally, total of 1155 species categorised under 278 genera, 51 families, six superfamilies and two suborders (Daly and Fautin, 2020). In Andaman and Nicobar

Islands, altogether, 28 sea anemones belonging to 20 genera and 13 families under the order Enthemonae were reported. Among the thirteen families, Stichodactylidae represents the highest species diversity in Andaman and Nicobar Islands (80 %) in comparison with the world. Globally, only 10 species belonging to family Actiniidae and Stichodactylidae host to anemone fishes (Fautin and Allen, 1992). All 10 host species are reported in Andaman and Nicobar Islands (Madhu and Madhu, 2007; Raghunathan *et al.*, 2014). Earlier, Parulekar (1969) observed the commensal relationship between the sea anemone *Neoaipiasia commensali* and hermit crab in Indian waters. Choudhury *et al.* (2015a) observed inter specific relationship between *Calliactis polyopus* and hermit crab in Andaman and Nicobar Islands. In the same year, Choudhury *et al.* (2015b) found *Nemanthus annamensis* associated with black corals *Cirrhopathes* sp. as parasitism. Recently, Choudhury and Raghunathan (2019) conducted an experiment to study internal brooding and larval development of *Anthopleura handi* in India.

Among the reported species, *Actinodendron arboreum* is highly venomous, released numerous nematocysts to the diver. The author has witnessed to the stinging capabilities that caused great discomfort, dizziness, local inflammation and severe pain for six months.

Depth wise distribution revealed that only two species *Bunodactis nikobarica* and *Parabunodactis inflexibilis* were recorded from abyssal depth 296 m (Carlgren, 1928). It is observed that *Stichodactyla haddoni* under the genus *Stichodactyla* is found individually at depths of 40 m on sandy bottoms where as *Stichodactyla mertensii* and *Stichodactyla gigantea* are found on the hard substrates (Choudhury *et al.*, 2015a). During the several surveys, it was observed that the appearance of *E. quadricolor* is highly diverse, with ten colour morphs observed in Andaman Islands, whereas there are sixteen colour morphs at North Solitary Island, Australia (Scott and Harrison, 2009). And also, there are six colour morphs of the column of *Heteractis magnifica* observed herein. The species under genera *Phymanthus* and *Telmatactis* shows different morphotypes. Hence, it is very great challenges and dilemma to identify *in situ* as well as in *ex situ*. Even though, the identification of sea anemones is less debated, but it is very complex and critical to study the features of taxonomic value of this fauna and it has been the subject of re-evaluation (Cappola and Fautin, 2000; Daly and den Hartog, 2004).

The actiniarian fauna of Andaman and Nicobar Islands are moderately good as compared to the records from other regions in the world. So far, 49 species were documented from South Africa (Acuna and Griffiths, 2003); 17 species from Antarctic and sub-Antarctic areas (Dunn, 1983; Daly *et al.*, 2013); 26 species from Panama (Garese *et al.*, 2009); 16 species from Costa Rica (Acuna *et al.*, 2013); 44 species from Venezuela (Gonzalez-Munoz *et al.*, 2016); 22 species from Madang Province of Papua New Guinea (Fautin, 1988); 19 species from the Moreton Bay, eastern Australia (Fautin *et al.*, 2008); 22 species from Singapore (Fautin *et al.*, 2009 and Fautin *et al.*, 2015). Indeed, it is an essential to enhance the studies on the actiniarian communities to explore more new record as well as new species from this marine ecosystem.

## References

- Acuna, F.H. & Griffiths, C.L. 2003. Species richness, endemism and distribution pattern of South African sea anemones (Cnidaria: Actiniaria and Corallimorpharia). *African Zoology*, 9(2): 193-200.
- Acuna, F.H., Garese, A., Excoffon, A.C. & Cortes, J. 2013. New records of sea anemones (Cnidaria: Anthozoa) from Costa Rica. *Revista de Biología Marina y Oceanografía*, 48(1): 177-184.
- Annandale, N. 1907. The fauna of brackish ponds at Port Canning, Lower Bengal. P.1. *Records of the Indian Museum*, 1(4): 45-74.
- Annandale, N. 1915. Fauna of the Chilka Lake. The Coelenterates. *Memoirs of the Indian Museum*, 5: 21-55.
- Bengtson, S.S., Conway Morris, B.J., Cooper, P.A.J. & Runnegar, B.N., 1990. Early Cambrian fossils from South Australia. *Memoirs of the Association of Australasian Paleontologists*, 9: 1- 64.
- Cappola, V.A. & Fautin, D.G. 2000. All three species of Ptychodactiaria belong to order Actiniaria (Cnidaria: Anthozoa). *Journal of the Marine Biological Association of the United Kingdom*, 80: 995-1005.
- Carlgren, O. 1925. A revision of the Actiniaria of the Chilka Lake. *Arkive for zoologi*, 17A (21): 1-21.
- Carlgren, O. 1928. Actiniaria der Deutschen Tiefsee-Expedition. *Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dampfer 'Valdivia' 1898-1899*, 22(4): 125-266.
- Carlgren, O. 1940. A contribution to the knowledge of the structure and distribution of the cnidae in the Anthozoa. *Kunliga Fysiografiska Sällskapets Handlingar*, 51: 1-62.
- Carlgren, O. 1945. Further contributions to the knowledge of the cnidom in the Anthozoa especially in the Actiniaria. *Kunliga Fysiografiska Sällskapets Handlingar*, 56(9): 1-24.
- Carlgren, O. 1949. A survey of the Ptychodactiaria, Corallimorpharia and Actiniaria. *Kunliga Svenska Vetenskapsakademiens Handlingar, Fjärde Serien*, 1(1): 1-121

- Choudhury, S. & Raghunathan, C. 2018. New records of Actinarian sea anemones in Andaman and Nicobar Islands, India. *Proceedings of the International Academy of Ecology and Environmental Sciences*, 8(2): 83-98.
- Choudhury, S. & Raghunathan, C. 2019. First report of internal brooding and larval development of Actinarian sea anemone (*Anthopleura handi*) from India. *Journal of Marine Biological Association, India*, 61 (1): 86-93.
- Choudhury, S., Raghunathan, C., Raghuraman, R. & Venkataraman, K., 2015a. Actinarian Sea Anemone diversity in Andaman and Nicobar Islands. *Uttar Pradesh State Biodiversity Board*, pp. 58-66.
- Choudhury, S., Raghunathan, C. & Venkataraman, K. 2015b. First record of black coral associated Sea anemone (*Nemanthus annamensis* Carlgren 1943; Family Nemanthidae) from India. *Records of Zoological Survey of India*, 115 (4): 351-356.
- Daly, M. & Fautin, D., 2020. World List of Actiniaria. Actiniaria. Accessed through: World Register of Marine Species at: <http://www.marinespecies.org/aphia.php?p=taxdetails&id=1360> on 2020-09-21
- Daly, M. & den Hartog, J. C., 2004. Taxonomy, circumscription, and usage in *Anthopleura* (Cnidaria: Anthozoa: Actiniaria) from the Gulf of Mexico and the Caribbean. *Bulletin of Marine Science*, 74(2): 401-421.
- Daly, M., Rack, F. & Zook, R. 2013. *Edwardsiella andrillae*, a New Species of Sea Anemone from Antarctic Ice. *PLoS ONE*, 8(12): e83476.
- den Hartog, J.C. & Vennam, J. 1993. Some Actiniaria (Cnidaria: Anthozoa) from the west coast of India. *Zoologische Mededelingen*, 67 (42), 24.xii.: 601-637,
- den Hartog, J.C. 1995. The genus *Telmatactis* Gravier, 1916 (Actiniaria: Acontiaria: Isophelliidae) in Greece and the eastern Mediterranean. *Zool Meded Leiden* 69(14): 153-176.
- Dunn, D.F. 1981. The clownfish sea anemones: Stichodactylidae (Coelenterata: Actiniaria) and other sea anemones symbiotic with pomacentrid fishes. *le. Transactions of the American Philosophical Society*, 71:1-115.
- Dunn, D.F. 1983. Some Antarctic and sub-Antarctic sea anemones (Coelenterata: Ptychodactiaria and Actiniaria). In: *Biology of the Antarctic Seas XIV, Antarctic Research Series* Vol. 39 (Ed. Kornicker, L. S.), American Geophysical Union, 2000 Florida Avenue, N.W., Washington D.C., p. 1-67.
- England, K.W. 1990. Description of two new mud-dwelling actiniids from Maharashtra, India: *Edwardsia athalyei* sp. nov. and *Acontiactis* gen. nov. *gokhalae* sp. nov. and a note on *Edwardsioides mammillata* (Bourne, 1916) (Cnidaria: Actiniaria). *Indo-Malayan Zoology*, 6: 141-158, figs. 1-7.
- England, K.W. 1991. Nematocysts of sea anemones (Actiniaria, Ceriantharia and Corallimorpharia: Cnidaria): nomenclature. In: Williams RB, Cornelius PFS, Hughes, R.G. and Robson, E. A. (Eds.) *Coelenterate Biology: Recent Research on Cnidaria and Ctenophora*. Kluwer Academic Publishers, Belgium, pp.691-697.
- England, K.W. 1992. Actiniaria (Cnidaria: Anthozoa) from Hong Kong with additional data on similar species from Aden, Bahrain and Singapore. In: Morton, B. (Ed.), *The Marine Flora and Fauna of Hong Kong and Southern China III*. Hong Kong University Press, Hong Kong, pp. 49-95.
- Fautin, D.G. 1988. Sea anemones (Actiniaria and Corallimorpharia) of Madang Province. *Science in New Guinea*, 14(1): 22-29.
- Fautin, D.G., Crowther, A.L. & Wallace, C.C. 2008. Sea anemones (Cnidaria: Anthozoa: Actiniaria) of Moreton Bay. In: Davie, P. J. F. and Phillips, J. A. (Eds.), Proceedings of the 13<sup>th</sup> International Marine Biological Workshop, The Marine Fauna and Flora of Moreton Bay, Queensland. *Memoirs of the Queensland Museum-Nature*, 54(1): 35-64.
- Fautin, D.G., Tan, S.H. & Tan, R. 2009. Sea anemones (Cnidaria: Actiniaria) of Singapore: Abundant and well-known shallow-water species. *Raffles Bulletin of Zoology*, 22: 121-143.



- Fautin, D.G., Tan, R., Wei Liang, N.Y., Tan, S.H., Crowther, A., Goodwill, R., Sanpanich, K. & Tay, Y.C., 2015. Sea anemones (Cnidaria: Actiniaria) of Singapore: shallow-water species known also from the Indian subcontinent. *Raffles Bulletin of Zoology*, 31: 44-59.
- Garese, A., Guzman, H.M. & Acuna, F.H., 2009. Sea anemones (Cnidaria: Actiniaria and Corallimorpharia) from Panama. *Revista de Biología Marina y Oceanografía*, 44(3): 791-802.
- González-Muñoz, R., Simões, N., Guerra-Castro, E. J., Hernández-Ortiz, C., Gabriela Carrasquel, G., Mendez, E., Lira, C., Rada, M., Hernández, I., Pauls, S. M., Croquer, A. & Cruz-Motta, J.J., 2016. Sea anemones (Cnidaria: Actiniaria, Corallimorpharia, Ceriantharia, Zoanthidea) from marine shallow-water environments in Venezuela: new records and an updated inventory. *Marine Biodiversity Records*, 9:18
- Madhu, R. & Madhu, K. 2007. Occurrence of anemone fishes and host sea anemones in Andaman and Nicobar Islands. *Journal of Marine Biological Association of India*, 49(2): 118-126.
- Ostman, C. 2000. A guideline to nematocyst nomenclature and classification, and some notes on the systematic value of nematocysts. *Scientia Marina*, 64 (1): 31-46.
- Panikkar, N.K. 1935. On two new halcampactid Actiniaria from Madras brackish waters. *Current Science*, 4: 177-178.
- Panikkar, N.K. 1936. The structure, bionomics and systematic position of two new brackish water Actiniaria from Madras. *Proceedings of the Zoological Society of London*, 106: 39-52.
- Panikkar, N.K. 1937a. The morphology and systematic relationships of a new boloceroidarian from brackish-water near Madras, together with an account of its asexual reproduction. *Proceedings of the Indian Academy of Sciences*, 5B: 76-90
- Panikkar, N. K. 1937b. A study of the actinian *Phytocoetes gangeticus* Annandale, with an account of the post-larval development and the occurrence of neoteny in the anemone. *Zoologische Jahrbücher Abteilung für Anatomie und Ontogenie der Tiere*, 62: 395-422
- Panikkar, N.K. 1937c. Notes on *Nevadne galuca*. *Records of the Indian Museum*, 39: 371-376.
- Panikkar, N.K. 1938a. Studies on *Peachia* from Madras. *Proceedings of the Indian Academy of Sciences*, 7B: 182-205
- Panikkar, N.K. 1938b. Studies on the brackish-water anemone *Pelocoetes exul* Annandale, and on a new marine species from Madras. *Proceedings of the Zoological Society of London*, 108B: 669-688.
- Parulekar, A.H. 1967. Two new species of sea anemones (Actiniaria) from Maharashtra. *Journal of Bombay Natural History Society*, 64(3): 524-529.
- Parulekar, A.H. 1968. Sea anemones (Actiniaria) of Bombay. *Journal of the Bombay Natural History Society*, 65(1): 138-147.
- Parulekar, A.H. 1969. *Neoaipiasia commensali* gen et sp nov: An actinarian commensal of hermit crab. *Journal of the Bombay Natural History Society*, 66 (1): 57-62.
- Parulekar, A.H. 1971. A new sea anemone, *Cribrinopsis robertii* (Endomyaria: Actiniidae) from Maharashtra and Goa coast. *Journal of the Bombay Natural History Society*, 68(1): 291-295.
- Parulekar, A.H. 1990. Actinarian sea anemone fauna of India. In: *Marine Bio fouling and Power Plants* (Eds. K.V.K. Nilttil and V.P. Venegopalan). P. 218-228.
- Raghunathan, C. & Choudhury, S. 2017. New distributional records of Actinarian sea anemones from Andaman and Nicobar Islands. *Records of Zoological Survey of India*, 117(1): 26-33
- Raghunathan, C., Raghuraman, R., Choudhury, S. & Venkataraman, K. 2014. Diversity and distribution of sea anemones in India with special reference to Andaman and Nicobar Islands. *Records of Zoological Survey of India*, 114(2): 269-294.
- Scott, A., & Harrison, P.L. 2009. Gametogenic and reproductive cycles of the sea anemone, *Entacmaea quadricolor*. *Marine Biology*, 156(8), 1659-1671.
- Sachithanandam, V., Dhivya, P. & Mohan, P.M. 2011. Collection of *Aiptasia mutabilis* (Cnidaria: Anthozoa) from Andaman Coastal Region, India. *World Journal of Zoology*, 6(2): 183-186.

- 
- Seshaiyar, R.V. & Cuttress, C.E. 1969. *Edwardsia jonesiin*. sp. (Actinaria, Edwardsiidae) from Porto Novo, South India. *Journal of the Marine Biological Association of India*, 11 (1&2): 73.
- Stoliczka, F. 1869. On the anatomy of *Sagartia schilleriana* and *Membranipora bengalensis*, a new coral and a bryozoon living in brackish water at Port Canning. *Journal of the Asiatic Society of Bengal*, 38(2): 28-63, pls. 10, 11.

---

Received : 11<sup>th</sup> March 2020

Accepted : 12<sup>th</sup> August 2020

---